Power from Statistics: data, information and knowledge

OUTLOOK REPORT

2018 edition

STATISTICAL REPORT

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Keeping up with the trends in migration

INTRODUCTION

International migration is becoming one of the main components of population change in some EU countries. The increasing importance of this phenomenon highlights the need for more accurate, timely and harmonised data to better understand migration and its wide range of features.

Governments make decisions on migration policy based on various aspects, including understanding how and why migration takes place, who migrants are, and what the socioeconomic impacts of policies will be. Although an essential part of this understanding comes from statistics, it is clear that official statistics cannot cover the entire range of administrative procedures which form the basis of operational information.

At the same time, collecting and releasing more detailed and timely data, so as to give a clearer picture of migration and of the motivations, channels of migration, behaviours, skills and level of integration of immigrants, particularly from non-EU countries, is crucial in situations in which migration evolves rapidly. In addition to immigration, emigration from EU countries and its impact on the countries of origin are an emerging information need.

DRIVERS OF MIGRATION

To obtain a clearer picture of migration drivers, it is important to understand the reasons people choose specific destination countries and model the number and structure of emigrants coming from particular countries or regions, on a temporary, permanent, or circular basis, by category (labourers, dependent family members, refugees, students, etc.).

Some countries track the trajectory from one kind of permission to another, including work permits, but the metadata are rarely specific enough to enable researchers and policy makers to make useful comparisons or even understand how comparable the figures are.

The recently set up EU data collection and analysis system mainly had the short-term aim of dealing with a crisis. It is therefore not appropriate for arrivals driven mainly by economic motivations, which are a permanent occurrence. It is thus necessary to restructure and streamline data collection in a more systematic way, strengthening cooperation between the various stakeholders, to allow continuous and timely monitoring of the situation. Given that these are operational data, responsibility for collecting it falls outside the remit of the European Statistical System (ESS). Nonetheless, the expertise of the members of the ESS could be put to use in optimising the quality of this type of migration data, and to make them compatible with official statistics data.

DEFINING MIGRATION

Statistics on international migration are influenced by the relevant national legislation and administrative practices of the various EU/EFTA countries, and the level of harmonisation in the measurement of international migration is not as high as for other phenomena, such as the labour market. Similar efforts should be made for international migration, so that comparable data can be produced, migrant behaviour can be modelled and forecast, and the impact of policies can be evaluated.

Change of usual residence and duration of stay are critical components in defining migrants, and for measuring migration flows in particular.

Pure categories of migrants (economic, climate and so on) are becoming increasingly difficult to identify.

Perhaps new migration trends will call for a reassessment of how 'usual residence' is conceptualised, implying changes in estimates of usual residence, as well as how household-level data are collected, in view of increasingly mobile households and complex living arrangements.

The status of 'regular immigrant' and 'irregular immigrant' might need to be revisited to cover the sometimes complex status transition situations encountered. Unauthorised immigrants, but also migrants living in collective households or camps, are often missed from both administrative and survey-based regular data sources, including censuses. Currently, there is a strong interest in specific migrant groups, such as unaccompanied minors or migrant children, the various types of irregular immigrants, and return to the countries of origin. Methods developed for hard-to-reach populations might be used to better assess the size of such populations.

MEASURING MIGRATION AND INTEGRATION

In addition to the scale of migration, normally measured in terms of stock and/or flow, evidence-based policies need data on the characteristics of migrants, such as age, sex, level of education, occupation, etc. In particular, more timely estimates of the skills of immigrants and other kinds of breakdown data could be compared against the mapping of labour market demand to provide crucial information for integration policy. Better classification is needed to provide a complete picture of the type of contractual situation that migrant workers frequently face.

The country of origin is very relevant for policymaking. It has therefore been argued that such data should be

collected and complemented by the duration of stay and the impact of migration on migrants themselves, as well as on their countries of origin and destination, from social, economic (remittances), demographic, labour market and skills perspectives.

Administrative data currently compiled in EU countries make a limited contribution to the production of statistics since, even within the EU, they show some mismatches, mainly because emigrants often do not de-register from the country of origin. Due to the limitations of the data collection methods applied, the resulting data cannot achieve all objectives (for example, covering rare populations like specific migrant groups in household surveys). While more focused approaches (such as dedicated surveys/oversampling techniques) could possibly respond to this problem, such studies are typically very costly.

Evaluating the impact of migration flows on the demographic characteristics and dynamics of EU countries is becoming increasingly important, as is the decomposition of migration into its various constituent parts. In order to achieve these aims, the different components of migration have to be taken into consideration (immigration, emigration, their characteristics, etc.).

Policy makers need information to be able to assess and compare the impact of the different integration measures adopted for the various types of immigration (such as, work, study, asylum, family), including the characteristics and numbers of migrants admitted as a result of the various integration policies. A number of EU-level indicators, including the so-called Zaragoza indicators, are currently available.

Data on the level of integration are crucial in assessing the impact of integration policies. Most countries lack good data on the paths that migrants take through the residence permit system. This includes information on the extent to which people switch from one category to another and which groups are most likely to eventually receive long-term status or permanent residence. There is widespread evidence that migrant integration (in particular through language skills, links with host-country communities and labour market inclusion) progresses in line with the time spent in the host country. Being able to track migrants through the system and having an overview of how long people stay, their characteristics, etc., would be very helpful in understanding the consequences of migration and the level of integration.

Few, if any, of the studies carried out so far have been able to clearly assess the impact on integration of proficiency in the language of the receiving country. The low level of proficiency in the local language could explain some cases of people being over-skilled for the kind of job they do. This aspect could be better understood by including specific questions in the labour force survey questionnaires.

NEW APPROACHES AND NEW SOURCES FOR MIGRATION STATISTICS

There is real potential for administrative data to play a much greater role in informing policy. This is because they regularly cover the entire population of people interacting with a particular government body or service, and are often longitudinal, i.e., they track the same individuals over time, making it easier to identify the reasons for changing trends.

However, the available variables are often restricted to the information that is needed for a particular government process. Comparing administrative sources across countries can also be a challenge, since policy differences between countries will affect the populations covered and the definitions of the variables. While clearly falling outside the remit of official statistics, it is worth noting that an EU-wide system for residence permits or other types of authorisations to enter and stay in the EU (visas) and migrant relocation would generate potentially useful administrative data. One of the data sources could be the Schengen Information System. Closer collaboration between National Statistical Institutes (NSIs) and relevant national immigration authorities could facilitate this process. Administrative data improved and harmonised in this way could be used to track the trajectory of migrants through the system. The integration of different data sources, including data from hotspots, is carried out by the European Commission's Directorate-General for Migration and Home Affairs, on a weekly basis.

The measurement challenges generated by international migration can be made more manageable by using the data already available, namely by making fuller use of model-based approaches in official statistics. In addition to projections, another key area for application of model-based approaches to migration data is small area estimation, which is important, for example, in producing subnational estimates or projections. There are also different methods of combining the existing data sources, either by 'fusing' aggregates (at the macro level) or by linking individual-level observations at the micro level.

However, to provide for longer-term policy and statistical impact, a new EU agenda for better migration statistics requires even greater coordination, harmonisation and data exchange between Member States, possibly coupled with the use of data linkage methods. The EU is well placed to deliver this, bearing in mind the necessary safeguards for individual freedoms, privacy and accountability. To be successful in this, not only must appropriate models be designed, but their outcomes and caveats must also be effectively

communicated to users and the public.

Traditional data sources are either only able to capture one point in time or they are (while longitudinal) unable to follow the migration trajectory of a migrant once they cross the border. Big Data obtained from sources such as e-mail or social media usage have the potential to overcome these limitations and generate information on certain hard-to-reach migrant populations. The use of Big Data to complement migration statistics thus merits further study.

Delivering sustainable evidence for development

INTRODUCTION

Sustainable development entails looking at both the spatial and temporal dimension of development of our societies and economies, in order to safeguard the wellbeing not only of the present generation in a given place (here and now), but also the wellbeing of other populations (elsewhere) and future generations (later).

The power of data to change development outcomes ultimately rests on their ability to inform policymakers as they allocate resources, evaluate results, and make course corrections. Only when the needs and behaviours of decision makers, journalists, citizens, parliamentarians and the general public are properly understood can the statistical system collect data in meaningful ways and turn those data into important and inspiring insights that can drive action and change.

A NEW PERSPECTIVE IN MEASURING

An overall framework used to 'measure' sustainable development is the capital approach: safeguarding the wellbeing of present and future generations essentially depends on how societies choose to use their resources, i.e. their capital. The different kinds of capital are not independent, however; they form part of complex systems, often characterised by non-linear relationships between the different variables. Sustainability has social, economic and environmental aspects that call for the development of cross-cutting indicators and further analysis of complex links between competitiveness, sustainability and resilience. Moreover, interlinks between economic, social and environment aspects of sustainability and their relationships with production and consumption systems deserve particular attention. Therefore, a complementary way of evaluating and measuring sustainable development is by taking a systemic approach, which requires a new 'mindset' in measurement, according to which appropriate indicators to measure sustainability should be defined for the target, context and outcomes across the pillars of sustainable development in a holistic approach.

Frequent, high quality data are needed to capture dynamic interactions that have non-linear changes and understand the impact of shocks and the effectiveness of any recovery efforts. Having information for baseline pre-shock, shock and post-shock periods is vital to better understand the interactions between different parts of the system at different times. However, there are different types of shocks; a shock can be a sudden, unforeseen event or stem from a controlled event such as a policy action. Only in the latter case can an appropriate monitoring system be set up *a priori* and the effect of the policy assessed over time.

Sustainable development goals incorporate different topics and the system boundaries are yet to be delineated. The appropriate strategy can vary according to the field (in some fields, preservation is sustainable, in others, change and acceleration of change can guarantee sustainability) and the location, as the problems and the trends in cities (e.g. mobility systems) differ from those in rural areas. Disaggregated statistics are therefore needed, in addition to country level statistics.

SUSTAINABLE SOCIAL SYSTEMS

Since the sustainability of social systems is affected by inequality in economic, health, education, opportunities, access to natural resources, health facilities, the internet and share economy, as well as by inequality between generations, gender and third countries, measurements of the different aspects of inequality should be improved. Particular attention should be paid to the sustainability of social protection, also in relation to changes due to new economic models and new forms of employment, renewing the Stiglitz focus on household economic wellbeing and its measurement. Health-related issues and their relationships with economic, social and environmental sustainability also deserve further analysis. Indicators to assess the impact of social protection should be improved, also taking into consideration new economic models and new forms of employment.

ENVIRONMENTAL PROTECTION AND SUSTAINABLE USE OF NATURAL RESOURCES

The current production and consumption patterns pose a challenge for the management of natural resources, which may result in depletion for future generations. As climate change alters the geographic distribution and economic availability of some resources, new trading

relationships and patterns will emerge and international trade will increasingly be needed in order to replace ecologically inefficient uses of resources with those with lighter environmental footprints. Areas of relative resource scarcity may become increasingly dependent on the transfer of natural capital from more abundant areas, especially as the decreasing accessibility and increasing cost of resource inputs progressively constrain future production. Concerted efforts to improve resource efficiency and address climate change could, according to a United Nations Environment Programme analysis, reduce extraction by as much as 28 % relative to the 2050 baseline, and cut greenhouse gas emissions by 60 % relative to 2015 levels. This will require a significantly more efficient use of primary raw materials and increasingly replacing them with secondary raw materials (materials that are reused or recycled after first use, for example scrap metals, spent plastics, and biomass).

To effectively serve and scrutinise dematerialisation efforts, continued innovation in the quality and transparency of embodied environmental data will be required. The most appropriate measurement approach in any given circumstance will continue to depend on the circumstances in which it is being deployed and the decisions that it is informing. For example, the most appropriate tool to support investment decisions with regard to company-specific deforestation exposure may look very different to that employed to assess the global material footprint, and different again to the one used for understanding the global carbon footprint of a specific commodity.

In order to understand the full environmental impact of consumption, indicators should take into account not only direct resource inputs but also indirect material flows along the (global) supply chain of goods and services consumed in a country. This includes indirect flows associated with processing products and with trade flows. Externalities and embedded impacts of production and consumption should be measured in Europe and in other countries and specific indicators to measure the impacts of the inputs and outputs on biodiversity should be developed with harmonised methodologies and data requirements across Member States and at regional and local level, to ensure transparency and comparability.

Improving resource efficiency in the EU will require strong engagement by the private sector; policy-makers and business leaders will need to marry political commitments with business opportunities.

Real-time or high temporal resolution (as well as high spatial resolution) remote sensing of environmental outcomes (such as those employed by World Resources Institute's Global Forest Watch and the EU's Copernicus programme) could be combined with higher temporal resolution commodity trade data, e.g. weekly or real-time tracking of cargo as opposed to more temporally aggregated data.

SUITABLE DEVELOPMENT OF ECONOMIC/FINANCIAL SYSTEMS

Environmental constraints, climate change and the transition to a sustainable, low-carbon economy will have profound impacts on production and consumption patterns, and on enterprises and workers. The necessary shift will be impossible without a persistent effort towards the greening of enterprises across the economy. Moreover, the sustainability of the economic systems themselves has to be taken into consideration as the most recent global financial/economic crisis has shown. It was clear that many actors lacked appropriate and timely data to help them respond effectively. For instance, there is a need for outcome indicators to complement input indicators, particularly with regard to public investments, in order to assess the sustainability of public financial systems.

Appropriate indicators to measure the evolving labour market and new business models and their secondary impacts are needed. A breakdown of resource productivity by sector would be useful to assess the sustainability of business models in the various sectors. Here, the role of taxation is crucial, for example, in the shift from more labour intensive to less intensive work, as well as in accompanying workers in the reconversion. Taxation, basic income and strategies to foster equal opportunities are the main tools to promote sustainable social systems. Governance indicators are needed to assess the impact of these strategies.

Making the necessary data on investments and risks available will be essential to scaling up and connecting 'green' or 'sustainable' projects with sustainable finance and, ultimately, contributing to more and better jobs and growth.

NEW APPROACHES FOR MEASURING AND COMMUNICATING SUSTAINABLE DEVELOPMENT

Monitoring of the Millennium Development Goals has led to a significant increase in investment to improve monitoring and accountability data but, in spite of this significant progress, there are still huge data and knowledge gaps regarding some of the biggest challenges. Furthermore, the cost and effort required to fill those gaps are substantial. One potential remedy may be the new data sources that are becoming available through social media, mobile mapping, geo-sensing and citizens. Another opportunity for the knowledge providers that underpin governance frameworks and government decisions to tackle the challenges associated with sustainable development

would be foresight. For this reason, foresight and official statistics should work more closely together for the benefit of both.

A second hurdle to overcome is making existing data accessible. The World Wide Web Foundation assessed 1 725 datasets from 15 different sectors across 115 countries in its 2017 report, and found that only seven governments include a statement on open data by default in their current policies. Only 7 % of the data are fully open, and only half of those datasets are machine readable, while one in four datasets has an open licence. While more data have become available in a machine-readable format and under an open licence over the past years, the number of truly open global datasets is at a standstill.

The policy process is not a straightforward cycle into which facts and evidence can be injected at the time of decision making; it is messy and often unpredictable, and the same injection of evidence can have no effect or a major effect depending on timing. It is therefore necessary to attract policymakers' attention, including by using emotional appeals and simple stories.

Being able to capture someone's attention at the right time is hard and this is where good data visualisation comes in. Research shows that many data portals and dashboards that were developed over the last 15 to 20 years were not used effectively by policymakers and key stakeholders. In order to cut through the information overload, effective visualisation is crucial. Moreover, one strategy could be to keep in mind the questions to be answered with the data and the target audience, exploring the data and constructing a storyline.

The power of data to change development outcomes is ultimately based on their ability to inform policymakers when they allocate resources, evaluate results, and change course. The challenges ahead to reduce current gaps in data and between data users and consumers are huge. The data revolution could, if managed well, succeed in closing these gaps, but it will require political will and global commitment to do so. The focus should be shifted from the supply of data to the demand side of potential data users. We have to properly understand the needs and behaviours of decision makers, journalists, citizens, parliamentarians and the general public in order to collect data in meaningful ways and turn it into important and inspiring insights that can be drivers of action and change.

Statistics in the digital era

INTRODUCTION

The era of the data revolution has begun. On the supply side, the availability of enormous amounts of data gives the statistical community a completely new push in a direction that is not yet sufficiently understood.

On the other hand, new demand in terms of 'evidence based decision making', new (public) management and so on create a driving force on the pull side. Statistics count more and more: by providing understanding, they allow for more effective action, and they facilitate assessments that improve how we react. Data requests cover a wide range of aspects of society, including relatively new fields such as wellbeing, climate change and new economic models. The last financial and economic crisis led to stronger economic governance of the European Union and highlighted its need for reliable, trustworthy statistics in order to succeed. Against this backdrop, reflection is needed on the part of the official statistics community, the scientific community and various sectors of society, with the aim of defining the quality of official statistics in a broad sense with a wide scope, including production and use of statistical information and the interaction of these two sides in a dynamic relationship.

THE ROLE AND IMAGE OF STATISTICS IN SOCIETY

As politicians need to make policy for the future, and policy needs forecasts, the official statistics community needs to collaborate with politicians to provide the evidence they need. Through working groups on specific issues, the statistical community can improve the connection with end users collaborating with the private sector and engaging stakeholders from the very beginning of the statistical cycle, to identify the main information needs and indicators. To make a decision about relevance, it is important that there is democratic control on what is included in official statistics programmes. Hence, parliaments should participate in developing the agenda of statistical offices.

At the same time, the core value of official statistics is trust; a balance must therefore be struck between the priorities of the governments and the imperative need for trust. Indeed, due to the trade-off between independence and relevance, the bottom line of reviews or revisions of existing statistical governance for future improvements is sustaining the capacity of the statistical authority to provide trustworthy and relevant statistical information.

Official statistics has demonstrated its excellent record in being a trusted authority at the crossroads of three fundamental rights: data protection (a person's right to privacy), freedom of information (a person's right to be governed in an open and transparent manner) and official statistics (a person's right to live in an informed society). Ensuring common European Union rules on access to privately held data for statistical purposes will allow the European Statistical System

to successfully continue to play its role in the current challenging times. Furthermore, openness and access to data are crucial elements in guaranteeing freedom of information, and open data are the basis for open government. Thus, statistical offices should enhance access to statistics in open formats and enable the free use of data (with due consideration given to privacy), its interoperability and consumption in an integrated way.

The national statistical offices should work towards strengthening the brand of 'official statistics' compared to other data producers by emphasising the quality aspects of their data, which is their main competitive advantage, and transparency. Strengthening this brand also implies production of statistical products tailored to users' needs and employing marketing techniques to increase appreciation for official statistics, leading users to perceive the statistical offices as trustworthy.

INNOVATION IN OFFICIAL STATISTICS

To cater for emerging topics where policy evidence is needed, and taking resource constraints into account, the present infrastructure might not be sufficiently agile. Official statistics should be able to innovate, also taking advantage of new technologies (including remote sensing and Big Data) with the aim of increasing relevance and accuracy while reducing costs. To innovate and tap into new technologies and access new data sources, collaboration with the private sector, and a multidisciplinary approach, which also supports better understanding and interpretation of emerging topics, is required.

Regarding innovation, the actual potential and limitations in dealing with the increasing availability of data must be established. The world can now be seen as an immense source of data, and broad consensus reigns with regard to the wonderful opportunities which the 'Big Data' phenomenon can provide in relation to the statistics acquired from traditional sources, such as administrative records and surveys.

However, the Big Data phenomenon also poses a certain number of challenges: these data are not the result of a statistical production process designed in accordance with standard practice. They do not fit the currently used methodologies, classifications and definitions, and are therefore difficult to harmonise and convey in statistical structures. In addition to this, Big Data raise many major legal issues: security and confidentiality of data, respect for private life, data ownership, sustainability of access, etc. All in all, at least for now, Big Data can be used only to a limited degree to supplement rather than replace sources of traditional data in certain statistical fields.

COMMUNICATION AND STATISTICAL LITERACY

In order not to leave society behind and to reduce the gap between evidence and all citizens, media campaigns are necessary to reach the part of society that does not have the skills to understand statistical reasoning and is not familiar with evidence. The European Statistical System could improve its capacity to reach these people by presenting succinct and easy-to-read analysis in an accessible format on some important issues, published online in all European languages. Moreover, qualitative description, storytelling, data visualisation and the combination of statistics with a warm, friendly voice that explains phenomena, striking the balance between simplification and explanation, helps citizens understand why the numbers matter to all.

One of the reasons why the relevance of official statistics is not evident to all citizens is the fact that some topics that are perceived to be important by citizens are not the focus of official statistics. A readiness to rapidly develop statistics is the first step in addressing this problem and avoiding speculations.

Another reason why the relevance of official statistics is not evident to all citizens is the mismatch between personal experience and the averages that are estimated by official statistics at macro level. Complementing the communication of averages with distributions and estimates for smaller domains could reduce the perceived mismatch.

The communication of official statistics should take advantage of qualitative description, storytelling and data visualisation, although a common misconception about visualisation is that it consists of pictures that can be interpreted intuitively. The process of widespread adoption of graphic forms follows a trickle-down process: (a) a pioneer invents a way of encoding and showing data, (b) a small community of experts adopts it, (c) the media tentatively tries to use it as well, (d) by being constantly exposed to the new graphic form, the general public begins seeing it as 'intuitive'.

Using graphic methods to communicate the accuracy of official statistics as a measure of their quality is a big challenge, since accuracy is a statistical concept quite unfamiliar to users. The communication of uncertainty to the general public could be improved by being transparent about all sources of uncertainty, using modern methods of representing uncertainty, including short explanations of how to read and interpret them and being clear without being simplistic.

Awareness of and trust in statistics are crucial for open government in open societies and can be improved by teaching some statistics to secondary school students, in

order to plant a seed of critical thinking in their mind and improve statistical literacy, by building on and supporting current programmes, initiatives and networks.

Depicting globalisation

INTRODUCTION

The future business ecosystem could, due to the future evolution of technology, plausibly be heavily populated by small and medium-sized enterprises (SMEs), start-ups and self-employed workers. Alternatively, we could see greater consolidation and even monopolisation of business activities: large organisations can invest more in technology infrastructure; they have greater access to data, which they can use to optimise production systems and improve products and services; and, as their value chains become more networked, they may be reluctant to transmit 'business secrets' to outsiders. The role of multinational enterprise groups (MNEs) in production and trade is difficult to capture and not always correctly accounted for by the statistical systems. As they become more highly networked, global value chains will produce massive amounts of real-time data, potentially creating more transparency and flexibility for the actors involved. This opens potential opportunities for official statistics agencies to collect more data, in a more timely way.

Geo-political and economic uncertainty, further affected by the rise of protectionism and economic nationalism, will surely have an impact on the future configuration of global value chains. Further impact will come from the use of economic tools to settle geopolitical disputes, the growing importance of state capitalism in some corners of the world, and the erosion of strategic trust among world powers. New categories of products and services will emerge along existing global value chains. Trade in services is an area where the impact of fast technological change (e.g. digitalisation, the Internet of Things, artificial intelligence) is particularly likely to lead to new economic outcomes.

THE ROLE OF ENTERPRISES

Production and trade carried out by MNEs are difficult to capture and are hardly accounted for by the statistical system. In order to improve data on multinational trade, the first step could be asking big companies for cross-border data and perhaps begin innovating in public-private data sharing. In fact, MNEs play a key role in the international exchange of goods and services, in global value chains, in the international division of labour and in production arrangements. MNEs operate in a dynamic regulatory, tax and business context and constantly adapt. Tax competition, even among EU Member States, has an impact on the gross domestic product figures and on income distribution.

Improvements in logistics have an impact on flows, which have become more fragmented in an interconnected system, since the components of goods and services are often produced in different countries. Moreover, companies are able to shift activities quickly from one place to another. Consequently, identifying the country where the activities of MNEs should be accounted is a difficult task.

Multinational companies constitute a great potential data source but they have concerns about the way their data are used. If MNEs do not know how the data are used, or perceive that their statistical reporting burden increases, they would have concerns about giving their data to NSIs.

In some markets, small and medium-sized enterprises play a crucial role. Moreover, most big companies rely on SMEs. Since SMEs often have a light structure, specific support should be provided to them to facilitate their participation in the data collection system, including by developing standards for the exchange of information in digital format, such as the XBRL (eXtensible Business Reporting Language).

One way to capture globalisation could be 'following the money', by using data collected for regulatory purposes for statistical purposes. Solutions along these lines, respecting confidentiality norms, should be pursued by the ESS.

INTERNATIONAL TRADE

International trade in goods and services are highly interlinked, and traded goods often include services. The same enterprises are involved in imports and exports of both goods and services and, due to their intangible nature, services are difficult to capture and measure. This is particularly relevant for some services; those who download an app hardly realise that they are buying something. Furthermore, services are often part of trade/business arrangements in the context of globalised production such as factory-less goods production, inward and outward processing, trade, etc. and the competition among shops has become global, as a result of e-commerce. The effects of globalisation generate specific difficulties in the production of statistics. For example, streaming services are delivered from 'the cloud' and related financial flows do not necessarily reflect a traditional producer-consumer model; thus cross-border statistics are difficult to compile. Similar issues concern other services delivered and goods acquired via the internet, which is an emerging market that will probably grow in the future and is currently not covered by statistical data.

International trade statistics are expected to provide answers to 'real' and pertinent trade policy issues, such as the link between services trade and jobs, the value-added share of services in international exports, the importance of SMEs in international trade and the split of services in modes of supply.

As evidence-based decision making requires timely data, official statistics should focus more on timeliness in the statistical production processes, although there is a trade-off between timeliness on one side and data accuracy and robustness on the other side. Official statistics should explore the possibility of modifying data collection systems and statistical infrastructure to take advantage of innovative data sources, like web-scraped data.

E-commerce will become more widespread as consumers use mobile devices more frequently to buy online, but there is surprisingly little evidence regarding its global implications. In the future, most traded objects will be services, which will be acquired mainly through web transactions, which need to be traced. Moreover, markets are moving from a product-driven to an Intellectual Property (IP) driven value chain, and this change will have an impact on future data needs and data collection.

In the near future, the majority of transactions between business partners, consumers and the public sector will be in digital form, thus enabling the so called real-time economy where transactions are increasingly completed without delays. This will generate huge potential also from the perspective of statistics. In some cases, it could mean automated collection of raw data through on-line data transmissions from systems to systems. Therefore, official statistics will need to devise ways to collect data over electronic networks, including credit card transactions, on purchases and sales of goods and services, and on the transmission of funds and data.

Input/output data can help in understanding the impact of globalisation. Hence, NSIs should assess the feasibility of acquiring administrative data from private sector actors and combining them with traditional approaches, in a multisource official statistics production system.

ICT AS AN ENABLER

Information and Communication Technology (ICT) acts as an enabler of new businesses or innovation in the traditional businesses, nationally and internationally. Technologies underpinning the digital economy include, most importantly and roughly in order of maturity: advanced robotics and factory automation systems; new mobile and internet-connected data sources; cloud computing; Big Data analytics; and artificial intelligence.

The ways in which ICT can be leveraged to positively generate socio-economic gain are just beginning to emerge. Yet, despite this promise, a set of interrelated questions is evolving over the regulatory requirements, policies, ethics and norms that guide the use of ICT in the context of the global economy. Many of the existing approaches that guide creation, collection, storage and use of ICTs were based on decades-old policies of developed economies first established in the era of mainframe computing. They need to be updated and refreshed to address the new challenges of networked systems and also to suit the unique needs of individuals and marginalised communities.

Much progress has been made on the issue of security, as a result of the growing recognition of security needs. Cyber security and cyber criminality have an impact on globalisation, particularly for SMEs that cannot devote considerable funds to cyber security.

ICT creates opportunities for data collection, but, the algorithms for Big Data processing and analysis are human-designed black boxes; thus, there are concerns about the trust, security and accountability of ICT infrastructures. Moreover, the use of Big Data for official statistics implies a separation between data collection and statistics production, so that the data collection process is not under the control of the statistics producers.

The use of networked information and communications technologies in the context of globalisation is associated with a number of issues. While much potential exists, a more defined set of principles and risk taxonomies are needed to ensure that a more trustworthy and stable digital ecology can emerge. In particular, clarity on data ethics, accountability of all stakeholders and local information ecosystem knowledge are all needed. If leaders within the official statistics community could establish inclusive and 'safe spaces' where ethics-related conversations can take place (both within institutions and across them), it would be an important first step. Additionally, by creating an informal multi-stakeholder community of practitioners to explore ways to design and deploy implementable protocols which address these ethical challenges, progress could be made in identifying ways of balancing competing interests in an iterative and adaptive manner.

Capturing emerging phenomena

INTRODUCTION

The internet has transformed economies around the world in many different ways: old products are being delivered in new ways, new products and services are being invented and brought to consumers outside traditional outlets, and the roles of producers and

consumers are changing. In addition, changes are constant and rapid. Certain technologies allow a closer connection to be made between consumers and producers, reducing the need for brokers or other third parties (e.g. in the banking sector, energy provision, and more broadly in services such as transportation and accommodation).

LABOUR MARKETS

People are moving more frequently from job to job, and the distinction between self-employed and employee is becoming increasingly hazier, as is the definition of entrepreneurship. One challenge is to try to understand whether these changes will lead to a stable 'new normal'. This new situation calls for an accurate description of the different kinds of work, which is becoming increasingly difficult to obtain as a result of the broader change in employer and employment status.

We need to revise the statistical definitions of labour in order to tackle two main problems: what to measure and how to measure it. For example, with reference to what to measure, the relevant aspects are productivity, use of time and employment, with particular reference to new forms of work that fall into the 'grey area' between the traditional classifications of employment and self-employment. This 'grey area' of employment relationships could be better captured by the following approach:

- identify individuals who are simultaneously employees and self-employed and measure the relative importance of these forms of work to them;
- include variables to identify quasi self-employment;
- incorporate new variables to identify quasi employment.

In the labour market, increased demand for new skills due to the increasing use of ICT at work could also be observed. This presents a major challenge to skills development systems because while there is awareness that the skills profile of citizens and workers will be very different than in the past, the skills of the future are hard to identify with certainty due to rapid changes in technology. As for measuring skills, job tasks surveys are extremely useful for identifying how job characteristics change over time and to infer the implications of these changes on the demand for skills, but they are costly to develop and conduct. Whereas job task surveys rely on self-reporting, skills assessment programmes rely on formal testing and could hence be considered less subjective. Another approach is science-based evaluation; if carried out in a systematic manner, this could support skills assessment as well as skills development policies. Finally, online job vacancies have big potential as a source of information on the characteristics of job offers, job seekers and the duration of job postings, allowing labour market movements to be tracked in real time, providing high frequency data. Furthermore, they allow shifts in job profiles based on a large range of job requirements on skills, education and experience to be analysed. Online job vacancies also have some shortcomings (such as representativity, completeness, consistency and granularity) that future developments in data collection and treatment may be able to overcome. Since each of the four approaches has its own limitations, a combination of them could provide useful and timely insights in the changes in skills demand driven by digitalisation.

DATA ON NEW ECONOMIC AND BUSINESS MODELS

It is necessary to collect appropriate data in order to understand new business models and follow their evolution. This may include attempts to capture changes in organisational structure and culture in the sectors where new business models are evolving. Questionnaires developed by the statistical offices are complex and companies have difficulty understanding them. Furthermore, companies change fast and often their data no longer fit the questionnaires. The world economy could be said to be increasingly moving towards a household-to-household economy, and imposing the same kind of reporting on households as on enterprises is obviously impossible in view of the increased administrative burden this would involve. Currently, a number of services are produced all over the world and assigning a portion to each country is difficult.

There is a growing interest in other kinds of data sources, such as Google search; for example research is being made on 'now-casting' value added and other economic variables from Google search histories (Google Trends). These data have benefits over survey data in terms of immediacy, scale, breadth and greater flexibility/specificity compared to pre-classified statistical schemes. However, there are significant challenges in associating Google trend data or other web-scraped data with economic variables such as revenue, value added or employment on a technological, statistical and institutional level.

As the collaborative economy may be driving a rise in informal work and self-employment, there is concern that it may have an effect on tax levels and compliance. This could arise from several effects. For example, salaried employment could be replaced by informal work carried out by several providers who each fall beneath the tax threshold. Secondly, salaried employees could be replaced by self-employed who pay less tax on the work undertaken. Thirdly, tax compliance may diminish due to the absence of a third party involved in tax collection, such as an employer. The digital foundation of the collaborative economy can help

mitigate some of these effects. Electronic payment systems increase tax salience by providing traceability and making it easier to make payments between consumers and providers. Collaborative platforms may also have attracted some activities from the informal sector that were previously settled in cash. Current approaches to data collection may need to be revised to make use of future technologies, such as digital tax accounts for entrepreneurs that can ensure continued access to information.

New information needs for policymaking concern reliable statistics on the collaborative economy. Priorities comprise statistics on the size and growth of the collaborative economy, feedback from providers via surveys on the ease of paying taxes, as well as accurate and perhaps more frequent statistics on the size of the informal sector. Finally, existing tax revenue statistics will require fine-tuning and guidance in the collection of data on national taxes raised to provide for a more accurate distinction between revenues from employment and those of self-employment.

New services may offer higher perceived quality sold at lower prices than more traditional services. Also, traditional methods may struggle to measure prices adequately when new technologies allow on-line and brick-and-mortar shops to change prices at any time of the day, depending on the demand that is registered at that moment or on the profile of the browsing consumer. For e-commerce, accessing and using e-commerce platform data may lead to savings on the side of the statistical offices, reducing data collections. On the other hand, these new data sources often have a reduced signal-to-noise ratio, which requires more data preparation (pre-processing) or cleansing, as well as using different data sources to produce statistics that meet the high quality aspirations of official statistics.

In the future, demand for trusted information will increase and several producers of data will try to expand into the realm of official statistics. One possible solution could be to develop a system of standards for statistical quality that could be adopted by third parties to become trusted producers of statistics. The role of statistical offices would partially change from producing trusted statistics to producing standards enabling others to produce statistics at certified quality levels.

FINANCING AND INVESTMENT

The large decline in gross fixed capital formation in the EU during the recession of 2008-2009 and the weak dynamics of subsequent years have been of primary concern for policy makers.

More timely and disaggregated data should be produced on gross fixed capital formation infrastructure, investment needed by sector of activity, investment in climate change mitigation and intangible investment. These are crucial to support effective policymaking.

In some EU countries, financing and investment data are collected by central banks. However, there are several firms in the financial records that are not only financial companies, although they are considered as purely financial. There is a need to identify and integrate different data sources that can reduce data gaps and inconsistencies. Other sources of macroeconomic data and firm level data should be integrated, particularly with regard to financing and investment, and national accounts. Central banks are moving in this direction and are trying to transform the data they collect, in order to make them available to other institutions (after anonymisation).

A Keeping up with the trends in migration

A1 Perspectives for model-based official migration statistics

Jakub Bijak(*)

Introduction

International migration is becoming an increasingly more important aspect of social life and policy across Europe (see e.g. EC 2015), yet many aspects of the existing official statistics on migration flows and stocks remain problematic. As the same time, there is an ever-growing demand for better and timelier data that would enable various European stakeholders to better deal with the various challenges posed by migration. In particular, there seems to be increasing public and policy demand for some forms of migration management, which requires more and better migration data as a prerequisite.

According to Article 9 of the Regulation (EC) No 862/2007 on community statistics on migration and international protection, 'scientifically based and well documented statistical estimation methods may be used' to develop official statistics on migration and asylum. However, despite the presence of the legal framework, the use of model-based approaches in the official statistics on migration and asylum remains under-utilised in most European countries and at the EU level. As a result, the available migration data do not achieve their full information potential.

The aim of this contribution is to make the case for a fuller use of statistical modelling to combine the advantages of data from different sources and to deliver new ideas – such as early warning mechanisms – that will better equip European policy-makers of tomorrow to deal with the challenges of brought about by various forms of migration.

The contribution is structured as follows: after a brief discussion of some of the key unmet policy needs related to migration statistics in Europe, in the following section four areas for potential use of statistical modelling techniques are examined. These include: small domain (small area) estimation, integration of multiple data sources, privacy and disclosure control, and acknowledgement of uncertainty in model results. The final section contains reflections on the potential for producing and using model-based migration statistics in the future.

BACKGROUND: POLICY NEEDS

There are three important unmet needs for policy-related migration data in Europe. The first one is related to the timeliness of statistics in such areas, where rapid operational response or short-term capacity planning is required, such as asylum flows or other types of high-volume mobility. This was especially visible during the 2015 asylum crisis. The second need is related to the usefulness of data – the availability of consistent, harmonised, high-quality migration statistics across Europe – which could map onto the different definitions of migration (short-term, long-term, etc.), depending on policy requirements. The third need, related to the two above, is related to the readiness of the data for immediate use in a specific policy context, without the need for excessive analysis or processing.

In more general terms, there is a need for flexibility of the framework for conceptualising and measuring migration and mobility along its three key dimensions – space, time and type of mobility. Crucially, in the context of contemporary migration, mobility type cannot be seen as a dichotomous or sometimes even categorical variable – the work on environmental migration or asylum-related flows suggests that

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there exists a continuum of migration forms, complicating attempts to measure it (King 2002; Black et al. 2011).

Several of the challenges listed above can be at least partially met by adopting the model-based approach to official migration statistics. The four main areas in which statistical modelling can help address these challenges, are discussed next.

COMPLEXITY AND UNCERTAINTY

Fundamentally, migration processes are uncertain, and their uncertainty and volatility are exacerbated by a range of unpredictable factors and complexity of the underlying drivers, factors and processes (Bijak 2010). Given this complexity and issues with conceptualisation of migration, it is very difficult, if at all possible, to measure it without error, not to mention trying to make assumptions for the future, as an input to official population projections. Hence, there is a need to produce reliable assessment of uncertainty for the migration estimates and predictions, in order to better inform the decision making (Bijak et al. 2015).

Assessment of estimation errors is of course present in the design-based approaches, whereby the randomness in surveys is an important source of uncertainty. However, for administrative data, multiple data sources, structurally complex problems, or predictions, a comprehensive assessment of different sources of uncertainty, not limited to sampling, is called for. This necessitates the adoption of model-based approaches, ideally embedded in a Bayesian statistical framework, which is also capable of incorporating expert opinion in a formal and coherent way (Bijak and Bryant 2016). The existing examples of using Bayesian methods in official statistics include subnational population estimates in New Zealand, comprising the migration component (Bryant and Graham 2013, 2015), and probabilistic forecasts of global population prepared by the United Nations Population Division (UN 2015), extended to include the uncertainty of migration prediction in Azose et al. (2016).

The challenges brought about by migration uncertainty and volatility are also likely to bring about a greater need for new data, and timelier, or even pro-active, estimates and warning systems. This information capability gap was laid bare during the recent asylum crisis in Europe, when timely warnings would have been very helpful in managing the migration processes and allocating resources. Model-based approaches can provide comprehensive and bespoke solutions to these challenges, especially whenever the problems at hand are too highly structured or too complex to be dealt with through other methods.

PROMISING AREAS FOR MODEL-BASED MIGRATION STATISTICS

Small domain estimation

One of the key areas for application of model-based approaches to migration data is the small domain (or small area) estimation, important for example for producing sub-national estimates or projections. Especially in the context of survey data, the analysis of small geographic areas and other dimensions with low cell counts naturally lends itself to the use of structural and hierarchical models, which allow for borrowing of strength across different units of analysis (e.g. Fienberg 2011). The same holds for predictions based on relatively short time series, as exemplified for example in the global population projections involving the migration component (Azose et al. 2016). In such cases, design-based survey methods alone are not enough for allowing inference at detailed levels of disaggregation.

However, it is also worth noting that the dichotomy between (direct) design-based and (indirect) model-based approaches, often based on Bayesian statistical methodology, in this context is not insurmountable. In the literature, there are examples of synergetic methods, which have been suggested with the aim of taking advantage of the desired features of both approaches. One such method is the 'Calibrated Bayes', proposed by Little (2013) in his comprehensive article, which also evaluates the prevailing design- and model-based approaches. The 'Calibrated Bayes' approach is Bayesian in spirit, but the results of estimation can be subsequently calibrated at higher levels of aggregation, in order to preserve the desired design-based properties.

Reconciliation of data sources

Another very promising area for employing model-based approaches to migration statistics is the reconciliation and combination of various data sources to produce the estimates. There are different methods through which the existing data sources can be combined, either by 'fusing'

aggregates (macro) or by linking individual-level observations (micro).

The macro-level approaches can offer both merging and harmonisation of the data through modelling. A natural choice of methodology involves hierarchical approaches, for example log-linear or generalised linear models. Such methods have several desired properties: not only they allow integration of data, but also offer bespoke solutions and flexible design for mapping the different data sources onto different concepts, definitions and mechanisms used for data collection. Existing examples include models for harmonising migration data for different European countries (Raymer et al. 2013), or for different sources for a single country (such as Disney 2015 for the United Kingdom), both of which rely on Bayesian methods to estimate migration. The key challenges of the macro-level approaches include conceptual mapping of the data sources and – in many cases – the need for eliciting and incorporating the expert opinion on various meta-features of the data being combined.

An alternative approach relies on individual-level data linkage and on employing such methods as multiple system estimation (Bishop et al. 2007). The micro-level matching can be based on the existing probabilistic matching techniques, dating back to the seminal work by Fellegi and Sunter (1969). Multiple system estimation is already used in official statistics for census adjustments based on post-enumeration surveys (Fienberg 2011), and its application could be extended to other areas related to migration and asylum. Existing examples of non-statistical micro-level integration of migration data include information exchange between population registers in Nordic countries (Kupiszewska and Nowok 2008).

Micro-level methods can be potentially more exact than macro-level data integration, but are at the same time more resource consuming. They also come with their own set of challenges, some of them intrinsic, such as the linkage quality, but some more general, such as ethical concerns, which are discussed next.

Privacy and disclosure control

In situations involving linked datasets, such as those involving combined sources, the ethical challenges surrounding the production and use of data are amplified. Edwards et al. (2015) report several key apprehensions: firstly, in the era of ubiquitous 'Big Data', the notions of anonymity and informed consent need rethinking; secondly, there are privacy-relates concerns around widening the purpose of collection of the existing data; and thirdly, there is a need for legal safeguards and data governance mechanisms that are better suited to meet these challenges. Thus, even though data linkage brings about important opportunities for the science and society, there is a need for a new ethical reflection surrounding the use of linked or 'Big' data.

However, more generally, privacy protection and disclosure control of statistical outputs is another important official statistics domain linked to migration and asylum, where model-based methodology can be potentially very useful. As noted by Fienberg (2011), this is a natural area for applying Bayesian statistical methods, as they are capable of quantifying the trade-offs between disclosure risk and utility of data to the users in a formal, explicit and transparent way. In the context of data linkage methods discussed above, and given the political sensitivity of migration and asylum, this line of enquiry is definitely worth pursuing.

MODEL-BASED MIGRATION STATISTICS: A REFLECTION

As argued before, model-based approaches can help the official statistics community as well as the users of statistics overcome some of the challenges of migration data. Article 9 of the Regulation 862/2007 makes an explicit provision for the use of model-based approaches in official migration statistics. These possibilities remain underutilised.

Specifically, more work can be done to explore the potential and limitations of using non-traditional migration data sources, including 'Big Data'. There exist encouraging examples of utilising migrant stock data to model the flows (Abel and Sander 2014), or feasibility studies for the use of new data, new methods, and approaches, which can be followed up (Hughes et al. 2016). Of particular interest may be some non-traditional data sources, such as social media or mobile phone data (idem), although the problems with their quality, limited transparency, and selection biases would need to be taken into account explicitly in the models.

There seem to be also some clear trade-offs between how various migration statistics may meet the policy needs discussed before. The

existing and potential sources vary with respect to how they meet these needs, especially given that many of them are not created with migration statistics in mind. Thus, administrative registers are timely and ready to use, but do not necessarily map well onto the population categories of policy interest. Bespoke migration-related surveys are ready to use and respond to user needs by design (save for small-domain issues), but typically are not timely. The 'Big Data', on the other hand, are very timely and could be potentially useful, but they need additional processing and investigating before they can be ready to use. Without adopting a model-based approach, it is highly unlikely that any given source of data will have all three desired features at the same time.

Obviously, modelling alone would not be capable of resolving all issues with migration data, which itself may be an impossible task. However, in order to achieve longer-term policy and statistical impact, the new EU agenda for better migration statistics will require greater co-ordination, harmonisation and data exchange between the member states, possibly coupled with the use of data linkage methods. The EU is well placed to deliver this, but bearing in mind the necessary safeguards with respect to individual freedoms, privacy and accountability. Here, a success would require not only designing appropriate models, but also communicating their outcomes and caveats efficiently to the users and the public.

CONCLUSIONS

To sum up, the challenges brought about by international migration can be made more manageable by using the already available data in a more creative way and making a fuller use from model-based approaches in official statistics. Important objectives for the longer-term future include better coordination, harmonisation and exchange of migration and asylum data across Europe. Direct exchange of information – which already takes place amongst Nordic countries – could facilitate the process. With appropriate legal safeguards and accountability in place, this new approach to migration statistics can help strike the right balance between civil liberties and security in Europe with respect to not only measuring, but also managing migration.

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A2 Managing the migration crisis: How statistics can help

Rita Di Prospero and Luca Pappalardo(*)

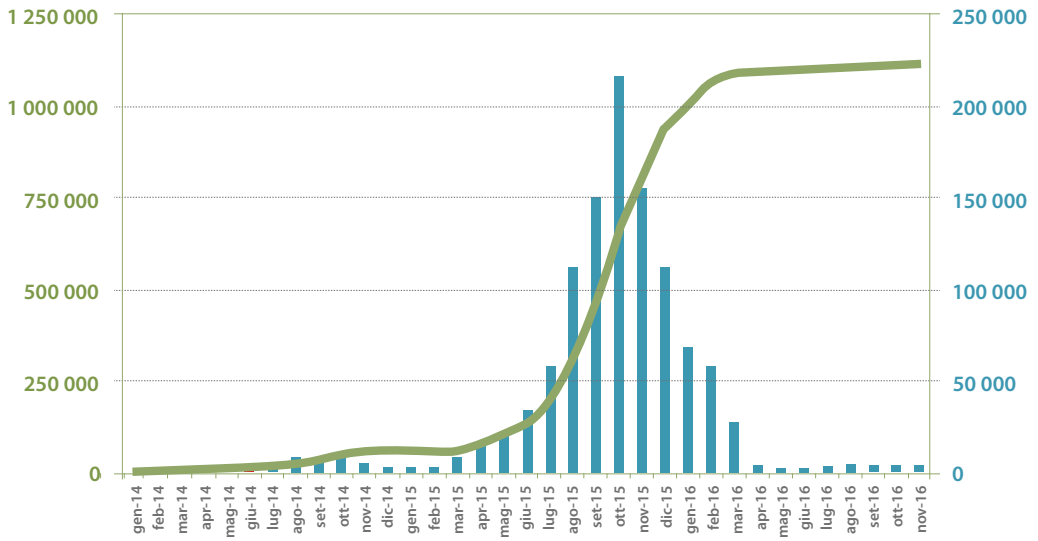
Introduction

In autumn 2015, the migratory crisis hit Greece and the European Union in all its strength. About 900 thousands migrants reached Greece in 2015 and in the month of October, arrivals peaked at more than 200 thousands. **Figure 1** shows very well the shock suffered by the migratory pattern.

The histogram in blue shows monthly arrivals (left axis), the line in green shows the cumulated arrivals since 1January 2014 (right axis)

Whereas the migratory crisis is a well-known fact, documented in the news worldwide, it is probably less known that, in coincidence with this peak of arrivals, the European Union swiftly took extraordinary, unprecedented measures to tackle the crisis at political level. As the crisis unfolded, the European Union acted as a crisis manager. At the end of October 2015, for the first time in the history of the European Union, the Luxembourg Presidency activated the European Union Integrated Political Crisis Response arrangements (IPCR). The IPCR mechanism was initially activated in information-sharing mode. Ten days later, on 9 November 2015, in full. The IPCR is a mechanism that supports the Presidency of the Council of the European Union in dealing with major natural or man-made disasters. The IPCR arrangements provide the Presidency with tools that facilitate information sharing, joint decision-making, and coordination of the response at the highest political level. Both levels of activations, 'information sharing' and 'full activation', entail the possibility for the Member States and the European Institutions to exchange information on a dedicated web platform, accessible to a closed community of users. This web platform is also the dissemination channel for the Integrated Situational Awareness

Figure 1: Arrival of migrants to Greece along the Eastern Mediterranean route



Source: European Border and Coast Guard Agency.

(*) Directorate-General for Migration and Home Affairs (European Commission)

and Analysis report (the so-called 'ISAA report'), a key document within the IPCR arrangements. It is a confidential, analytical report, prepared by the relevant services in the European Commission or the European External Action Service for the specific crisis. The aim of the ISAA report is to provide decision-makers with a clear consolidated picture of the current situation, on the basis of joint efforts in collecting and analysing information.

For the migratory crisis, Directorate-General Migration and Home Affairs of the European Commission is the editor of the ISAA report, which has the responsibility to gather and coordinate the inputs from all the stakeholders: other Commission services, the European External Action Service, European Union Member States, Schengen Associated States, the relevant European Union Agencies (European Border and Coast Guard Agency, the European Asylum Support Office, Europol, the Fundamental Rights Agency), etc. The ISAA report is tailored to fit the needs of the corresponding political level: it translates operational information into a strategic overview of the situation, allowing an informed debate within the Council of the European Union. It contains:

- factual, evidence-based analysis of the situation – which includes an assessment of trends about arrivals along the main routes and at specific locations, secondary movements within the European Union and along the Western Balkans, number of incidents occurred and the results of Search and Rescue operations, asylum applications in the Member States and Schengen Associated States.
- the assessment of the European Union response – which includes an assessment of trends on reception capacity and availability in the European Union Member States, relocations of migrants carried out and the pledges for relocations put forward by Member States, resettlements of migrants, assisted voluntary returns of migrants, deployment on the ground of European Union Agencies officers and experts, as well as of technical equipment, in-kind and financial support provided by the European Union.
- the identification of possible shortcomings

After more than a year since the IPCR arrangement was triggered, it is widely acknowledged that the goal to have a level playing field and reliable reference data for decision-making purposes both in the Member States and in the European Institutions was achieved. The crisis had also the effect to stimulate new data collections, mostly of operational data, which helped monitoring migratory flows and supported policy.

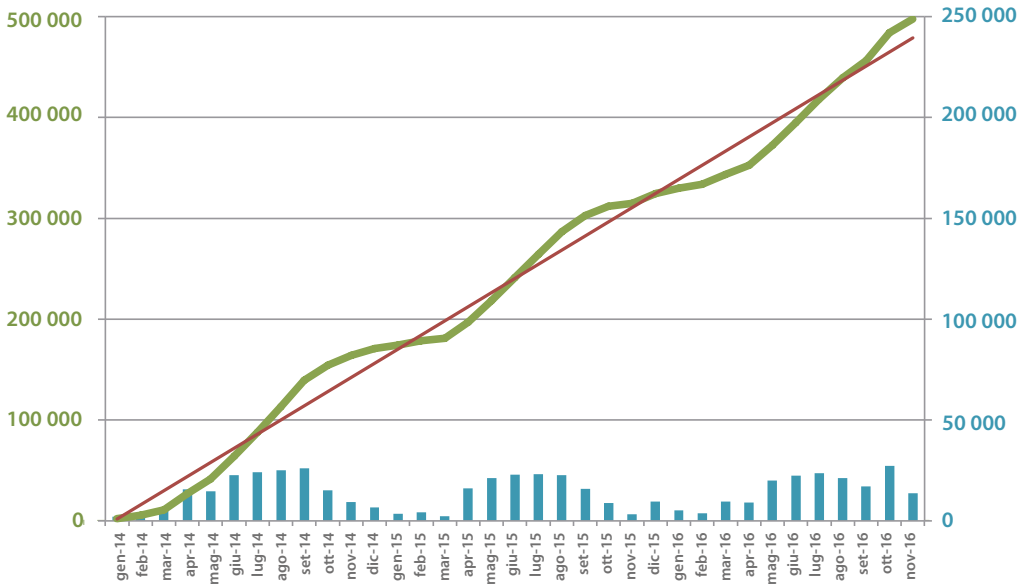
When drafting the ISAA report, we strive for the accuracy of our data. Yet, often, we have to strike a balance between imprecise operational data, and no data at all – because the validation of data requires more time than that we have to inform the policymakers. In this context, timeliness is more important than accuracy. The ISAA report is published weekly every Tuesday evening, and presents updated information of the previous week. Hence, high frequency statistics are needed, and to use operational data is the only feasible option in this context. However, our experience with their use shows that the underlying statistical process of gathering and treating the information needs to be streamlined. There are often inconsistencies, which are difficult to be explained. Moreover, as users, we feel the strong need to formalise and harmonise definitions. And finally, in order to better analyse data, the overall process needs to be more thoroughly (and openly) documented. These considerations are even more appropriate when applied to non-operational, public data. These are all issues that official statistics may address, supporting the stakeholders in developing the quite specific expertise needed to find answers to these questions.

As concluding remark, let us go back to the data.

The histogram in blue shows monthly arrivals (left axis), the line in green shows the cumulated arrivals since 1/1/14 (right axis)

Figure 2 shows the arrivals on the central Mediterranean route, from Northern Africa to Italy. The cumulated curve, with its linear trend, clearly shows that there is a steady, continuous flow along this route, with a strong seasonality. The crisis from acute is getting chronic and we need to readjust the monitoring tool to this mode. Instruments that proved to be efficient for the management of a shock might be less appropriate when we are dealing with a situation that has stable behaviour. This entails restructuring and streamlining the data collection in a more systemic way, reinforcing the cooperation among the different stakeholders in order to allow a continuous and timely monitoring of the situation.

Figure 2: Arrival of migrants to Italy along the Central Mediterranean route



Source: European Border and Coast Guard Agency

A3

Statistics on international migrants: Data quality issues for descriptive characteristics especially when using administrative registrations[1]

Eivind Hoffmann[*]

Introduction

The users of statistics on international migration and migrants need statistics that can be distributed according to a range of descriptive variables. Beyond headcount statistics of flows and stocks of international migrants, policy makers and other actors need to know their characteristics to have a better understanding of the migration impacts for both destination and origin countries, and the policy options that might be possible and useful. Then it is necessary that these descriptive characteristics have been registered and coded (when needed) with the required reliability, validity and detail.

The validity of the registered descriptive variables depends on whether or not the categories used, i.e. the value sets, can provide the distinctions needed for the descriptive and analytical questions posed by the users of the statistics. The reliability depends on whether the recorded information is a (reasonably) correct representation of the characteristic it is intended to reflect: i.e. has the correct information been given, and is the recorded value a reasonably correct and complete reflection of the information given. The detail (resolution) with which the information has been registered determines the extent to which statistics based on valid and reliable information can be used for a range of descriptive and analytical purposes. These requirements can normally only be satisfied if certain well-defined procedures are being followed in the collection and processing of the information, and if the staff involved have received the necessary training and tools.

Descriptive characteristics which are frequently needed both for those moving across international borders and for the stock of migrants, include, but are not necessarily limited to, the following:

(a) Age (group);
(b) Sex;
(c) Address/locality (in both countries);
(d) Citizenship;
(e) Capacity to use (main) language of host country
(f) Educational attainment;
(g) Marital status.
(h) Type of family and living situation in home and host country;
(i) Purpose of move;
(j) Presence in host country: length and timing of previous residence and work periods in host country;
(k) Absence from host country: length and timing of periods of absence from host country, after first residence period.

As most international migrants either are migrant workers or may (aim to) become employed in the host country, the following descriptive variables are frequently important in addition to the variables (a) through (k) listed above:

(l) Labour force status: i.e. whether employed, unemployed or outside the labour force before and after the migration;
(m) Occupation of last main job before migration and current job (job looking for) after migration;
(n) Industry of last main employer in home country and of the current job after migration;

(1) This note is based on experiences gained when working in the Norwegian Directorate of Immigration (UDI), as well as on chapter 8 in Hoffmann, E & S. Lawrence ((1996).
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(o) Type of work contract (status in employment) in last main job in home country and in the current job after migration;

(p) Income gained and fees paid, both in the country of origin and in the host country[2].

Especially some of the administrative registrations cannot be expected to capture and store reliably the information needed for a number of these variables, because of they are of limited relevance to the main objectives of the administrative processes and thus not recorded (reliably) in their registration systems.

Not included in the above list are a number of variables which are important for many types of analysis and descriptions using statistics on international migration and migrants present/absent and their situation before or after migration, but where the necessary information may be difficult to obtain reliably from routine data collection programmes. Examples are information that can be used to produce statistics on the number and characteristics of individuals illegally present in the host country or who are engaged in (economic) activities that illegal or not permitted under the terms of their residence permit. This also applies to information that can be used to identify employers or owners of dwellings that provide substandard working and living conditions on terms deemed to unacceptable.

European and/or international recommendations exist on the definition and value sets for many of the variables listed above, e.g. in the Population Census Recommendations[3] , but operational guidelines are fewer. In general, it may be relevant to suggest that to capture the information needed for each of the listed variables one or more questions must be included on the registration or survey form. These questions must be formulated in ways that makes it easy for the respondents to understand the type of answer which should be given. Pre-coded response alternatives should be carefully labelled to make it easy for a respondent to relate the alternatives to his/her situation. Where a written response is required, e.g. for country of citizenship, type of educational attainment, type of industry or type of tasks and duties in the job (to record occupation), enough space must be made available to make it possible for the respondent to give the pertinent information[4].

Below are observations on specific issues with respect to some of the variables listed above:

(A) AGE

'Date-of-birth' is the characteristic most commonly used to define age. Most regulatory agencies regard this as an important element for establishing the identity of a migrant. This is one reason why significant efforts are made to establish an (approximate) age and date-of-birth for asylum seekers and irregular migrants who cannot document their age, and to determine and record a date-of-birth consistent with this assessment. Such assessments are particularly important for the age of unaccompanied minor asylum seekers who cannot document their date of birth[5]. For statistical description and analysis, the 'age' variable can be derived from the registered date-of-birth information, either by using the year of birth or by subtracting the date of birth from the date of registration or the date of arrival or departure. The former method is preferable for many purposes because it does not rely on precise information about the day and month of birth and it permits statistics to be produced for birth cohorts, making it easy to follow the same 'generation' over time. However, for statistics used to describe the application of age-dependent regulations, the age variable has to be defined with reference to the last birthday.

(F) EDUCATIONAL ATTAINMENT

Information about 'educational attainment' by level and type of specialization, or about 'training completed', 'formal qualifications' or 'certificates' is reliably collected and registered by the migration control agencies when these characteristics are used to determine whether or not the (potential) migrant (worker) satisfies the standards set for (different types of) visas and/or work or residence permits, otherwise not. Depending on the relevant legislation the categories may be very broad (e.g. indicate level only) or very narrow (identifying (a few) quite detailed specializations). This means that the number of different categories identified may be quite limited, and of limited usefulness for many

(2) The SDG indicator 10.7.1 requires such statistics.
(3) See e.g. UNECE (2015).
(4) These observations may seem like simple common sense, but they are ignored in many registration systems. This results in inconvenience and uncertainty to those giving the requested information, long-term extra costs to the responsible agency and unnecessary deficiencies in the quality of the resulting registrations as well as in the statistics depending on them.
(5) See e.g. EASO (2013).

descriptive and analytical purposes. The control agencies tend to use their own classification systems, reflecting the regulations, normally unrelated to any national or international standard classification of 'education' used by the countries of origin or host countries for their educational statistics or for statistics on the educational attainment of their populations. Special procedures are needed therefore to convert the information given to, and controlled by, the regulatory agencies into a classification system that will be consistent with that used in other areas of statistics. To code the educational attainment of foreign citizens is particularly complicated for the host country's authorities, because the national classification of education in that country normally is constructed to reflect its current system of education, whereas foreign migrants may have been educated over a period of up to 20 years in another country's educational system[6]. The most reliable transformation of information given on the registration form to codes in the host country's national classification of education can be best achieved if there is: (i) a set of questions designed to obtain the highest level of education attained and a separate (set of) question(s) designed to determine the field of specialization; and (ii) a pre-coded list of alternatives specified for the levels. In addition: (iii) coding the specialization should be done with as much detail as possible from the information provided; and (iv) coding should be done with the help of strict coding rules and a coding index constructed from previous experience with such responses. For the statistics computer algorithms should be used to construct the appropriate educational attainment category during the tabulation process.

(C) GEOGRAPHIC LOCATION

Most problems and opportunities associated with the international migration are local, in the sense that their impact and concrete manifestations are found in specific localities (i.e. they are more important in some districts, villages, towns or cities than in others). This applies whether we are considering the sending or the receiving countries. It is therefore important to be able to answer questions such as 'Where do the (international) migrants come from?" and "Where do the (international) foreign workers work?' with the name of a geographic location. Geographic context is important in formulating and implementing policies, as well as for the analysis which can provide the basis for an evaluation of those policies and related developments. Various mechanisms may be used to determine the geographic references: (i) home address of the migrant, and employer's address, respectively for the countries of origin and destination, are frequently collected to facilitate identification of and communication with the workers and/or the employers. (ii) The initial reception of the visa or permit application may be handled by a local representative of the national authority. Depending on the type of geographic references which these mechanisms provide and on the degree of detail and compatibility with other data which can be obtained, statistics on migrant workers by geographic region of origin or destination can be linked to other types of relevant information about these geographic areas.

(I) PURPOSE OF MOVE

Information about the 'purpose of move' may be obtained from (i) asking the migrant (or a proxy), or (ii) the type of permit for residence or work that an immigrant has been granted. In a survey or population census, or in a registration system such as the one established in several member countries in EU/EFTA for those exercising the right to free movement. In a survey with method (i) it may be possible to recognise that migrants may have mixed motives and ask the respondent to grade the degree to which different possible motives influenced the decision to migrate (e.g. work, studies, family, international protection, natural or man-made disasters). For statistics based on the registrations made by regulating authorities it is (ii) which may serve as basis for the value set of this variable.

(J AND K) CIRCULAR AND RETURN MIGRATION

Information on an individual international migrant's movements across the country's international borders and the duration, presences and absences from the national territory is of interest to the regulatory agencies in several contexts, e.g. because they determine whether the qualification requirements for seasonal work permits or for citizenship are satisfied[7].

(6) In the latest version of ISCED there is a suggested coding scheme for 'educational attainment' (see Annex III in Unesco Institute of Statistics (2011)), but there is no guidance on what questions to ask and how to code to this coding scheme. These observations are based on Hoffmann (1992), an early attempt to reflect onn these issues.
(7) In this context there may be no difference between external or internal Schengen borders.

This means that these agencies may make a serious effort to establish and (possibly) register such movements when considering relevant applications, but for other international migrants the relevant information may only be available in administrative registrations for the (regrettably few) migrants who report their emigration movements to the authorities. Thus for these groups the only feasible method would seem to be to collect relevant travel information through retrospective questions in household surveys and/or a population census[8]. All respondents in the survey/census then need to be asked these questions, not only those who are immigrants to the country.

(M) OCCUPATION

Information about the occupation of past, current or future jobs, reflecting the 'type of work (to be) performed' by the migrant worker and/or the working migrant, is frequently collected by the migration control agencies to determine whether or not the potential migrant worker satisfies or not the requirements for (different types of) visas and/or work permits. This information may frequently be requested for certain (types of) occupations only, without other detailed distinctions. Recruitment agencies often make use of the same type of information for their job recruitment and placement operations: this may require that quite detailed distinctions be made, but normally only between a limited number of different occupations because of the tendency of recruitment agencies to specialise according to type of job, worker or type of employer. Both the control and the recruitment agencies therefore tend to use their own classification systems for 'occupation', or a 'short' version of the respective national standard classification of occupations of the sending or receiving countries (These are used for national statistics and/or for job placements by national employment services.) Special procedures may therefore be needed to convert the information given to, and checked by, the agencies into a classification system which will be consistent with that used for other areas of statistics. The most reliable coding of occupation to the national classification of occupations normally results if: (i) there are one or two questions designed to obtain information which correspond to an occupational title and the main tasks and duties of the job; and (ii) coding is done with as much detail as possible from the information provided, with the help of strict coding rules and a coding index constructed from previous experience with such responses[9].
The fact that many of the national standard occupational classifications are based on or linked to the International Standard Classification of Occupations (ISCO-88 or ISCO-08) will facilitate the exchange and comparison of information about the occupations of migrant workers and working migrants, subject to the quality of the coding procedures used.

(N) INDUSTRY

Agencies concerned with the control of migrant workers will often ask for information about the future (sponsoring) employers of the workers, for control purposes. However, information about the sector of those employers will normally only be of interest to the controlling agency in the receiving country if only employers in certain sectors, e.g. agriculture, food processing or tourism, are allowed to hire migrant workers, e.g. to cope with seasonal peaks in workloads. Recruitment agencies need precise information about the type of industry of their employer clients only to help them determine the type of experience and skills needed by the workers they recruit, and there is a tendency of recruitment agencies to specialise according to type of worker or type of employer. Both the control and the recruitment agencies therefore tend to use their own classification systems for employer's activity, or to use a 'collapsed' version of the national standard classification of industrial activities, used for the national industrial statistics. Much less detailed information can therefore be expected concerning 'industry' than for 'occupation' or 'educational attainment', and probably also less detailed statistics than most users would like to have. Reliable coding of industry according to the national classification will normally result if: (i) there are one or two questions designed to obtain information which corresponds to the title of an industrial sector and the main products and services provided by the establishment to which the job belongs; and (ii) coding is done with as much detail as possible from the information provided, with the help of strict coding rules and a coding index constructed from previous experience with such responses[10]. The fact that many of the national

([8]) The Conference of European Statisticians (UNECE/CES) has adopted in 2016 a report on statistics for circular migration, see e.g. UNECE (2016). It is still (October 2017) too early to see whether, when and how national statistical authorities will be implementing these recommendations.
([9]) Detailed guidelines are given in e.g. United Nations & ILO (2010). Early computer assisted coding systems using this approach include ASCO (from Australian Bureau of Statistics) and CASCO (from Institute of Employment Research, University of Warwick, UK)
([10]) See United Nations & ILO (2010) for detailed guidelines.

standard industrial classifications are based on or linked to the International Standard Industrial Classification of All Economic Activities (ISIC ,rev. 3), or its EU parallel, NACE, rev.2, should facilitate the exchange and comparison of information about the industrial sectors of migrant workers when such information is available.

(O) TYPE OF WORK CONTRACT ('STATUS IN EMPLOYMENT')

The types of visas or work permits under which migrant workers are allowed to take up work in a country often limit the type of contract which can be established between the employer and the worker, e.g. with respect to its duration, the type of work to be done and the respective possibility for the worker and the employer to terminate the contract and to seek other employment or another employee. For migrant workers the type of visa may therefore provide a good classification of the type of contract that they have. However, that classification may not correspond to any classification of contracts or employment situations used to produce statistics for national workers. Such limitations frequently do not correspond to the terms of contract between the same employers and nationals. National statistical collections on employment may use a classification of status in employment which is designed to reflect the type of authority and economic risk which the work contract establishes for a job. The classification used will normally at the most only distinguish between 'employees', 'employers', 'own account workers', 'members of producer's cooperatives' and 'contributing family workers'. The terms of the visas/work permits can frequently be seen as specifying particular subcategories of 'employees' or 'self-employed workers', but one of the short-comings of most national labour statistics systems is that there have been no efforts to reflect in the national 'status in employment' classifications the type of contractual situation with which migrant workers frequently face. The International Classification of Status in Employment (ICSE-93) exemplifies some sub-groups of 'employees' and 'self-employed workers' which can correspond to some of the contract situations specified by visas or work permit requirements for foreign workers. However, the effort is tentative and needs to be further developed on the basis of systematic analysis of specific work contract implications of various visa and work permit requirements from a range of countries[11].

CONCLUDING REMARKS

All 'statistical' data collection instruments (statistical surveys and censuses of persons and establishments) are facing the same challenges when trying to obtain relevant reliable information on the descriptive characteristics of international migrants and migrant workers. Administrative registrations also face the same challenges, but as primary observations for statistics on international migration such characteristics can only be expected to be recorded reliably if they are relevant for the decisions that administrations have to make. Because, and as long as, characteristics such as age and sex are considered important as identifying characteristics they may be registered correctly, but other descriptive characteristics will only be registered reliably if they are important for the decisions (if any) to be made by the administrative authority.

([11]) It is expected that a report on a revised and updated ICSE-93 will be presented to the 20th International Conference of Labour Statisticians (ICLS), to be organised by the International Labour Office (ILO) in the fall of 2018. However, the current drafts do not indicate that any special contract situations of migrant workers are to be reflected

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A4 International standards for measuring international migration: Definitions, concepts, and terminology

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Introduction

Improvement of the collection and quality of migration data, for both those entering and leaving countries, has been a long-standing concern for data producers, users, and policy makers. The ability to accurately measure international migration is imperative for evaluating and monitoring policy decisions related to a wide range of topics, such as regional population growth and decline, out- or in-migration of highly skilled workers, impact of migration on the local labour market, the socioeconomic integration of migrants, working conditions for migrant workers, or even evaluating the economic impact of remittances. However, the improvement of statistical systems to measure migration has been a slow process, a result of many factors, including lack of coordination between migration statistics producers, failure to accept common terms and definitions, challenges related to data collection, difficulty measuring the true size of migration (e.g. migration is a relatively rare event, or is attempting to measure people who would prefer not to be measured), as well as lack of information to measure the impact of migration on both receiving and sending countries.

A critical question to address is how statistical systems operationalise and define international migration, thus the first step towards creating comparable migration statistics is to come to agreement on common terms and definitions. Lack of uniform definitions on migration is an important reason for inconsistency in migration statistics between countries. Even within countries data comparability issues exist, as many individual systems are set up to respond to specific administrative objectives, not for accurate measurement of international migration. Tackling these challenges are necessary to improve migration data at the national, regional and global levels.

KEY CONCEPTS AND DEFINITIONS FOR THE MEASUREMENT OF MIGRATION

Migration, both internal and international, is often studied by looking at its size, characteristics of migrants, and the impact migration has on both migrants themselves and areas from which they come and to where they go. At its most basic level, migration consists of two primary units of analysis, the person (who moves) and geography (where the person moved from and where the person moved to). Migrants are normally defined as persons who have changed their place of usual residence. For the purpose of international migration, a person's country of usual residence is where a person lives, that is to say, the country in which the person has a place to live and where the person normally spends their daily period of rest (United Nations Recommendations on Statistics of International Migration, 1998). Whether the change of residence crossed international or local borders, as well as duration (time) and purpose (reason) of stay, are additional criteria for defining a migration typology.

While dependence on change of usual residence is sometimes criticised for being too restrictive and tied to demographic methods, thus inadequately measuring international

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migration, it is the current international standard by which migration statistics are generated. However, in practical terms, these standards are often not followed by national statistical agencies, as data sources tend to drive the way international migration is measured.

Statistics on the size of the migrant population are normally collected on the basis of migrant stock or flow. Simply put, international migrant stock is the total number of international migrants living in a country at a particular point in time, while the international migration flow is the number of migrants entering or leaving a country over the course of a specific time period (e.g. one year). The main criteria for measuring international migrant stock and flow are country of citizenship and birth, while duration of stay further delineates statistics on migration flows.

Immigration refers to migrants entering or living in a country, while emigration applies to those exiting or living outside their country of origin. Both of these concepts can be measured in terms of stocks and flows. Migration events can occur over the life-course for individuals. Thus, migrants can be both immigrants and emigrants from the viewpoint of return or circular migration, that is migrants who leave their country of origin, but then return to their country of origin at a later date (or continue this pattern repetitively, which refers to the circularity of moves).

FOREIGNERS AND THE FOREIGN BORN

From a policy perspective, countries tend to distinguish between the immigration and emigration of local and non-local residents. Depending on whether one is trying to measure movement to or from a country, as well as whether primary interest lies in the movement of nationals or non-nationals, different operational issues exist. Nationals and non-nationals (foreigners) are normally identified via their citizenship status. Foreigners are defined as those without citizenship of their current country of residence, thus 'non-citizens' are distinguished from 'citizens'. While this distinction is often important from a policy perspective, a potential drawback to this approach is that it can include foreigners who were born in their country of residence, thus have never moved and should not technically be considered international migrants (have never changed country of usual residence). This approach also includes naturalised immigrants as citizens, which could be less useful from a policy perspective.

Alternatively, or in addition, many countries look at a person's country of birth to identify migrant status. Those born in their country of residence (natives) are distinguished from those born outside of their country of residence (foreign born). Use of the foreign-born classification has the advantage of corresponding to actual change of residence if a usual resident of a country was born in another country. Relative to policy relevance, people born outside their country of current residence, but citizens of this country at birth (e.g. born abroad of national parent(s) living abroad) are often excluded from 'foreign-born' tabulations. The foreigner and foreign-born criteria apply to measurement of migrants in terms of both total stock and flows over specified periods.

MEASUREMENT OF MIGRANT STOCK

A country's stock of immigrant population can be measured by all persons who have that country as their country of usual residence and who are citizens of another country (foreign population) or whose place of birth is located in another country (foreign-born population). Conversely, one can also measure the stock of emigrants, that is all citizens of a country (or those born in a country), who currently live outside their country of origin.

Thus, the foreign born are the group of persons who were born in another country. This group corresponds to the stock of international migrants that migrated at least once in their life and reside outside of their country of birth. Persons born in the country are defined as natives. Foreigners are the group of persons who do not have citizenship of the country. Foreigners can be foreign born or native born. Persons having citizenship of the country are defined as nationals, and can also be foreign or native born. Regarding measurement of the foreign born, geography at time of data collection should be used, thus it is important that those who have never moved, but whose country of birth changed due to international boundary changes, not be counted as foreign born or migrants.

Both methods of measurement have advantages and disadvantages. The advantage of using citizenship based criteria to measure migration is that it is often policy relevant, is a relatively objective measure, and is commonly reported across many countries. Disadvantages of

using citizenship to measure migrants are that citizenship is fluid (can change over time), the possibility of dual-citizenship (persons can be citizens of more than one country), and the aforementioned fact that foreigners are not necessarily migrants. The advantages of using country of birth as a measure are permanence (place of birth does not change, though country borders can change over time, e.g. former Soviet Union), it is an objective measure (though some countries use the measurement of the mother's place of usual residence at time of birth, rather than actual place of birth), and it directly measures whether or not a change of residence has taken place over one's lifetime. However, this variable is often deemed less policy relevant than citizenship, can include nationals (born abroad of native parents or naturalised citizens), and as already mentioned, country borders can change over time (possibly making someone foreign born who has never made an international move).

Given these strengths and weaknesses, it is often more effective if one can collect (and combine) both country of citizenship and country of birth information at the same time. On the basis of place of birth and citizenship, the following migrant and non-migrant population groups can be identified: foreign-born foreigners, native-born foreigners, foreign-born nationals, and native-born nationals. However, information on these groups is often not sufficient to monitor and analyse the impact of international migration over time, particularly from an integration perspective. Therefore an additional population group, descendants of the foreign born (persons with foreign/national background), is often identified, which includes persons born in the country whose parents were born outside the country. Persons in this group may or may not have directly experienced an international migration event. Several generations of descendants can theoretically be distinguished, that is: persons whose parents, grandparents, etc., were born abroad. However, in practice, data collection is generally restricted to those persons whose parents were born abroad (often referred to as the 'second generation').

These different criteria for measuring migrant stock are important for understanding the size of migrant populations and their descendants. While change of usual residence is the underlying theoretical assumption for measurement of international migrant stock, it is even more essential, combined with duration of stay, for determining migration flows.

DURATION OF STAY AND MEASUREMENT OF MIGRATION FLOWS

Duration of stay for migrants, either actual or intended, is a critical criterion for measurement of migration flows. According to the United Nation's 1998 'Recommendations on Statistics of International Migration,' for the purposes of measuring migration flows, an international migrant is defined as 'any person who changes his or her country of usual residence'. As shown earlier, a person's country of usual residence is that in which the person lives, that is to say, the country in which the person has a place to live where he or she normally spends the daily period of rest. Temporary travel abroad for purposes of recreation, holiday, business, medical treatment or religious pilgrimage does not entail a change in country of usual residence.

The UN recommendations further define two types of migrants by duration of stay criteria. In brief, long-term migrants are defined as those who move to a country other than their country of usual residence for a period of at least one year, while short-term migrants are people who move to a country for a period of at least 3 months but less than one year. In practice, most countries collect migration flow data on a yearly (12-month) basis, though some survey based questions use a five-year period. International migration flow data are more typically reported for foreigners than the foreign born. In terms of international migration data availability, in-flow data (immigration) are much more common than out-flow data (emigration).

LONG-TERM AND SHORT-TERM MIGRANTS AND DATA CONSIDERATIONS

In practice, the distinction between short- and long-term migrants is often difficult to make, particularly given different data collection systems used by different countries. The complete UN definition for long-term migrants is 'a person who moves to a country other than his or her usual country of residence for a period of at least one year (12 months), so that the country of destination effectively becomes his or her new country of usual residence.' The complete UN definition for short-term migrants is 'a person who moves to a country other than that of his or her usual residence for a period of at least 3 months but less than a year (12 months) except in cases where the movement to that country is for purposes of recreation, holiday, visits to friends

and relatives, business, medical treatment, or religious pilgrimage.'

These recommendations potentially make migrant flow classifications difficult to collect using current data systems, either administrative or survey based. Not only does country of usual residence need to be determined, but so does the migrant's duration of stay. Per the UN recommendations 'the act of being inscribed in a population register or country other than their own, being granted a permit to reside in country, or declaring intention of staying for at least one year, are all ways of making the concept of change of usual residence measurable'. This means countries can use different methods to determine duration of stay, which further complicates data comparability at the international level.

The duration of stay criterion for a long-term migrant can be determined by either actual or intended duration of stay of at least 12 months, thus is subject to practices used by different national data collection systems. For example, different countries have different time criteria for entering migrants into population registers (e.g. 3 months, 6 months, 12 months) or to be included in sample surveys (e.g. two months for the American Community Survey), which can complicate determination of change of usual residence. While duration of stay is often inferred from visa types or permit lengths, various work and residence permits have varying lengths of duration, depending on type and formal agreements between countries (e.g. many countries now have visa free regimes, which allow persons to move to countries for up to 3 months without visas or registration). Also, migrant self-declaration of length of stay upon entry will not necessarily correspond to their actual time spent in the country.

The UN recommends using actual duration of stay rather than intended duration of stay, since it provides a more accurate picture of long-term migration. Obviously, some migrants' intended duration of stay will not match reality (either determined at 12 months and leaving earlier, or determined at less than 12 months, and staying longer), thus it is recommended that migration figures be retroactively adjusted (using a lag of 1 ½ years to produce migration flow statistics), which is often difficult to compute methodologically, and especially difficult to explain from a policy perspective. These 'status changes' include short-term migrants who become long-term, foreigners originally admitted as non-migrants, irregular migrants who have become regularised as long-term migrants, as well as asylum seekers whose refugee status has been determined.

The difficulty of determining change of usual residence and duration of stay is even greater when measuring short-term migrant flows. Short-term migrants are presumed to be a rapidly growing and increasingly important group of migrants, particularly for labour migration, coinciding with increased globalization and frequent repeated moves back and forth across international borders (e.g. circular migration). Technically, short-term migrants do not normally change their country of usual residence (which remains their country of origin), but for the purposes of international migration statistics, the country of usual residence of short-term migrants is considered to be the country of destination during the period they spend it in. In addition, the 1998 UN recommendations make an effort to distinguish short-term migrants from tourists, which is often misinterpreted to mean that short-term migrants only include those who move for work or study-related reasons. In fact, asylum seekers or other humanitarian migrants, those moving for family reunification or formation, or even climate-related migrants, would be counted as short-term migrants if the duration of their moves were greater than 3 and less than 12 months. Also note these definitions exclude many temporary migrant workers (e.g. some seasonal migrants), who often move to a country for a period of less than 3 months.

Another related group of interest, but not migrants per definition, are cross-border (or frontier) workers. These are foreigners who have been granted permission to be employed on a continuous basis in a receiving country provided they depart at regular or short intervals (daily or weekly) from that country. This group could also include those without formal permission (informal) to work in another country, but none-the-less commute across borders to work on a regular basis. Information on both citizens and foreigners working under these arrangements are of interest to many countries. In addition to change of usual residence and duration of stay, the final dimension for measuring migrants is based on their reason for move.

PURPOSE OF STAY

While many would agree that people have mixed and multiple motives for migrating, including both economic and non-economic reasons, there is no simple answer to the question of

why people move. An individual's reason to leave a country of origin could differ from their reason to come to a country of destination. From a measurement perspective, it is important to determine the main reason or purpose of stay when developing migrant typologies. Some basic groups defined by purpose of stay are those moving for work-related, family-related, education-related, and for humanitarian reasons. As such, in addition to distinguishing between short- and long-term migration, migration flow statistics are also often further disaggregated by purpose of stay.

Employment-related migration is one of the most important categories for defining migrants and includes foreigners admitted or allowed to remain in the country for employment reasons. This group includes migrant workers, either seasonal, contract workers, project tied workers, or temporary, as well as those with the right to free establishment (e.g. citizens of the EU) or long-term settlement based on high-skilled qualifications. As noted before, people may move for temporary work for a period of less than 3 months, thus are not counted as migrants. Another category of migrants are those admitted for education or training, including students, trainees, and interns. A third major group of migrants are those who move for the purposes of family reunification or formation. This group includes foreigners admitted because they are immediate relatives or fiancé(e)s of citizens or other foreigners already residing in the receiving country, or because of other family ties. The fourth major group of migrants are those admitted for humanitarian reasons, which include refugees, asylum seekers, foreigners granted temporary protected status, and persons admitted for humanitarian reasons. Additional migrants may be granted legal permission to move to (or live in) a country on the basis of criteria like ancestral ties, retirement, entrepreneurship, or by having their irregular migration status regularised.

IRREGULAR MIGRATION

Regarding regularization of irregular migrants, irregular migrants remain the most difficult migrant group to measure. In theory, international migrants should be determined by change of country of usual residence, thus if the duration of stay criteria is met, irregular (or illegal) migrants should be counted. In practice, this is much more difficult, as irregular migrants, by the nature of their irregular status, are often missing from regular data sources used to measure migrants.

It is also important to distinguish between irregular entry and irregular stay. Many irregular migrants enter a country through legal means but overstay visas (or had refugee status rejected) and remain in a country without authorization (irregular stay). Others bypass formal methods altogether and enter a country via invalid travel documents or through non-controlled borders, which are examples of irregular entry. Because irregular migrants often use informal methods of entry, it is extremely difficult to measure this population, especially seasonal migrants and others who repeatedly move back and forth between two or more countries, leading to under measurement of this group when regular data sources are used. Given the inherent difficulties measuring this population, methods often rely on residual methodologies or border apprehension data (plus police records on returns/deportation/expulsions). However, border apprehension methods are particularly limited in their accuracy as only a fraction of illegal border crossings are documented with apprehension data, and is highly dependent on fluctuations in the intensity of border enforcement. Since many irregular migrants are undocumented, it is only after regularization of migrants that an accurate 'after the fact' measure of their size is obtained (based on the number of regularizations/amnesties granted). These same issues arise when looking at sub-groups of irregular migrants, such as trafficked or transit migrants.

It should also be noted that categories classifying migrants by purpose of stay are not mutually exclusive, which can create challenges when determining these groups. As people often move for many reasons, determining a single reason for move can be difficult. However, purpose of move can be gleamed from a number of different data sources, including both administrative and self-reported. One of the most common methods to determine a migrant's purpose of stay is to use visa or resident permit information which includes the legal reason for a migrant's stay in the country. Another method is to ask migrants themselves as to their reason for move, either through a household survey or population census. However, the results of these two different methods can vary greatly.

CONCLUSIONS

As can be seen, measurement of the size of the migrant population is dependent on a number of criteria, which are often difficult for countries to measure. However, adherence to internationally recognised definitions will

improve the comparability of international data which is critical for making evidence based policy decisions. Migrants can be defined as either foreigners or as foreign born, or a combination of the two, while the descendants of migrants are also important to identify for the purposes of monitoring long-term migrant integration. Change of usual residence and duration of stay are critical components for defining migrants, particularly for the measurement of migration flows, while purpose for stay is the final important piece for further categorising these groups.

A5 Reason for migration statistics and policy research

Madeleine Sumption[(*)]

Introduction

When governments make decisions on migration policy, they do so based on an understanding of how and why migration takes place, who migrants are, and what the socio-economic impacts of migration policies will be.

An essential part of this understanding comes from statistics. Alongside qualitative analysis that helps us to 'see inside' the process of migration and integration, quantitative data are crucial for assessing the scale and reach of a phenomenon. Nationally representative statistics enable us to understand, for example, whether generalisations about the characteristics or activities of particular migrant groups are valid or are simply stereotypes; whether perceived problems are large enough to warrant action; or how many people a policy change is likely to affect.

The quality of migration statistics has improved dramatically in high-income countries over the past twenty years. Migration variables are routinely included in Censuses and government surveys, and there is a growing corpus of administrative data, more and more of which is available for research. Given the importance of systematic quantitative analysis to policy decision-making, however, it is perhaps surprising that the statistics on which most quantitative academic migration research relies are still quite generic, providing few opportunities distinguish between different reasons for migration and legal channels through which people move.

This matters because, unlike much of the quantitative evidence, government decisions on whom to grant admission or settlement – the core of migration policy – cannot treat all migrants as interchangeable. Migration policies comprise differentiated rules covering people who face very different circumstances, from refugees and asylum seekers to people joining family members to international students, employees and entrepreneurs. Even policies that appear to treat migration as a monolithic category, such as the UK's target for reducing net migration to below 100,000 (which includes people of all citizenships and reasons for moving) must be implemented through a series of policy changes to individual migration channels. If these policies are to be informed by quantitative evidence, they require data that enables at least some consideration of the different routes through which people migrate.

GENERIC MIGRANTS

A large strand of the quantitative research on migration concerns economic impacts in countries of destination, particularly the effects in labour market and public finances. Almost all the literature in this field defines 'migrants' by country of birth or nationality, sometimes broken down into groups (for example, people born in EU vs. non-EU countries) and year of arrival.

These studies receive a lot of scrutiny in public and political debates, often to justify generic statements such as 'migrants boost public finances' or 'migration drives down wages'. But many of them are not particularly helpful as a guide to immigration policymaking. This is because they typically combine all migrants into an undifferentiated pool of people who in practice have very different characteristics and were admitted to the country for different reasons[(1)].

(*) The University of Oxford's Centre on Migration, Policy and Society (COMPAS)

(1) Of course, generic evidence can be more useful for policymaking that does not involve adjusting migration criteria themselves; for example, research on the impacts of migration on public services–even if it does not distinguish between people arriving for different reasons and with different legal statuses–should help policymakers consider how public services might respond to demographic changes.

But knowing the net contribution of the foreign born to public finances – for example – is of relatively little practical use for policy. If policymakers want to adjust migration policy based on evidence about its fiscal impacts, for example, it matters not what the average fiscal contribution of a foreign-born person is, but whether the specific groups of people they plan admit or restrict are net contributors and by how much. Understanding the potential impacts of policy changes thus requires us to consider specific legal migration channels, rather than 'migration' as a generic whole..

AVAILABLE DATA

A default set of variables on country of birth, nationality and year of arrival are now widely available in household survey data and summary administrative statistics (i.e. visa records) – at least in high-income countries, where technical capacity and financial resources for the complex business of data collection are greatest. But a still relatively small group of countries systematically collect good data that give insight into both the social and economic life of individuals and households and their reasons for migration or the type of residence permit on which they arrived – which are crucial for analysing the impacts of policy[(2)].

Key exceptions include Australia and New Zealand, which run dedicated longitudinal surveys of people receiving permanent residence through different legal routes; and the UK, which now collects regular data in household surveys on the self-reported reason for migration. Several countries have collected one-off or ad hoc data on reason for migrations, including EU countries as part of two Eurostat Labour Force Survey modules, or the United States' Princeton-based New Immigrant Survey. Other countries, such as Canada and Sweden, have exploited administrative data from tax and employment records to track migrants' outcomes over time including by initial residence permit type.

These more specific variables on different categories of migration open up possibilities for breaking down migration into different routes that approximate the policies under which people were admitted. Of course, such categorisations will remain somewhat crude, 'flattening' the complex motivations that actually shape migration decisions into a single 'main reason' or visa category. As with any statistical exercise base on inevitably simplifying data, this is an inevitable limitation that it is important to bear in mind when interpreting the results.

THE FUTURE OF MIGRATION STATISTICS

What kind of data does policy-relevant migration research need? First, there is real potential for administrative data to play a much greater role in informing policy. Administrative data have two major advantages. First, they often cover the entire population of people interacting with a particular government body or service, greatly reducing the problems of small sample sizes that can make it hard to analyse specific subgroups, as well as the problem of declining response rates that many high-income countries have seen in their household survey data[(3)]. Second, administrative data are often longitudinal – that is, they track the same individuals over time, making it easier to identify the reasons for changing trends. Administrative data also have the potential to be more cost effective than survey sources, especially compared to longitudinal surveys that require interviewers to contact and re-contact interviewees on an individual basis and can therefore be quite labour intensive.

Unlike survey data, that are explicitly collected with statistical goals in mind, administrative data are a by-product of government activities – for example, the collection of taxes or delivery of public services. This brings limitations, since the available variables are often restricted to the information that is needed for a particular government process. Comparing administrative sources across countries can also be a challenge, since differences in policies between countries will affect the populations of people covered and the definitions of the variables.

The limited variables in administrative data can in some cases be resolved by linking datasets together (using individual identifiers such as tax ID or passport numbers). Canada, for example, has linked its tax and visa records, allowing it to

(2) The impacts of policy changes can, of course, be analysed using various econometric techniques that trends appearing to result from a policy change that took place at a given point in time; however, since migration policies are only one of the factors affecting migration (others include economic growth, labour market institutions, geopolitical events, and policy changes in non-migration fields), it often difficult to isolate the impacts of a migration policy change.

(3) Roger Tourangeau and Thomas J. Plewes (eds), Panel on a Research Agenda for the Future of Social Science Data Collection, National Research Council, 2013.

track people who entered the country on specific visa types and analyse their employment and earnings several years later, providing a unique insight – for example – into whether specific economic migration channels were successful in admitting people with good integration prospects in Canada. This opens up enormous numbers of analytical possibilities that traditional survey-based approaches struggle to offer.

Despite these potential benefits, administrative data are often not developed into a format that can be easily analysed, and are typically difficult for academic researchers (and in many cases even government analysts) to access for research purposes. Fully developing the possibilities of administrative data and of linking different administrative and survey data will require an initial investment but could have significant statistical benefits. Since administrative data have the potential to become more significant sources of information in the years to come, it would also be worth carefully assessing the problems of international comparability that these datasets raise, and how they might be addressed.

Second, governments could identify secure ways to make the complex set of migration data sources more widely available for analysis outside of government. Government statistics and analysis departments are constrained by limited staffing, while non-government researchers also have more freedom to explore broader trends that are not tied to the most immediate policy agenda. Of course, governments must be careful about how potentially sensitive data are released into public use. However, access can be improved in various ways such as accredited or 'trusted' researcher programmes, secure data labs, and portals that allow users to query the data without accessing individual records. Making a larger volume of survey and administrative migration data systematically available in this way would require resources but could have an important payoff for our knowledge about migration.

Third, migration statistics will never be perfect and there will always be unexplained discrepancies between sources and data collection methods. This is particularly the case if we become more demanding of the data, analysing specific subgroups by reason for migration. An ongoing programme of inquiry into the limitations of key statistical sources – including linking different datasets and piloting different methods of data collection to understand the role of definitional and data collection discrepancies should, over the long term, greatly improve the accuracy of the statistics and their policy relevance.

CONCLUSIONS

Migration statistics have greatly improved in many countries, but so have the demands on the data as both migrant populations and public scrutiny of migration have grown. As governments continue to develop statistical systems to understand the phenomenon, our ability to move away from binary categories of 'migrants' and 'non-migrants' and examine different migration routes and motivations will be crucial to developing research and policy that reflects the complexity of migration itself.

A6 Statistics on the duration of migration: Evaluations of data availability and quality

Filip Tanay[(*)], Madeleine Sumption[(**)] and Laurent Aujean[(***)]

Introduction

The duration of migration in the sense of how long a migrant stays in the host country is a common topic in migration studies and public policy alike, but one that has a scarcity of data available to support it. It is nevertheless an important variable as it largely influences the overall impact of migration for host and origin countries. There is wide evidence that integration including of migrants (in particular through language skills, links with host-country communities, labour market inclusion) progresses over time spent in the host country.

The topic is examined when looking to the past and the future, examining how long on average migrants tended to stay in a given host country and/or how long recently arrived migrants are likely to stay. The backward looking perspective is can be used when analysing return migration i.e. how long did those that returned to their country of origin stay in their previous host country (e.g. interviews with returnees reported in Eurofound, 2012). The future perspective is also used in modelling exercises where research examines preferences of migrants (Dustmann and Kirchkamp, 2002; Van Dalen and Henkens, 2004; Fouarge and Ester, 2008) including how initial intentions regarding the duration of stay prior to migrating or upon arrival correspond to the intended duration of stay after a given time in the host country (Mara and Landesmann, 2013a and 2013b). Measuring duration is also likely to be made more difficult by the changing temporality of flows where migration in the EU is becoming more and more circular and temporary in nature (European Commission, 2016).

EXISTING WAYS OF MEASURING THE DURATION OF MIGRATION

In order to obtain EU-wide data on the duration of migration in the host country, the most representative data can be obtained from the EU Labour Force Survey (LFS) using the Years of residence in this Member State (YEARESID) variable. The Years of residence variable in the LFS has also been used in the past to proxy flows or estimate retention rates (OECD and European Commission, 2014).

Figure 1 shows the average distribution of EU mobile persons and third-country nationals residing in the EU for the period 2005-15. However, this method is likely to be biased by changes over time in the size of migration cohorts, difficulties in capturing recent arrivals and differing response rates among migrants between countries depending on the available languages of conducting the survey[(1)].

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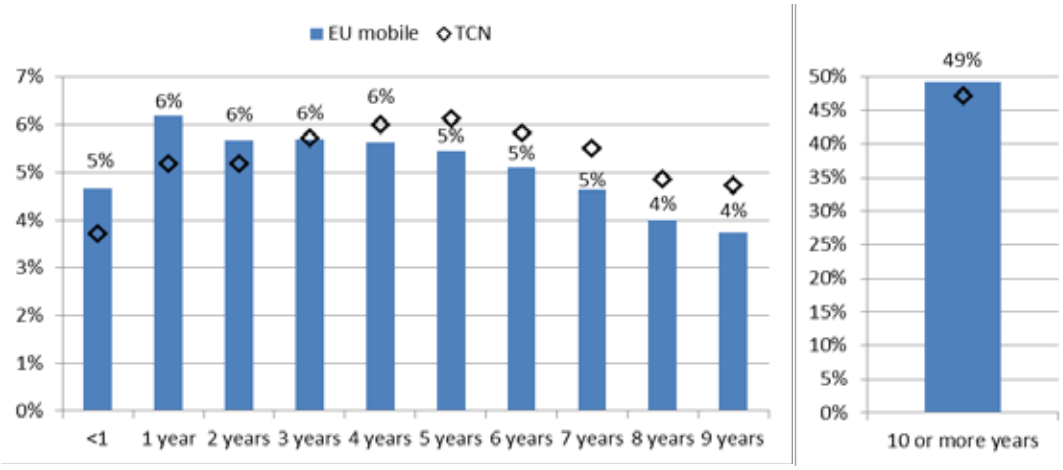
(***) Directorate-General for Migration and Home Affairs (European Commission)
(1) Indeed, if all migration cohorts would be of the same size and if recent arrivals would be equally caught in the survey sample as others, chart 1 would look like a decreasing trend with the largest bar being <1 as some migrants gradually leave the host country and new ones arrive.

Figure 1: Distribution of EU mobile persons and third-country nationals (aged 15-74) living in the EU, 2005-15



Source: Eurostat (EU-LFS).

Table 1: Summary of possible traditional methods to measure the duration of migration and their advantages and disadvantages

Method	Advantages & disadvantages
Population/labour force survey data Tracking how stocks of migrants by year of arrival change over time, to see what share of all migrants/specific subgroups remain in the country after a given number of years.	Data are widely available and comparable across countries. Sample size limits analysis of subgroups unless pooling years of arrival (the latter limiting ability to track changes in stay rates over time). Hard to capture those who are in the country for less than one year, who are often also undercounted (or not sampled) in the first few months after arrival. Usual problems with under-counting and non-response among migrants.
Visa transitions and expiration/settlement data Tracking the journey of residence permit-recipients through the system, including identifying what share of people receiving different residence permit types no longer hold a permit vs. have received permanent settlement vs. are within x years (example: UK 'migrant journey' dataset).	Possible to identify differences by legal route of entry (not just self-reported reason for migration), nationality, and/or whichever other variables are contained in administrative data. Potential for some degree of comparability across countries – even if limited as related to a given country specific scheme so difficult to make comparable across countries due to differences in systems . Does not capture EU citizens and doesn't capture people who overstay (assumption is that expired residence permits = person has left).
Tax records and other longitudinal administrative databases Measures interactions of individuals with the government, e.g. through tax payments, benefits receipt, etc. and how long these interactions last – for example, does someone show up in the database just for a few months or for several years. Example is recent UK ONS publication using tax data as well as reports by Statistics Sweden on migrant integration.	Provides large-scale, longitudinal data that can – with necessary variables or linking – be divided into subgroups. Scope of data collection defined by policy: some people will not be required to interact (e.g. because they do not have a tax obligation); some people will stop interacting with the data system but may not have left. Difficult to make comparable across countries due to differences in tax collection systems.
Self-reported intentions Survey data asking movers about expected duration of stay when arriving and self-reported actual duration of stay/year of arrival, when leaving (e.g. UK International Passenger Survey)	Depending on which other variables the data contain, can be broken down to identify trends by country of origin, gender, etc. Intentions are unreliable: plans can change. Does not work as easily for Schengen countries unless it forms part of the residence permit procedure.
Entry and exit checks Passport swipe data or API collected by airlines, matching exit and entry records for the same individuals (e.g. using passport ID, DOB), potentially linked to information on visa type. Example: new UK exit checking system; Australian entry-exit system. European Commission proposed to establish an Entry-Exit System in April 2016[(2)].	Enables measurement of duration of stay including for overstayers, for different types of permit holders (see above on visa expiration data). Error associated with non-matched records and incomplete entry/exit records. Requires coverage of most ports of entry and exit (may be difficult e.g. in Schengen, especially if design is to link to residence permit information).

(2) For more info see http://europa.eu/rapid/press-release_IP-16-1247_en.htm

POTENTIAL ALTERNATIVE DATA SOURCES

The issue with almost all of the traditional data sources is that they are either able to capture one point in time (e.g. surveys) or they are unable to follow the migration trajectory of a migrant once they cross the border (e.g. survey panel data or tax records and other longitudinal administrative databases)[3]. Big data coming from email or social media usage have the potential to overcome these limitations. While they are unlikely to provide much in terms of reliable demographic and labour market data, the fact that a user is likely to log into the same account regardless of where he is located means that it should be easy to know with relative certainty the migration pathway of the user.

There are indeed indications that this may be possible as studies exist where estimates of migration flows were done utilising Twitter data (Zagheni et al. 2014), IP addresses (State et al. 2013), cellphone data (Bayir et al. 2009, Blumenstock 2012, Candia et al. 2008), Foursquare (Noulas et al. 2011) or even Google latitude data (Ferrari and Mamei, 2011)[4]. Nevertheless, it is important to note that while it seems it was possible to do so, no study to date has used big data to estimate length of time a person spends in a host country.

A further drawback of big data, especially of those coming from social media, are:

- potentially low/differing coverage (e.g. LinkedIn might be used more in some countries and less in others);
- sample bias and representativeness (e.g. not everyone has an equal likelihood of being a Facebook, LinkedIn or Gmail user so calibration with traditional data sources is needed);
- access to data (most data are owned by private companies);
- sustainability of measurement (users might change social media or email providers); and
- legal limitations/privacy concerns in using the data outside of the services as part of which it was collected.

CONCLUSIONS

Further efforts are needed to try and obtain a reliable and sustainable source of data and method of measuring the duration of migration. For comparable EU-level results the EU LFS is likely to remain the easiest and most complete (albeit far from perfect) way to estimate the average duration of migration – even if some changes in sampling/surveying methods could even improve its usefulness. For individual Member States, administrative longitudinal records, if available, are likely to be both the most cost efficient and precise methods for measuring the duration of stay of migrants and mobile workers in the country in question. Nevertheless, big data holds great promise as it has the potential to provide reliable and comparable longitudinal data across multiple countries and hence this avenue should be investigated further.

(2) For more info see http://europa.eu/rapid/press-release_IP-16-1247_en.htm
(3) Surveys such as the EU Labour Force Survey also have a longitudinal component enabling to also track changes over time but these are commonly very limited for the migrant subgroup due to issues mentioned in **Table 1**).
(4) For a more complete list, please see table in Annex

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B Delivering sustainable evidence for sustainable development

B1 Sustainable indicators for a resource conscious Europe

Arno Behrens(*)

Introduction

All economic activity depends on the consumption of energy and natural resources. This relationship between the economy and the natural environment (or ecosystem) is at the root of all global environmental problems, including climate change, biodiversity loss, marine pollution and more broadly ecosystem degradation.

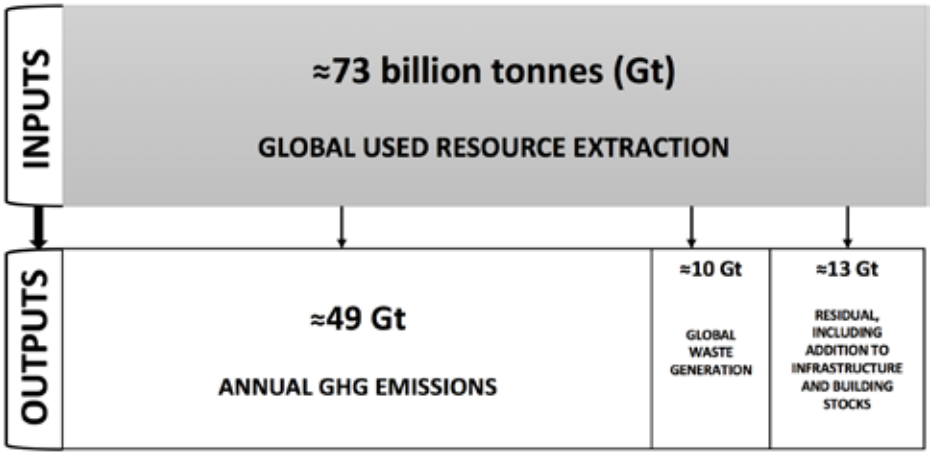
QUANTITY OF MATERIAL INPUTS DETERMINES AMOUNT OF WASTE AND EMISSIONS

The link between the consumption of natural resources and environmental impacts becomes evident when considering the economy as a subsystem of a much larger, finite and non-growing ecosystem. Similar to living beings, this subsystem requires a constant throughput of materials and energy to function. The relationship between these two systems is mandated by the laws of thermodynamics: Total material inputs to the economy must eventually equal its total outputs back into the ecosystem. Given that the outputs occur in the form of emissions and waste, it follows that an overall reduction of material consumption in the European Union and globally will be key to combatting climate change and ecosystem degradation.

DIRECT LINK BETWEEN RESOURCE USE AND CLIMATE CHANGE

There is a direct link between the use of natural resources and greenhouse gas (GHG) emissions. **Figure 1** illustrates this link.

Figure 1: Estimates of material inputs and outputs of the global economy, 2010



Source: Author's own calculations based on data from WU Vienna (2016), IPCC (2014), World Bank (2012) and Frost & Sullivan (2012).

Regarding the material inputs to the global economy, an estimated 73 billion tonnes of resources were extracted and used in economic activities worldwide in 2010. By definition, global inputs must equal global outputs. Regarding the latter, global GHG emissions stood at about 49 billion tonnes[1] while global (industrial and municipal) waste amounted to roughly 10 billion tonnes. An additional 13 billion tonnes are attributed to a residual mainly consisting of 'additions to the stock' of the global economy in the form of buildings, infrastructure and others. These figures underline the importance of emissions in the physical output of the global economy: GHG emissions accounted for almost 70% by weight of material outputs in 2010, thereby making the atmosphere by far the largest disposal site for global waste.

ALL MATERIAL CATEGORIES CONTRIBUTE TO CLIMATE CHANGE

Addressing the climate change impacts of material use requires an assessment based on different material categories. Behrens et al. (2007) established four aggregated material categories, including fossil fuels, biomass, industrial and construction minerals, and metal ores. Each of these categories contributes directly and/or indirectly to energy use and global GHG emissions (see also Behrens, 2016).

Fossil fuels alone contributed to some 65% of global GHG emissions in 2010. The link with climate change is thus evident. Biomass, on the other hand, is often considered carbon-neutral, based on the assumption that its use releases more or less the same amount of CO_2 as was absorbed during the growth phase. However, agricultural activities contribute to GHG emissions mainly through land-use changes and through the use of fossil fuels in production, processing and transport. For example, the Global Forest Resources Assessment 2015 (FAO, 2015) reports that carbon stocks held in forests decreased by over 11 Gt since 1990, mainly due to the conversion of forests to agricultural and residential land, as well as due to the degradation of forest land.

Construction minerals can be indirectly linked to GHG emissions mainly through housing, energy and transport infrastructure. The cement sector alone was responsible for about three percent of total EU GHG emissions in 2016 (EUTL, 2017). The building sector is the largest energy end-use sector in the EU, responsible for almost 41% of final energy consumption in 2013 and with similar contributions to CO_2 emissions (European Commission, 2015).

Finally, metals have the highest supply chain carbon intensity of all the commodities used in an economy (Aldersgate Group, 2010). Mining, processing, extracting and refining are estimated to account for seven to eight percent of the world's total energy consumption (UNEP, 2013). Iron and steel production alone accounted for some four percent of EU GHG emissions in 2016 (EUTL, 2017). With the increasing need to access less productive sites with lower-grade ores (e.g. for gold, copper and nickel), future energy requirements and related GHG emissions from the production of primary metals is likely to increase.

A SHIFT OF THE POLICY FOCUS IS NEEDED

Reducing global GHG emissions by at least 60% by 2050 compared to 2010 to limit global warming to 'well below 2°C above pre-industrial levels' (as stipulated in Art. 2 of the Paris Agreement) will thus require more than a shift to low-carbon and renewable energy sources. Improved resource efficiency, greater recycling and re-use, as well as an absolute reduction of raw material use must become key elements of environmental and climate policies in the context of a resource efficient and circular economy.

The advantages of focussing on restricting input into the economy in the long run over limiting output for reducing generic pressure on the environment are manifold. Most importantly, input oriented environmental policies act on the cause of ecological problems rather than on the symptoms. The reduction of inputs reduces potential consequences of economic activity on the environment and thus potential external effects. Similarly, there are (potential) economic incentives for adopting more resource efficient technologies and practices, which could ease the introduction of input related policies. In addition, input orientation is generally better suited for dealing with the complex links between population, poverty, growth, resources and the environment.

(1) It should be noted that GHG emissions data is presented in CO2-equivalents. This means that the physical mass of total global GHG emissions as presented in Figure 1 changes when aggregating the actual mass of all non-CO2 greenhouse gases (incl. CH4, N2O and F-gases). However, given that CO2 alone accounted for 76% of total anthropogenic GHG emissions in 2010 (IPCC, 2014), this change in the physical mass of GHG emissions would not impact the overall message of Figure 1, i.e. that GHG emissions are the major part of the global economy's physical outputs.

MULTIPLE BENEFITS FROM REDUCED NATURAL RESOURCE USE

The benefits of reducing resource use obviously go far beyond combatting global warming. Other environmental benefits include biodiversity protection through reduced pressures on habitats, both due to less extractive activities and less pollution, emissions and waste. Similarly, the pollution of the world's oceans can be significantly reduced. According to the World Economic Forum et al. (2016), a third of all plastics packaging escapes collection systems into the environment, with 8 million tonnes of plastics leaking into oceans each year. The prevention of plastics waste and more circular business models in the plastics industry can thus help reduce significant environmental externalities.

Apart from environmental benefits, there are also economic benefits of reduced resource use. While the overall effects on growth and employment are still subject to debate, there are clear benefits for the EU and its industries to become less dependent on imports of natural resources. In fact, many natural resources required to maintain and expand economic activities are subject to increasing geological scarcity (e.g. antimony and gold, see Henckens et al., 2016) or economic scarcity (e.g. due to geographical concentration). These resources may be subject to increasing price fluctuations thus jeopardising future economic development if no substitutes can be found.

In addition, there is also a social dimension. On the one hand, the global poor are over-proportionately affected by the consequences of global resource use as their incomes and livelihoods largely depend on natural resources and services such as land, water and forests (see, e.g., Young/Goldman, 2015). On the other hand, the extraction of natural resources can have negative impacts on local populations, often associated with social unrest and conflict in some developing countries.

DELIVERING ON THE SUSTAINABLE DEVELOPMENT GOALS (SDGS)

It is therefore not surprising that resource efficiency is considered as a main enabler for the achievement of the Sustainable Development Goals (SDGs) in the context of the United Nation's 2030 Agenda for Sustainable Development. In fact, one of the 17 SDGs aims to 'ensure sustainable consumption and production patterns' (Goal 12). However, the importance of resource efficiency for the SDGs goes beyond SDG 12. The International Resource Panel (IRP, 2015) found that 12 out of the 17 SDGs promote human well-being through the sustainable use of natural resources. In addition, 10 SDGs are only achievable with higher levels of efficiencies in the use of land, water, energy, materials and other finite resources.

With ongoing global population growth and the justified aspirations of developing countries to reach standards of living comparable to high-income countries, global resource use could increase by over 50% until 2050 (compared with 2013 levels)[(2)]. Breaking the link between economic growth and resource use will thus be essential to avoid irreversible environmental damage and thus to stay within the 'planetary boundaries' (see Steffen et al., 2015).

WHAT DOES THIS ALL MEAN FOR INDICATORS?

Indicators play a crucial role in improving resource consciousness among policy makers and citizens. They are required for the identification of potentially worrying trends and priority issues for policy, but they are also indispensable for the formulation, assessment, monitoring and evaluation of resource efficiency and circular economy policies in Europe and elsewhere. However, the question remains: Which (set of) indicators are the most useful to measure progress towards a green and more resource efficient economy?

POLICIES REQUIRE A VISION, INDICATORS CAN PROVIDE SCIENTIFIC EVIDENCE

A lack of data and indicators is often used as a pretext for no action or delayed action on the policy level. A multitude of indicators exist, but resource efficiency policies will only be successful if they are linked to attractive visions for change, e.g. in the context of the SDGs. Indicators can be used to underpin this vision, providing scientific evidence for the benefits (and costs) that

(2) Own calculations based on WU Wien et al. (2017), Eurostat (2017a) and UN DESA (2015). This number is for illustration purposes only. It assumes that all projected 9.7 billion human beings living on this planet in 2050 will have the same per capita resource consumption (measured in Domestic Material Consumption – DMC) as EU citizens did in 2015.

resource efficiency can bring. Eventually, and as indicators mature, they can also be used to set voluntary and/or binding resource use reduction targets.

THE IMPORTANCE OF CHOOSING THE RIGHT HEADLINE INDICATOR

Of particular importance for political accountability and communication is the choice of headline indicator. The current Resource Efficiency Scoreboard uses a single such headline indicator called 'resource productivity', which is expressed as the ratio between GDP and Domestic Material Consumption (DMC)[3]. It thus measures how efficient an economy uses material resources to produce wealth.

This indicator has three shortcomings. First, the DMC indicator does not take into account indirect materials of imported and exported products. DMC is thus not robust against outsourcing material intensive industries or processes to third countries and substituting domestic extraction by imports. Second, GDP-linked indicators mask the substantial structural differences between EU economies. Countries with larger shares of the service sector will naturally perform better in terms of resource efficiency. Third, improved resource productivity can derive from an increase in GDP, a decrease in DMC, or both. However, the GDP/DMC indicator does not show whether resource use has actually decreased or even increased.

To overcome some of these issues, the use of Raw Material Consumption (RMC)[4] as the headline indicator should be considered. This would solve the issue of outsourcing production abroad and of varying economic structures across EU member states. Instead of measuring progress against GDP, the use of RMC would allow for identifying trends, thus giving a clear indication of where a society is headed in terms of resource use. Once fully mature, the RMC indicator would allow focus on environmental policy and targets solely on reducing material consumption as a proxy for environmental impact, costs and security (similar to CO2 emissions as a proxy for climate change in energy policy). This indicator would also need to be included in the EU SDG indicator set under Goal 12[5].

TIMELY PUBLICATION OF INDICATORS[6]

While data for GDP and its components are published by Eurostat on a quarterly basis and with a delay of only a few weeks, resource use related data is published much less frequently and with a delay of several years. For example, the most recent data available in mid-June 2017 for GDP was 2017Q1, while for DMC it was 2015. This also means that the Resource Efficiency Scoreboard's headline indicator (GDP/DMC) is only published with a delay of about two years. In order to be useful for policy-making, sustainability related indicators need to be readily available on a more frequent and timely basis. This will require more political will and emphasis on timely indicator development.

INCLUSION IN THE EUROPEAN SEMESTER

The European Semester is the EU's annual cycle of economic policy guidance and surveillance. Its main focus is on economic policies for growth, jobs and investment. All these three areas are closely related to the transition towards a low carbon, resource efficient and more circular economy. It is thus evident that the European Semester's evidence base will need to be expanded to areas of raw material use and resource efficiency, once timely and robust indicators are available[7] Eventually, the European Semester could be expanded to report on national strategies implementing the 2030 Agenda for Sustainable Development and progress towards the SDGs.

MORE HARMONISATION OF INDICATORS NEEDED ON ALL LEVELS…

The development of methodologically sound indicators based on complete and robust data is a prerequisite for EU action on resource efficiency. However, corresponding data will also be required on the member state, regional and local levels. To ensure transparency and

([3]) DMC measures the total amount of materials (in tonnes) used by an economy. It is defined as the annual quantity of raw materials extracted from the domestic territory, plus all physical imports minus all physical exports (Eurostat, 2017b).
([4]) According to Eurostat (2017b), RMC "measures the total amount of raw materials required to produce the goods used by the economy (also called 'material footprint')." Contrary to DMC, RMC therefore also includes all raw material required to produce the goods imported into the economy.
([5]) In its current form, the EU SDG indicator set includes the following indicators under Goal 12: waste generation, recycling and landfill rate, consumption of toxic materials, resource productivity, CO2 emissions from passenger cars, and volume of freight transport relative to GDP. See http://ec.europa.eu/eurostat/documents/276524/7736915/EU-SDG-indicator-set-with-cover-note-170531.pdf
([6]) The author is thankful to Mr Enrico Giovannini for his inspirations to this recommendation.
([7]) The EU-funded H2020 project „CIRCULAR IMPACTS" looks at possibilities for better integrating the circular economy in the European Semester. See www.circular-impacts.eu for more information.

comparability, there is a need for harmonised methodologies and data requirements across different levels.

On the regional level, Flanders, Belgium, is a good example of the development of regional indicators, based on specific local needs. While the development of such indicators should be supported, there is also a need for more harmonisation – also to avoid duplication of efforts.

…ALSO ON THE COMPANY LEVEL

Improving resource efficiency in the EU will require a strong engagement of the private sector. Policy-makers and business leaders will need to marry political commitments with business opportunities. However, there is currently no common framework or methodology to measure resource efficiency and circular economy activities in companies. There is therefore a need to identify operational 'key performance indicators' (KPIs) based on the inventory of available circular economy indicators and on an assessment of indicators already in use in companies in other areas (e.g. greenhouse gas emissions reporting etc.). The non-binding guidelines on the methodology for reporting non-financial information (NFI) published by the European Commission in June 2017[8] contain examples of environmental KPIs for companies. This is a step in the right direction, however, in order to ensure comparability of indicators and methodologies across companies from different member states, a more detailed and technical approach will be required.

Existing economy-wide circular economy measuring frameworks may serve as an inspiration for circular economy indicators for companies. For example, a KPI similar to the Resource Efficiency Scoreboard's 'resource efficiency' headline indicator could be constructed for companies, by putting the turnover (or a similar economic indicator) in relation to the company's raw material consumption.

Eventually, harmonised resource use/efficiency indicators – as part of the KPIs – need to become part of standard accounting practices and (compulsory) reporting requirements of companies. These harmonised indicators could then also play a role in the assessment of the creditworthiness of companies, improving transparency about exposure to carbon and other environmental risks. As always, the specific requirements and limitations of SMEs need to be taken into account.

TAKING THE ENTIRE SUPPLY CHAIN INTO ACCOUNT

In order to understand the full environmental impact of consumption, indicators should not only take into account the direct resource inputs but also the indirect material flows along the (global) supply chain of goods and services consumed in a country. This includes the indirect flows associated with processing products and with trade flows.

(8) http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52017XC0705(01)&from=EN

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B2 Measuring resilience in the context of sustainable development

Franco Conzato[*]

Introduction

There has been increasing prominence of resilience within the development agenda. Using resilience as a common, shared approach can facilitate closer collaborations between actors from different disciplines and communities increasing effectiveness and efficiency of EU interventions in the field of both development and humanitarian assistance. For example, all of the recent post 2015 inter-governmental frameworks and agreements – the 2030 United Nations Sustainable Development Agenda, the Sendai Framework for Disaster Risk Reduction, the Paris Agreement on Climate Change and the World Humanitarian Summit framework – give high prominence to resilience.

The EU has adopted in May 2017 a new European Consensus on Development that engages Parliament, Members States and the Commission to achieve the Sustainable Development Agenda 2030 and pursue actively resilience. In June 2017, the European Commission together with the European External Action Service adopted jointly a Communication on 'A Strategic Approach to Resilience in the EU's External Action' in which emphasis is extended from agricultural and environmental to state and societal resilience.

With increasing donor interest in resilience sector, 'it is critical that the development community have the necessary capacity and tools in place to monitor and evaluate its effort for transparency, accountability, learning, and impact[1].

UNDERSTANDING RESILIENCE

Resilience is a concept increasingly adopted within sectors beyond climate change and disaster, into sectors such as social inclusion, economics or even cyber security. As with sustainable development, resilience has been used an overarching concept that can help mobilise action across different sectors and systems around the globe. However, its ability to bring together different disciplines has also highlighted a key weakness – a lack of consistent definition or agreed principles. Different entry points and worldviews across disciplines have meant multiple interpretations and definitions of resilience. This in turn can make it difficult to deliver joint up actions working holistically across sectors and organisations, including on issues such as measurement and data collection.

The dynamic dimension of resilience seeks to capture factors in the system (country or sector) that better anticipates and adapts to future changes is a better fit in the context of sustainability development. We know a static system with business as usual practices are often not sustainable, e.g. in the climate sector; and/or not well aligned with development objectives, e.g. where the business as usual conditions led to the disaster, maintained corrupt institutional structures or locked people in poverty.

The European Commission define resilience as 'the ability of an individual, a household, a community, a country or a region to withstand, cope, adapt, and quickly recover from stresses

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I am grateful to Wei HUANG, DFID Official seconded to the European Commission, for comments and valuable discussion. I am also grateful to Manuela Maria Cabral and Patrick Rabe, European Commission, Directorate General for International Development, for comments to the latest version of the paper.
(1) "Options for Results Monitoring and Evaluation for Resilience-building Operations", Anna Williams, April 2016

and shocks[2]. Whilst not a universal definition, this definition highlights different relevant groups that are obviously interconnected and dependent. In this way, resilience should be considered as part of complex interacting system contributing to the achievement of sustainable development. For example, the close social networks that generally build individual/household resilience are the same factors that help to rapidly spread infectious diseases such as Ebola. This means that proposed changes to build resilience will likely have trade-offs in different part of the system, potentially creating winners and losers. In addition, any transformations may challenge current power and/or cultural dynamics, and so understanding the local political economy will be critical.

There are many other conceptual differences when considering resilience, which this note does not go into. However, there are a number of reviews on this subject, for example, see Schipper 2015[3].

MEASURING RESILIENCE

The measurement of resilience is a rapidly developing area, and a growing number of organisations are developing measures to assess progress towards resilience. However, the issue of measurement is caught up in the challenge of having multiple interpretations of resilience that often lack clarity. Current measurements are shaped by different theories of change that have different uses and assess resilience for different target groups, levels or areas of the system at varying scales. There is no clear consensus on exactly what to measure for which aspects of resilience, over which period for whom in which context.

There is some evidence that resilience measurement is moving towards a capacity-based approach (away from characteristics based approaches)[4]. Similar to impacts of overall international cooperation efforts in other areas, working with partner countries and monitoring country progress on resilience (whatever the definition, agreed measurement approach) will likely increase mutual accountability. It would also seem logical that work on resilience measurement be done bearing in mind the measurement of progress towards the SDGs/Agenda 2030.

Certain sectors such as food security and climate change adaption have more experience with resilience measurements than others. However, this is still a nascent area. Currently, the most common method to measure resilience is based on frameworks that outline different dimensions of resilience and associated indicators that are consider important to the authors. See table 1 for some examples of what is currently used.

WHAT HAVE WE LEARNT AND WHAT CAN WE DO NEXT?

Consistent definition - a clearer definition (or definitions) or agreed principles on resilience would certainly help with having a clearer idea of the data and measurement needs. While the debate continues, agencies (e.g. as part of the post 2015 frameworks) should coordinate monitoring efforts and develop data sharing platforms as much as possible to capture potentially different aspects of resilience across the system.

Producers of resilience data and indicators should be transparent about why and how the data was collected, the indicator methodologies and what they propose to measure for which part of the system and for whom (if relevant). This will help to build up a global knowledge base and encourage further discussions between different actors to hopefully reach a convergence on resilience principles.

Frequent, high quality data including from non-traditional sources – frequent, high quality data is needed to assess and understand the impact of shocks and the effectiveness of any recovery efforts. It's difficult to capture dynamic interactions that have non- linear changes with snapshot data. Having information for baseline pre-shock, shock and post-shock periods is vital to better understand the interactions between different parts of the system at different times.

(2) EU Factsheet – Resilience – 2016. Similarly, resilience is "the capacity of individuals, communities and systems to survive, adapt, and grow in the face of stress and shocks, and even transform when conditions require it. Building resilience is about making people, communities and systems better prepared to withstand catastrophic events – both natural and manmade – and able to bounce back more quickly and emerge stronger from these shocks and stresses" (Rockefeller Foundation 2015).

(3) Schipper, E.L.F. and Langston, L. 2015. A comparative overview of resilience measurement frameworks: analysing indicators and approaches, Working Paper 422, London: ODI

(4) Constas M., Frankenberger T.R., Hoddinott J., Mock N., Romano D., Béné C. and Maxwell D. 2014 A common analytical model for resilience measurement - causal framework and methodological options. Resilience Measurement Technical Working Group, FSiN Technical Series Paper No. 2, World Food Program and Food and Agriculture Organization

Most traditional data sources such as surveys are typically collected several years apart, with high costs and weak domestic capacity seen as barriers for more frequent collection. While we need to prioritise traditional methods, we should also heed the UN's call on a data revolution for sustainable development to complement these sources. We need to expand private-public partnerships to gather resilience related information and exploit big data for our needs. For example, UN Global Pulse[5] in partnership with BBVA (large multinational bank) used real time financial transactions data following a major hurricane in Mexico to measure economic resilience.

Data disaggregation – Given the complexity, inter-dependencies and uncertainties mentioned above, it is particular relevant to track and understand the potential trade-offs for the different parts of the system. For example, changes can help people build more resilience to droughts, but potentially at the detriment to resilience to flooding. In this case, having data on all natural hazards collectively is unhelpful, and data disaggregation is needed.

Capturing qualitative information – similar to measuring other complex concepts there has been difficulties in effectively capturing important qualitative and process orientated information using indicators (e.g. social capital, power dynamics, and other contextual information). As advocates for evidence based policy making, we should encourage the use mixed methods as part of robust monitoring and evaluation systems.

Subjective resilience – different capacities and world views of individuals impact on how they perceive risk and respond to shock, and so subjective resilience measures are increasingly recognised as an important complement to traditional measurements. With potentially less complex questions, the data collection might be cheaper and easier especially with the help of technological advances. For example, wide spread mobile phone use has made it possible to reach the most difficult regions on a large scale, in a near real time manner.

One indicator versus number of indicators – it is unlikely that resilience will be captured by one indicator. Table 1 give a range of indicators, covering different dimensions; financial resilience, food security, resilience to climate change. Which indicators are more important than others will depend on the context of the country/region in which resilience is being measured taking into account the identified fragilities or risks.

Cross-sectional versus longitudinal information – to measure the resilience as defined by the EU 'the ability of an individual, a household, a community, a country or a region to withstand, cope, adapt, and quickly recover from stresses and shocks' – it might be preferable to track the same people/households over time, and see what happens to them pre and post shock (financial shock/drought/flood etc). That could give a richer set of information than conducting cross-sectional surveys, where you will have different samples, who may not all have faced the shock.

Looking at resilience over long periods of time – it is well established that to look at economic resilience in developed countries, analysis is typically carried out to look at the rate of unemployment pre and post financial shock. In this example, looking at 2008/9 recession versus early 1990s recession, western countries have taken longer and longer for unemployment to fall to pre-shock levels.

(5) http://unglobalpulse.org/sites/default/files/2016%20BBVA%20Project%20Brief.pdf

Table 1: Approximate proficiency level of computer capabilities on PIAAC

FRAMEWORK/TOOL	DIMENSIONS/CHARACTERISTICS OF RESILIENCE	EXAMPLES OF INDICATORS
ARUP/Rockefeller Foundation City Resilience Framework	» Health and wellbeing of individuals » Infrastructure and environment » Economy and society » Leadership and strategy (knowledge)	» Diverse livelihoods and employment » Reliable communication and mobility » Availability of financial resources » Integrated development planning
DFID Building Resilience and Adaptation to Climate Extremes and Disasters (BRACED) projects	3A's – anticipatory capacity, adaptive capacity, absorptive capacity and transformation	For each project there will be specific outcome indicators relating to individuals (# of people with enhanced resilience). DFID's guide to developing indicators suggests considering dimensions common to other frameworks (i.e. assets, access to services, adaptive capacity, income and food access, safety nets)
FAO Resilie nce Index Measurement and Analysis Model (RIMA)	Physical dimensions » Income and Food Access » Access to Basic Services » Assets » Social Safety Nets Updated to include: » Enabling institutional environment » Natural environment » Agricultural practice/technology Capacity dimensions » Adaptive capacity » Sensitivity	» Average per person daily income » Access to school, markets, health facilities » Amount of cash and in-kind assistance » Housing (nr of rooms owned) » Diversity of income sources » Expenditure change
Feinstein International Center, Tufts Uni./World Vision	Aims to look at resilience in terms of changes in livelihood strategies, household asset portfolios,	» Household food insecurity and access scale » Coping strategies index » Food consumption score
Liveli hoods Change Over Time Model	policies and institutions, extending to measuring change in event of shocks/acute crises	» Illness score » Value of productive assets: land, livestock and tools » Net debt » Income (per capita daily expenditure as proxy)
Oxfam GB Multi-Dimensional Approach to Measuring Resilience	» Livelihood viability » Innovation potential » Contingency resources & support access » Integrity of natural & built environment » Social and institutional capability	Specific indicators/characteristics ar e developed for each context using bottom -up approach. Examples of social capability indicators: » Participation in drought preparedness meetings » Awareness of local action on adaptation
Tracking Adaptation and Measuring Development (TAMD)	Not a resilience measurement framework per se, but tracks adaptation success: Track 1 – climate risk management Track 2 – development performance	»Awareness of climate risks, trends, prospects, response options »Numbers of people becoming more or less vulnerable, measured by context-specific indicators
USAID Measurement Framework for Community Resilience	» Income and food access » Assets » Adaptive capacity » Social capital and safety nets » Governance » Nutrition and health	» Per capita expenditure (income proxy) » Change in household asset ownership » Access to credit » % of households with access to positive coping strategies » # of effective laws on natural resources » Prevalence of stunted children under 5

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B3 Data and sustainable finance: how data disclosure could redirect investment towards the economy of tomorrow[(1)]

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Introduction

In the aftermath of the COP21 international agreement on climate change and the adoption of the United Nations Sustainable Development Goals in 2015, 'sustainable' or 'green' finance is increasingly recognised as playing a crucial role in enabling the necessary transformation of the economy, making it more sustainable, low-carbon, energy and resource-efficient, in a socially fair manner.

While public finance will play a key role in mobilising and guiding capital, the scale of investment needs to make this transition successful is so large that it will inevitably also have to rely on large-scale private sector engagement, and in particular from the institutional investor sector. Indeed, sustainable finance goes well beyond increasing investments that can be directly linked to low-carbon sectors such as renewables. A profound transformation of the fundamentals of our society is needed: changing the way we live and work[(2)], making our cities smarter, with improved communications and digital networks, making our mobility systems and buildings more energy-efficient, and modernising industrial infrastructures, production processes and business models across all sectors. Capital markets will have to be mobilised to ensure a substantial re-focusing of investments from high to lower-carbon technologies and to projects that generate higher social impact.

This requires a fundamental remodelling of the financial system and the creation of real incentives to encourage a large-scale shift in investments and a recalibration of business models towards a more future-friendly capital allocation. Although investors and bankers have started to steer away from the most carbon-intensive assets, they still fail to sufficiently integrate wider sustainability factors into investment and financing decisions. Lack of long-term vision and common definitions and standards mean capital markets remain underutilised to redistribute funds from unsustainable investments towards future-friendly ones. **Investors need access to high-quality data on sustainable investment opportunities for effective capital allocation.** Yet, today, there is a lack of adequate and consistent information on the impact of positive green or social measures or on the climate risk exposure of portfolios. This prevents actors throughout the investment chain from seizing the opportunities of the transition, while increasing the risk of green-washing. How can these shortcomings be addressed?

TRANSPARENCY IS CRITICAL IN MANY WAYS

Increased transparency is essential at all levels. First and foremost, transparency is needed on the side of policymakers and regulators as they are the ones that set the targets and rules which businesses, investors and financial actors have to abide by. They must provide the long-term stability and confidence that is needed for all these players to invest in the sustainable transition. Next, transparency is needed on the side of all the other actors of the investment value chain to spread trust, facilitate benchmarking and the exchange of best

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(1) This article contains relevant excerpts on the topic of data from the Strategic Note 'Financing Sustainability. Triggering Investments for the Clean Economy' which was published on 8 June 2017 by the European Political Strategy Centre.
(2) Investing Initiative: *Assessing the Alignment of Portfolios with Climate Goals: Climate Scenarios Translated into a 2°C Benchmark*, Working Paper, October 2015.

practices, and enable better informed decisions through the investment chain. The potential benefits are wide-ranging.

On the supply side, measures to encourage transparency on climate – or other sustainable development-related – risks would have a positive impact, triggering corporate behavioural change as enterprises would be forced to publicly unveil any investments that are counterproductive to overarching sustainability objectives.

But, far from only naming and shaming companies lagging behind, disclosure can also provide reputational rewards for leading companies, thereby encouraging a greater offering of sustainable projects. This, in turn, could foster increased managerial and shareholder engagement. What's more, by facilitating benchmarking with other organisations, the disclosure of climate and other sustainability risks would enable companies to assess their level of contribution towards EU-led climate targets or other environmental, social and governance objectives, and to access standardised information to 'green' their processes, including procurement.

It could also create indirect incentives to deliver on the sustainability agenda. Interesting private sector initiatives are already burgeoning, such as energy-efficiency loans and mortgages that are linked to the energy-efficiency labelling of buildings. An initiative of the European Mortgage Federation and the European Covered Bond Council is looking to create a standardised 'energy-efficient mortgage' based on preferential interest rates for energy-efficient homes and/or additional funds for retrofitting homes at the time of purchase. The project will explore the link between investing in energy efficiency, borrowers' reduced probability of default, and the increase in value of energy-efficient properties[3].

An additional impulse could be provided through clarifying fiduciary rules and integrating a sustainability dimension in them. Today, these rules – which are basically designed to make sure that financial managers act in the best interest of the company they work for – are often vague and general, and even counterproductive when it comes to sustainability issues due to the frequent assumption that 'sustainability deducts from performance'.

Enhanced transparency, combined with standardised and commonly accepted definitions and metrics, would also encourage a more effective dialogue between companies and banks, insurers and investors. It could help to shift institutional investors from short-term index-based investments towards more active investment policies and result in the integration of sustainability into the algorithm programmes of investment traders. Currently, it remains difficult for investors to benchmark green investments against standard ones, as comparable pricing mechanisms and indices are lacking. Major stock market indices are not in line with the aim of limiting climate change. They remain overexposed to fossil fuel and carbon-heavy technologies, while renewable energy and low-carbon technologies, such as electric cars are underrepresented. In recent years, a number of private initiatives have seen the light, ranging from 'green building rating systems' to specialised sustainability rating agencies and index providers, assessing companies' economic, environmental and social values and performance, and their ability to benefit from opportunities and manage risks in the mid- to long-term. The problem, here again, is that the criteria used and the underlying data are rarely aligned, which detracts from comparability, creating confusion and affecting the credibility of such schemes.

Finally, by increasing the availability of data, supervisory authorities could develop climate stress tests focused on the sectors that are most exposed. The ongoing work of credit rating agencies to incorporate environmental and climate risks into corporate credit rating would be hugely facilitated as well. This would provide tools for monetary policy authorities and public authorities in general, to better integrate climate impacts in modelling and in their forecasting processes.

THE POWER OF DATA ANALYTICS

It becomes clear that data and data analysis will be crucial enablers of sustainable finance, requiring thorough reflections on the design of disclosure requirements. However, effective disclosure of the carbon intensity of companies – let alone the level of 'sustainability' – cannot be achieved overnight and it will take time before systems and/or processes can be developed

(3) More info: https://hypo.org/ecbc/market-initiative/emf-ecbc-energy-mortgages-initiative/

and implemented at company-level. It will take even more time before different initiatives can be streamlined to allow comparability and benchmarking between companies and between sectors.

In this sense, complexity science – i.e. the scientific study of complex systems – can do a lot to help increase comparability between sectors and facilitate the assessment of risks and opportunities, thereby delivering useful information to investors and regulators. For a start, when applied to climate risks, the complexity science approach can help to disclose the complex 'invisible' links between players across the financial value chain, and between these financial players and actors in the 'real economy'. It therefore makes it easier to understand who is directly or indirectly exposed to climate risks, and where to focus policy efforts to address issues in a more targeted way. Risk exposure can be assessed more precisely thanks to a more 'granular' approach, decomposing organisations into parts and fine-tuning climate exposure assessments up to the level of specific plants. For instance, rather than generally categorising companies like Shell or BP as 'fossil fuel companies', such assessments can also consider where they have also invested in renewables and other sectors. Taking account of all this disaggregated information helps to provide a clearer picture of the 'real' exposure' of a given company.

STREAMLINING AND MAINSTREAMING DATA DISCLOSURE

Initial steps to further transparency with regard to sustainability issues have been taken, including at EU level. Among others, there has been the adoption of EU legislation requiring pension funds to consider taking into account environmental, social and governance (ESG) factors in their investment strategies; the Shareholders Rights Directive, requiring corporate and investor disclosure of such factors; as well as a Directive on the disclosure of non-financial information, that will be evaluated in the course of 2018. However, these advances need to be mainstreamed across organisations and sectors.

Along this vein, a recent report by the Financial Stability Board Task Force on Climate-related Financial Disclosures recommends applying disclosure requirements to organisations across sectors and jurisdictions with regard to the following information: (1) the organisation's governance around climate-related risks and opportunities; (2) the actual and potential impacts of climate-related risks and opportunities on the organisation's businesses, strategy, and financial planning; (3) how the organisation identifies, assesses, and manages climate-related risks; and (4) the metrics and targets used to assess and manage relevant climate-related risks and opportunities. The EU will have to consider how to apply such requirements and whether to make them mandatory or not.

Some EU Member States have already developed more detailed provisions on disclosure requirements. This is particularly the case of France that has included some provisions in its Energy Transition Act. French institutional investors and asset managers will have to disclose how they take into account environmental, social and governance (ESG) criteria in their investment strategies, including a detailed assessment of climate-related considerations. Listed companies and large non-listed firms will also be required to report on the climate change implications of their activities and the measures to reduce them. The companies have to explain their strategy with regard to ESG factors, describe the criteria, the assessment methodology and the underlying information, and how this affects the firm's investment policy and/or its engagement strategy. Reporting requirements are adjusted for smaller companies. The Transition Act does not, however, at this stage impose any particular methodology or specific metrics to be reported by the targeted entities, allowing for innovations and the development of best practices in the coming years.

All these developments have already triggered a lot of discussion on the way forward within the affected companies, and stimulated the development of specialised consultancy firms, as well as additional academic research, thereby raising the profile of sustainability issues in general.

Work in this direction will have to be pursued. In particular, any disclosure requirements will have to be complemented by additional work on clarifying definitions and standards, as well as on tools for the proper verification and certification of green financial instruments, without, however, creating too many additional administrative burdens.

CONCLUSIONS

Data and data analysis will be crucial enablers of the sustainable development transition by ensuring that 'green' and 'sustainable' projects can better connect to sustainable finance.

Transparency and disclosure requirements will be essential to ensuring investors and economic actors along the whole value chain are able to make well-informed choices, based on comparable data and in full knowledge of the risks and opportunities, thereby providing them with the correct incentives to reorient funding towards more future-friendly investments, and ultimately, contributing to more and better jobs and growth. The ongoing work of the High-Level Expert Group on Sustainable Finance, which was set up by the European Commission with a view to making recommendations towards a comprehensive EU strategy and action plan on sustainable finance by the end of 2017, will be very important in this regard.

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- More info on the Task Force on Climate-related Financial Disclosures, see: https://www.fsb-tcfd.org/
- Art. 173 in the 'Loi relative à la transition énergétique pour la croissance verte'

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B4 What can foresight do for sustainability indicators and statistics?[1]

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Introduction

Official statistics are facing an increasingly turbulent environment. Rapid changes in the world of data (their supply side) combine with rapid changes in the world of policy (their demand-side). The world of data is changing through the increasing availability of digital data, the rapid development of digital data processing technologies and techniques, and the increasing sophistication of citizen's interactions with data – all this is part of the phenomenon described as big data. The world of policy is changing because of the increasing interdependence of people across the planet, which challenges profoundly nations and international institutions and politics. Sustainable development is central in the changes taking place. It brings institutional transformations, through mechanisms such as the UN agreement on the Agenda 2030 Sustainable Development Goals. It also brings fundamental changes in the way politics work, by challenging the appropriateness of existing levels of policy-making and governance arrangements. Should each neighbourhood be sustainable? Or should sustainability be achieved only at continental levels? What is the minimum requirement for each region if a country as a whole were meant to be sustainable? What are the permissible trades-off between different goals? Should high performance in air quality be tradable against lower standards in equality or hunger? Such questions are not a mere re-baptizing of existing political debates and divisions, but pose a profound challenge to existing policy structures and processes (Voss and Kemp 2006). The pursuit of sustainable development is far from a bureaucratic enterprise of setting goals and measuring performance.

> "Sustainability cannot be translated into a blueprint or a defined end state from which criteria can be derived and unambiguous decisions taken to get there. Instead it should be understood as a specific kind of problem framing that emphasises the interconnectedness of different problems and scales, as well as the long-term and different effects of actions that result from it. From this perspective sustainable development is more about the organization of processes than about particular outcomes" (Voss and Kemp 2006 p 4).

In other words, in the pursuit of sustainable development the key lies with the reflexivity of the policy process. Voss and Kemp (2006) argue that reflexive governance arrangements can be expected to be more effective than forms of governance characterised by competition and bureaucratic segregation. This is because reflexive governance combines democratic representation with processes of learning and knowledge creation. Stirling (2006 pp 228-229) illustrates reflexive governance by distinguishing between three states of governance:

- Un-reflectiveness, in which 'attention focuses only on the most obvious or instrumentally pertinent attributes of an object or problem';
- Reflection, which involves 'deep and serious consideration of all salient aspects of the object of attention'; and
- Reflexivity, in which 'attention simultaneously encompasses and helps constitute both subject and object'.

A state of reflexivity can only be achieved in the context of participative deliberative politics. Participation assures democratic functions while deliberation builds knowledge. For many deliberative politics constitute a much needed

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improvement in policy-making processes, for they provide much more effective learning environments and a better account of how governance structures operate (See Ester 1998, Ferrara 2014, Niemeyer 2014)

Because the content of deliberative decision-making is about the future, foresight – a process whereby alternative future scenarios are explored, visions are formed, and strategies are chosen - is a key tool of deliberative politics. Foresight can be analytical and expert based (some would say technocratic) or participative, inclusive and democratic in a deliberative sense (Barben et al 2008, Bell 2003, De Smedt et al 2013, Glen and Gordon 2009, Stirling 2006). Over the last 20 years there has been an emphasis on more participative foresight, which values the process at least as much as the results (see Hilbert et al 2009; Nikolova 2014).

This paper argues that in their new context, characterised by deliberative politics, especially associated with sustainable development, statistical offices must embrace foresight as well as big-data. This is more than using foresight to try to predict the needs of specific information clients. It is also about bringing openness and public ethos to bear on the data, trends, models and trajectories; as such, items become parts of policy deliberation.

The paper discusses foresight and the relationships between foresight, statistics and governance. It shows that deliberative policy creates a shared space between foresight and statistics that can be mutually beneficial. This space is then explored using the approach of the BOHEMIA study (Ricci et al 2017), the key foresight effort related to the reflection on the European Commission's future policy for Research and Innovation. Whilst the BOHEMIA study is not necessarily representative of all foresight associated with the sustainable development, in its deliberations it has given a central role to the UN Sustainable Development Goals, and sought to develop a broad framework for thinking about the future of Europe across the policies of the European Union. The discussion of the BOHEMIA framework gives rise to some key elements of foresight that could be useful for official statistics.

THE ORIGINS OF FORESIGHT AND THE ROLE OF STATISTICS

In periods of uncertainty, every organization feels compelled to contemplate alternative variants of the future. The process of thinking through alternative futures is called strategic foresight. Foresight originates in a critique to forecasting as a scientific discipline. There are three layers in this critique, each emphasizing a different characteristic of foresight:

- Forecasts are inaccurate: Following repeated deceptions with technology forecasting (Martin and Irvine 1989) foresight is less about predictive accuracy and more about broad trends and fundamental phenomena. Reads's (1913 p 351) conventional wisdom that "it is better to be vaguely right than exactly wrong" which is often attributed to Keynes, explains the increasing popularity of foresight since the 1970's.
- Forecasts are reductionist: they result from data series based on specific models and indicators which invariably – even in their most complex forms – tend to simplify situations. Foresight is more qualitative and typically aims at seeing the bigger picture (Ibid.)
- Forecasts assume that the future is determined and therefore predictable: Foresight recognises that people's will and strategies shape the future. Thus, its emphasis is not on predicting but on eliciting assumptions and illuminating objectives, strategies and tactics of people who shape the future. As such, it is part of what organizations do to shape the future themselves (ibid.).

As the above implies, statistics and indicators are much more important components of the world of forecasting than of the world of foresight. However, this does not need to be the case. First, statistics and indicators are a key part of the broader world of policy-making, which includes planning but also policy implementation, monitoring and evaluation. Foresight is related to history (Staley 2007) and monitoring and evaluation knowledge frame foresight and planning. Second, foresight and forecasting are performed for similar reasons. Their key function in planning is to reduce uncertainty, either by framing futures as being beyond the influence of the organization – therefore forecastable – or by framing futures as being within the influence of the organization – therefore interesting to explore as part of planning for the future.

In a seminal book Tetlock (2005) exposed expert political judgement to be worse than chance when dealing with forecastable questions. Subsequently Tetclock investigated the effect of the conditions under which the forecasts were made. Organizing forecasting tournaments with

experts showed that super-forecasting, much improved from that exposed in the 2005 book, can be achieved if conditions suppress the factors that cause bias (Tetlock and Gardner 2016).

One of the findings of this work was that experts rarely take position on what they forecast. One of the things that characterise experts is their ability to caveat their judgements so as to not get it wrong (ibid). Lack of indicators and the nonexistence of appropriate measurements are amongst the principle hideouts for those who do not wish to expose their expertise to the risk of being wrong. While on the face of it would seem that statistics and indicators would facilitate forecasts, the everyday reality of official statistics engages with a great deal of caveats about the knowledge content of particular measurements. Giovannini (2010) eloquently argues that the value of official statistics depends on the knowledge of the facts that the users of official statistics actually pose. In other words, official statistics are numbers that are meaningful to a community of experts who understand that theory and method associated with their production.

OFFICIAL STATISTICS AND BIG DATA: KNOWLEDGE AND GOVERNANCE

For scientific communities, official statistics constitute highly prized data, and Eurostat and the OECD constitute substantial infrastructures for economic and social sciences. In many ways, this is recognition of the effort of official statistical agencies to remove political bias from the numbers. In economic and social sciences, maybe with the exception of own measurements, official statistics are considered amongst the most valid data sets one can lay hands on. Official statistics impose rigour on the collection of administrative data, and their documentation and usability compares favourably to large-scale research projects in the economic and social sciences.

In political discourse however, the remark attributed to Disraeli by Mark Twain, about 'lies, damn lies and statistics', still holds credence[(2)]. Statistics are used to construct accounts of history – what really happened – and these accounts shape identities and perceptions of collective interests. It is their political nature that makes official statistics so potent and so powerful – they combine the power of science with the power of the state. Yet, this exposes official statistics to political critique. Official bodies do not hold the monopoly of economic and social measurements, and different measurements can be used to construct alternative accounts of what happened, and to shape alternative perceptions of collective interests and futures.

Statistical offices in democratic states have co-existed with vibrant scientific communities, and have benefited from the interaction with those communities. In recent years, this coexistence has been affected by the evolution of a pervasive internet and the emergence of big data analytics. The immense opportunities for social and behavioural observation and analysis that this provided became quickly captured by corporations, while the scientific communities were caught by surprise[(3)]. Ploug (2013) concluded that big data was an opportunity but also a huge challenge for statistical offices. How can you generate meta-data to extract statistical information from the internet? Ploug wondered. At the same time, the potential of the internet as a source of data was demonstrated by Kramer et al (2014). They published the results of an experiment on the transfer of emotional states through social networks that had been carried out by facebook on 689003 users. The publication raised strong ethical concerns in the scientific community, although the experiment in itself did not seem to affect the rise in the numbers of facebook users. In particular, the journal carrying the article of Kramer et al (2014) published a note of editorial concern that explained:

> "it is a matter of concern that the collection of data by Facebook may have involved practices that were not fully consistent with the principles of obtaining informed consent and allowing participants to opt out" (PNAS Vol 111 2014 p 10779)

The incident has been highly prevalent in the press (e.g. McNeal 2014, Jouhki et al 2016), but the number of facebook users worldwide continued its linear rise from 1.3 bn in June 2014 to 1.95bn in the first quarter of 2017[(4)].

Davies (2017 p 10) argues that the challenge to the statistical system is that private big data owners can construct convincing and effective

(2) See for example Huff (1954) and Best (2005).
(3) It was only about 10 years ago that discussions about cyber-infrastructures for Social sciences were taking place.
(4) Data from Statista: the statistics portal https://www.statista.com/statistics/264810/number-of-monthly-active-facebook-users-worldwide/.

accounts of history, identity and community using methods and data that they do not have to publish.

> "A post statistical society is a potentially frightening proposition not because it would lack any forms of trust or expertise altogether, but because it would drastically privatise them."

A different but related challenge comes from "alternative facts", the ability of actors to deliberately construct and politically manipulate data and narratives. The susceptibility of deliberative processes to political manipulation generates a strong need for the values of objectivity and respect to human values that characterise existing systems of official statistics. Deliberative contexts and reflexive governance place premium value on these attributes.

> "(T)he battle that will need to be waged in the long term is between those still committed to public knowledge and public argument and those who profit from the disintegration of those things" (Davies p 11)

The importance of data for governance is such that the governance of data is critical for our political and economic systems. However, changes in governance, for example towards more deliberative politics, form the context of the work of statistical offices.

FORESIGHT AND THE CHANGES IN THE CONTEXT OF OFFICIAL STATISTICS

What can foresight do for statistical offices? A shift towards reflexive governance and deliberative policy would require the production of meaningful statistics to become quicker, more agile, and engage in techniques like rapid prototyping[5], and "wind-tunnelling" using foresight scenarios to test indicators (see Nekkers 2016). Foresight could thus become part of the toolkits of statistical offices. For example, using big data analytics to develop and project to the future "trends" in science and technology is a growing business worldwide (with actors like Thomson-Reuters; Elsevier, McKinsey)[6]. The experience with the use of big data analytics in foresight can help official statistics. However, is there really a shift towards reflexive governance and deliberative policy? Or is it just wishful thinking on the part of some people? Is it normative positioning or analytical research finding? (See Shove and Walker 2007, 2008; Rotmans and Kemp 2008).

This is not a new debate. The idea that there are trends in history and that this has predictive value has been strong in structuralist and Marxist schools of thought. However, trend-based predictions are subject to considerable uncertainty. Financial products still carry a warning that past-performance is not an indicator of future success, and that what may appear as a trend has no weight on future events. In economic literature, trends are widely associated with business cycles, principal amongst which are the long waves of Nikolai Kontradiev. Famously Trotsky criticised Kontradiev's efforts to distinguish between the true trend and noise in his data by saying that both the trend and the noise were the result of human actions (see Freeman and Louca 2001). In an important way, trends are tools for looking at the past, and as the past continues into the future, trends can inform views of the future. However, as Rip (2001) eloquently argued, we should not confuse the tool with the phenomena. A trend is a hypothesis, and while hypotheses about the past can somehow be checked against people's experiences of the past, hypotheses about the future cannot be tested but against people's intentions, expectations and imaginations.

This is what foresight does. Foresight continuously gives rise to hypotheses about future trends, which it tests against people's intentions and intuition. Horizon scanning, weak-signals, future signposting are terms that indicate this search for trends, directions, and forces that may affect the future. The arguments about these hypotheses may be founded on scientific models, well documented by statistical data or new models and arguments for which statistical data are still being constructed, or on people's experience and values, which have no representation in statistical realities as yet.

Developing meaningful indicators, that reflect people's perceptions of emerging trends, are useful for policy and worthwhile for official statistics to invest in, is a huge challenge. Once indicators become associated with some kind of policy target – as is frequently the case for unemployment, inflation, economic growth, R&D investment, to name but a few – the relationship between the indicator and the phenomenon it is meant to indicate becomes subverted. Therefore, for example, measuring

(5) Design thinking is having an increasing influence on foresight. See Köhler et al (2015) and Tuomi (2012)
(6) See http://sciencewatch.com/tags/2025; Gabriel (2015); Colombus (2016)

scientific excellence through publications leads to a rise in the number of publications, thereby changing the nature of scientific communication and its relationship with excellence. As a result, a policy to promote scientific excellence needs to change regularly the way it considers scientific publications[7]. Davis and Kingsbury (2011) discuss the problem of indicators as a learning process. In their view, discrepancies in the framing between an indicator and "the gold standard" for the problem it is meant to be indicating and contestations around indicators (as well as around the "gold standard") result in a need for learning a revision of indicators. This learning process lies at the heart of reflexive governance. Or to put it differently, reflexive governance can be described as a knowledge production process (a deliberative process) in which the knowledge production process itself is part of the object of deliberation.

In this light, one can argue that the changes in the context of statistical offices requires a convergence of big data, foresight and official statistics, to join forces to ensure public knowledge (See **figure 1**).

FORESIGHT AND SUSTAINABLE DEVELOPMENT: WHAT IMPLICATIONS FOR INDICATORS AND STATISTICS

Whether there is a trend towards reflexive governance or not, is a fundamental question for official statistics but also for foresight. Stirling (2006) argues that reflexive governance for sustainability requires precautionary foresight. He identifies a convergence of concerns between precaution and foresight,

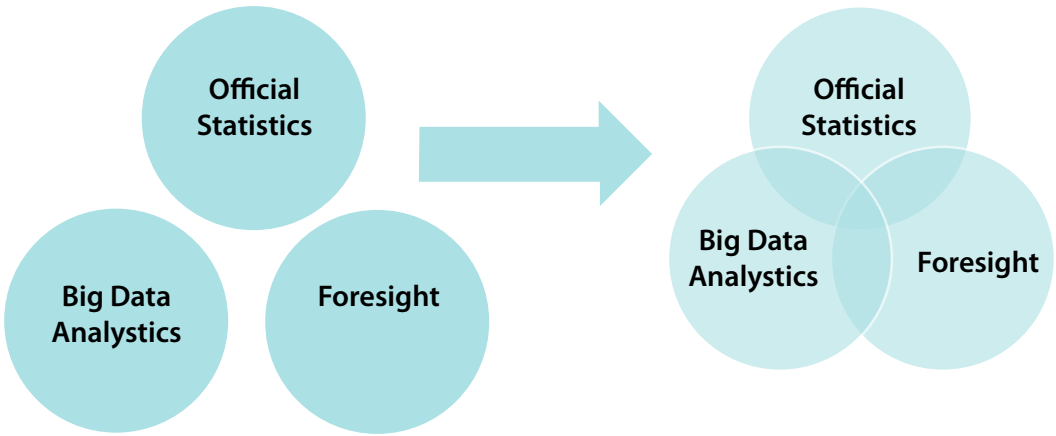
> "with intrinsic indeterminacy, social contingency, and path dependency in science and technology. Both display similar trends towards methodological pluralism and political engagement" (ibib p 31).

These are the kind of concerns one finds also in the arguments for a post-normal science (Funtowicz and Ravetz 1993). Foresight can be seen as the process of old map-makers mapping terra incognita (See Henseler and Dienel 2017)

The adoption of the UN Agenda 2030 and the Sustainable Development Goals launched a huge discussion on indicators and statistics. The United Nations Statistical Commission's Interagency and Expert Group on SDG Indicators (IAEG-SDGs) proposed 230 global indicators. The work on SDG indicators has been prepared by the countries of the United Nations Economic Commission for Europe (UNECE), countries with advanced National Statistical Systems. The UNECE Conference of European Statisticians sees the 230 global indicators as distinct from national indicators.

> "The global SDG indicator list is designed to measure progress with SDGs at the global level. National indicators may be justified: i) where there are specific national priorities not addressed by the global indicators, ii) when policy is in need of additional indicators to measure a country-specific part of an SDG in more detail; or iii) when global targets may

Figure 1: A convergence between data analytics, official statistics and foresight



(7) The key example here is the UK RAE

(not be) relevant in specific countries" (ECE/CES/2017/2 p 20).

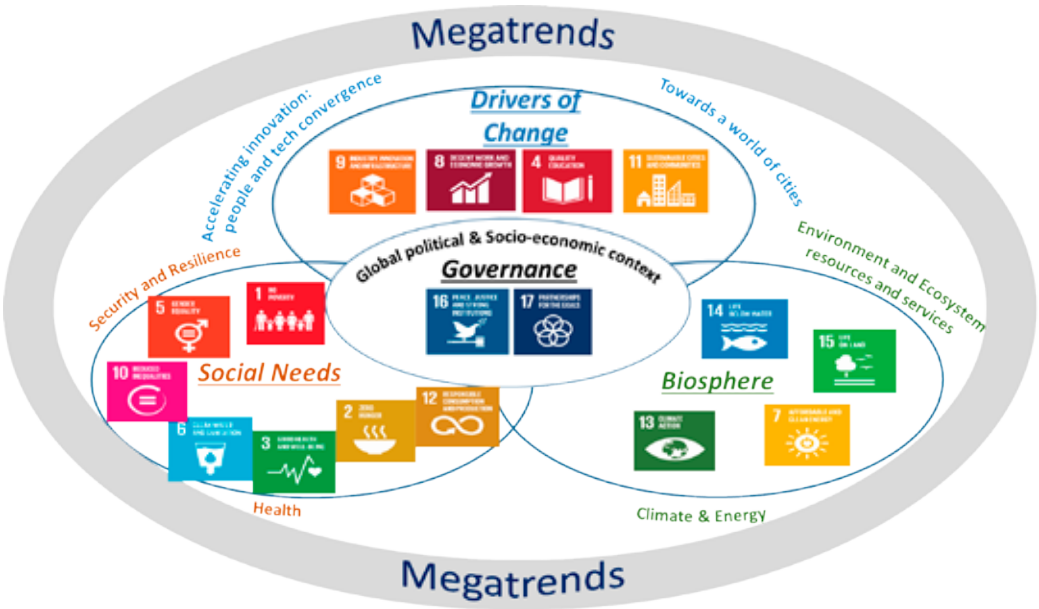
Yet, as Rothen (2017) reports on average UNECE member Countries are only able to produce about one third of the total indicator set, whilst half of the indicators lack agreed definition or coverage (Dunning 2016). As the statisticians agree, there will be a lot of work needed to monitor progress towards the sustainable development goals (ECE ibid). Further to that, the work will be politically complex, as the process is voluntary, and the way in which global objectives are divided into national responsibilities remains to be decided.

The Sustainable Development Goals have also become subjects of normative foresight. Analytically, the foresight literature has been preoccupied with global megatrends (Gore 2013; EEA 2010, 2015, OECD 2016, ESPAS 2015). Megatrends are mega-hypotheses about the global future, what constitutes it and what is important in it. In a sense, megatrends are arguments about indicators. They include a great deal of scientific exploration, as the discussion on global climate-change testifies to, but also a great deal of imaginary exercises based on what could be technically possible for different actors to do under certain conditions. The OECD (2016) describes megatrends in the areas of natural resources and energy, climate change and the environment (the Biosphere), globalization, roles of states (Governance) demography, economy, jobs and productivity, society, health and well-being (Social Needs). The EEA (2015) considers similar megatrends but singles out urbanization and accelerating technological change, as megatrends in their own right. There is considerable overlap between the concerns of the megatrends and the Sustainable Development Goals. The BOHEMIA study (Ricci et al 2017) structured the junction between megatrends and SDGs in four clusters: governance; the biosphere; social needs; and key drivers of change (see **Figure 2**). It then developed scenarios within each of the four clusters.

While the BOHEMIA study aimed at defining possible priorities for Research and Innovation policy, the broad reflection on the future provides ways of monitoring global progress towards sustainability that are quite different and maybe more practicable than the indicators of the SDG system. For example, as regards the biosphere, Hoff and Lobos Alva (2017) describe how the planetary boundaries framework can help implement the SDG agenda. The kind of measurements and data required for this purpose are not usually part of Official Statistics, yet without them progress towards the SDGs cannot be monitored.

In the areas that have to do with societal needs aggregated indicators of development

Figure 2: Estimated correlation between robots (by application) and employment (by occupation)[8]



(8) In figure 2 the curved titles within the circle denote the titles of scenarios developed in the BOHEMIA project.

can be developed based on economic activity, population characteristics, values and concentration of power, which would signal whether dependence relations and inequalities between people are decreasing. In the areas of social needs, perception indicators are of rising importance. Increasingly prevalent in the fields of health and business, they can be very useful in relation to poverty, security and all kinds of social needs.

The key drivers of change are based on hypotheses about power, competence and capacity. Drivers are actors in systems or networks[9]. Actors engage in policy and behave strategically to generate change. Knowledge, science and technology generate competence and capacity to act. Thus, together with the institutions and policies that support them, they form the category of drivers of change, the motors that can propel communities towards sustainable development pathways.

The capacity to act does not result in action without agency (motivation) and strategy. Foresight is mostly used for agency and strategy. Participative foresight empowers communities to reconfigure goals, strategies and behaviours. Bourgeois and Sette (2017) and Bourgeois et al (2017) illustrate such phenomena in relation to food security, the achievement of which is far more related to local perceptions and conditions that to aggregate scores on food prices and availability.

Finally, governance shapes the boundaries of acceptable strategies and behaviours. Governance frameworks draw their power from, and express it in, political or economic processes. Those processes may be characterised by competition or collaboration. Accordingly a typology can be drawn.

Governance frameworks rely on indicators for their functioning, and for monitoring their performance. Foresight, by exposing the relations, and potential mismatches, between needs and power relations at different levels (e.g. between local and national goals and means), facilitates transitions between different governance frameworks.

CONCLUSIONS

Statistical offices are facing an unprecedented set of challenges and opportunities. The Agenda 2030 has imposed huge demands on statistics – which requires unprecedented levels of investment and a great deal of work. At the same time, changes in the political and technological landscape generate challenges for the way statistical offices work. Can foresight help?

Statistical offices work within the context of governance frameworks. Anticipating important changes in governance that may require completely different sets of indicators is a key strategic foresight project for statistical offices. Strategic foresight is not something statistical offices have the resources or the expertise to carry out. However, it may well be something they wish to develop as a means of developing an innovation strategy of their own. With the pressure to develop and measure new indicators[10], foresight can be a valuable input in investment decisions, prototyping and wind-tunnelling alternative approaches.

Table 1: Impact of digitalisation on flexible types of employment

	Competitive	Collaborative
Political	Institutional arenas shape competition between interests and demands. Individuals enjoy voting rights based on position. Democratic procedures are characterised by voting, and referenda.	Institutional arenas are collaborative spaces that shape shared knowledge. Individuals enjoy rights based on position, but voting is seldom used. Democratic processes are characteri sed by consensus
Economic	Market based coordination where individuals express preferences based on money, by engaging in transactions. Costs and benefits of activities are born by the transacting parties.	Market -transactions are replaced by block agreements such as shareholdings and employment relationships. Corporate governance arrangements determine the distributions of costs and benefits.

(9) Depending on the theoretical assumptions of the models (References of system and of network theories
(10) EUROSTAT recently launched an initiative on experimental statistics – rather timid in terms of experimentation but a big step towards an innovative approach to statistical indicators.

Without necessarily developing internal foresight capability, regularly monitoring foresight may help statistical offices anticipate changes and become more effective and efficient in their roles. Monitoring foresight may also help identify areas where predictions need to be improved, and where they could match the need for better predictions with data.

Foresight exercises may also help statistical offices judge the relevance and appropriateness of the indicators they use for local level phenomena. This could help them decide on whether to develop perception indicators and policy indicators, whether to abandon national and international data collection or to switch to new types of data collection (e.g. internet-based indicators).

Yet simply monitoring foresight exercises may leave statistical offices vulnerable to important changes in public attitudes that may not be fully appreciated through reviewing foresight. The more important deliberation and engagement becomes in our politics, the more important it is for statistical offices to participate in and engage with deliberation processes. For such participation and engagement, an analysis of prospective changes in governance frameworks is a strategic foresight project that statistical offices need to master.

All in all, sustainable development is a huge challenge and opportunity for human societies and their governance, and as such it is a challenge and opportunity for the knowledge providers that underpin governance frameworks and government decisions. In this context, foresight and official statistics should come closer to the benefit of both.

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B5 Embedded environmental data in resource flows

Richard King, Felix Preston and Rob Bailey[*]

Introduction

Global resource extraction has been forecast to increase from 85 billion tonnes in 2015 to 186 billion tonnes by 2050. On a per capita basis, this represents a 71 per cent increase in resource use[1]. Unchecked, this could lead to irreversible environmental damage, with extraction destabilizing critical ecosystems, eroding biodiversity, and destroying carbon sinks. Such volumes of extraction, coupled with energy-intensive processing and transportation of resources, would undermine any prospect of stabilizing the climate or realizing the Sustainable Development Goals (SDGs).

The United Nations Environment Programme (UNEP) estimates that approximately 15 per cent of the 70 billion tonnes of resources extracted and used globally in 2010 were traded[2]. For fossil fuels and metals, around half of all production of these commodities were traded. Moreover, growth in trade in natural resources has outpaced growth in production since 1980[3].

Behind this trade in commodities lies an even greater volume of resource extraction, due to materials required as inputs for processing, or waste and by-products generated in the production process. The production of 10 billion tonnes of directly traded goods in 2010, for example, required 30 billion tonnes of total material extraction[4].

The environmental impacts of these trades are a consequence not only of their scale but also where they are found: many resource products are produced or extracted from highly sensitive ecosystems such as tropical forests; and in some cases the exporting countries have weak environmental and social governance. Traded products thus 'embody' all the resources used to produce them and their upstream components including land, water, energy, and so on – and their sustainability impacts – whether or not these contribute to the final market price.

Consequently, it is imperative to improve our understanding of the volume and value of international resource trade, as well as the environmental footprints of such trade. Indeed, this has become a critical dimension of international environmental policy. Better data and analysis are essential, for instance, to support the development of more effective policy instruments; to improve traceability and accountability along supply chains; to steer investments towards sustainable resource production; and to enable consumers to make more sustainable choices.

RESOURCETRADE.EARTH

A recent contribution of Chatham House in this area has been the development of a comprehensive bilateral resource trade database. Now publically available as an interactive website, https://resourcetrade.earth features powerful interactive visualisations that provide easy access to an extensive and authoritative database of international trade in natural resources, and

(*) Chatham House
(1) UNEP (2016) Resource Efficiency: Potential and Economic Implications. A report of the International Resource Panel. Ekins, P., Hughes, N., et al. Paris: United Nations Environment Programme.
(2) UNEP (2015) International Trade in Resources: A Biophysical Assessment, Report of the International Resource Panel. Paris: United Nations Environment Programme.
(3) UNEP (2016) Global Material Flows and Resource Productivity. An Assessment Study of the UNEP International Resource Panel. H. Schandl, M. Fischer-Kowalski, J. West, S. Giljum, M. Dittrich, N. Eisenmenger, A. Geschke, M. Lieber, H. P. Wieland, A. Schaffartzik, F. Krausmann, S. Gierlinger, K. Hosking, M. Lenzen, H. Tanikawa, A. Miatto, and T. Fishman. Paris, United Nations Environment Programme
(4) UNEP (2015) International Trade in Resources: A Biophysical Assessment, Report of the International Resource Panel. Paris: United Nations Environment Programme.

goes some way to revealing their environmental impacts.

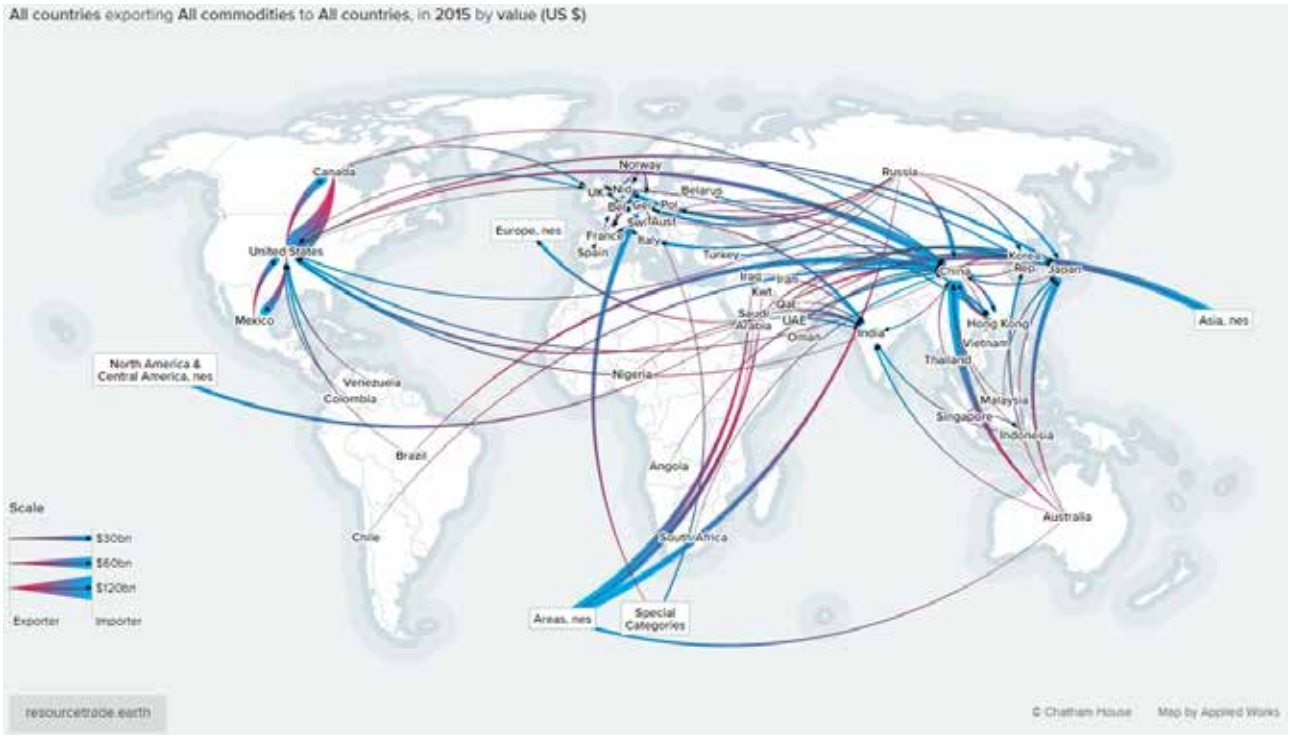
The site employs International Merchandise Trade Statistics (IMTS) collected by national customs authorities and compiled into the United Nations Commodity Trade Statistics Database (UN Comtrade) by the United Nations Statistics Division.

Resourcetrade.earth reorganises UN Comtrade data into a natural resource hierarchy, covering trade in over 1,350 different types of natural resources and resource products, including agricultural, fishery and forestry products, fossil fuels, metals and other minerals, and pearls and gemstones. This commodity hierarchy is built bottom-up from records of trade flows in very specific types of resources and resource products. This permits users to easily interrogate resource trade flows at varying degrees of granularity and aggregation depending on the breadth or depth of their interest. It also informs our approach to embedded environmental trade footprints – in the next section we briefly consider how this compares with other approaches and the comparative strengths and weaknesses of each.

As the site shows, at the global level the volume of natural resources traded increased by 60 per cent since the turn of the century to 12.5 billion tonnes in 2015. After more than a decade of rapid growth, resource trade has recently plateaued, with today's volumes close to the record level set in 2013. Although largely a result of slowdown in the global economy, particularly in China, there are hopes that this also reflects a decoupling of economic expansion from resource use.

Patterns in resource trade are also shifting. Our 2012 report 'Resources Futures' described how global trade was reorienting around China. It also noted how traditional resource-exporting emerging economies have become significant sources of demand, as they industrialise and move up resource value chains, exporting larger volumes of manufactured goods. One consequence is that nearly all countries are significant importers of some natural resources.

Nonetheless, levels of final resource use continue to be very uneven and efforts to reduce the materiality of the economy need to consider the equity implications. North America and Europe have the largest per capita 'material footprints'; the North American average is more than 10 times the African average[5]. As noted above, material use is strongly associated with other environmental pressures such as land use, water



(5) UNEP (2016) Resource Efficiency: Potential and Economic Implications. A report of the International Resource Panel. Ekins, P., Hughes, N., et al. Paris: United Nations Environment Programme.

use, energy use and carbon emissions, and waste flows[6].

STATE OF EMBEDDED ENVIRONMENTAL ACCOUNTING

Efforts to quantify the embedded environmental impacts of trade can be characterised as following one of three approaches:

- Wide resource coverage, high resource resolution, medium-low geographic resolution;
- Sector (or company) -specific, medium-high resource resolution, high geographic resolution;
- Economy-wide, low resource resolution.

The first approach is that adopted by resourcetrade.earth. Because the site leverages global data on resource-specific bilateral trade flows, embodied resource estimates can be calculated on a commodity-by-commodity basis: where resource intensity factors or coefficients (e.g. kilograms of CO_2 or hectares of land per kilogram of product) are available, they are multiplied by the exported mass.

This approach provides comprehensive data across commodities and bilateral flows and generally permits global coverage. Since bilateral trade between countries is the unit of analysis, the approach could play a role in tracking progress at the national level – for example on implementing the Sustainable Development Goals – or be employed by several other national environmental accounting efforts.

The trade-offs come in terms of decreased spatial resolution and the degree of assumptions required when integrating with environmental data. Because IMTS data are reported nationally, it can be difficult to ascertain where in the exporting country the resource was produced or processed (if indeed it was – some flows represent re-exports of goods originating from a third country) and therefore how the idiosyncrasies of the immediate environment affect products' environmental impacts. Consequently, intensity factors can often only be calculated as national or sometimes global averages.

This is problematic for estimates of some types of embodied environmental data. For example, without knowing where within a country a crop is grown it is difficult to make an assessment of its impacts on deforestation – some crops that don't displace other land uses may be benign to forest coverage, whereas others may be harvested from recently cleared land and will therefore have a more pernicious impact on tree loss. Similarly the carbon intensity of some industrially-processed resources will depend to a large extent on their power sources. Aluminium smelting is an electrolytic process using vast quantities of electricity. If this electricity is sourced from hydro-electric or other 'clean' power stations then the resultant embodied emissions from electricity will be significantly lower than were the industrial power sourced from fossil fuel sources.

The second approach aims to circumvent these issues of lacking geographical specificity by obtaining better estimates of the context in which the resource is produced. One such example is the work of Godar and colleagues[7] in assessing the environmental impacts of deforestation-risk agricultural commodities in South America. They combine international trade data with bills of lading and customs declarations to assess which port commodities were exported from, municipal-level production data, and a time-optimised transport model to assess how production in different places is linked to specific ports and specific bilateral trade.

Combined with a methodology for tracking re-exports (such as the estimation approach developed by Kastner *et al.*[8], this both permits assessment of the place-specific embodied environmental impacts and provides an indication of which supply-chain actors may bear responsibility for, or may otherwise be implicated in, generating the embodied environmental footprint. Because this approach is computationally intensive, and requires multiple high-resolution datasets (some of which are proprietary), its deployment is currently limited to a select few commodities, export countries, and types of embodied environmental data. However, advances in environmental data and supply chain traceability could start to overcome this.

The third approach takes an economy-wide view of countries' embodied environmental trade footprints. This loses the commodity specificity offered by the previous two approaches but

(6) http://www.resourcepanel.org/file/424/download?token=R_MdagO3 p35
(7) http://dx.doi.org/10.1016/j.ecolecon.2015.02.003
(8) https://doi.org/10.1016/j.ecolecon.2011.01.012

gains an increase in country and footprint coverage. One family of analytic techniques under this approach is Multi-Region Input Output analyses (MRIO), which trace monetary flows between different economic sectors and along international supply chains. These have been adapted to estimate national and sectoral environmental footprints, using factors for average environmental impact per monetary unit. Of particular significance in this field are the joint OECD-WTO initiative on Trade in Value-Added (TiVA)[9], the European Commission sponsored World Input-Output Database (WIOD)[10], Eora[11],EXIOBASE[12], and the Global Trade Analysis Project (GTAP)[13].

The complexity of the analysis involved under this approach necessitates large sectoral and geographic aggregations, and therefore results in a simplification of the global economy[14]. Whilst this approach is well-suited for consumption analysis and for measuring the contribution of traded outputs of highly-aggregated industry groups to nations' value added, income, and employment[15], it doesn't permit the granularity of analysis of specific commodities that is possible with conventional trade statistics. For example, under a MRIO approach soybeans would be considered as part of a sectoral aggregate that, at best, would include all other oilseed crops, which have very different origins and cultivation impacts from one-another[16].

MRIO analysis does have the benefit of giving a more accurate picture of the significance of trade to gross domestic product than conventional trade statistics are able to. Since conventional trade statistics measure gross trade flows, the value of commodities that cross borders several times for further processing are counted multiple times. This issue is avoided by MRIO approaches that are able to distinguish between intermediate and final demand.[17] However, conventional trade statistics (as employed by resourcetrade.earth) "are essential when the focus is on the (increasing) interconnectedness of economies or the study of supply-chains, and global production networks",[18] not least because the trade interdependencies in resource markets evolve rapidly and the baseline assumptions employed by some MRIO models may rapidly become outdated.

LESSONS FROM RESOURCETRADE.EARTH

The embodied environmental data currently included in resourcetrade.earth are estimates of the embodied carbon dioxide (across all resource categories) and of the embodied land and water – blue and green (across the majority of agricultural resources). Environmental data are more readily available for agricultural resources than other resource types. To the extent that other environmental footprints are compatible with existing approaches, expansion into these areas will be considered for future iterations. National-level indicators of countries' standings across a range of environmental, socio-economic, and governance domains are already included, to further contextualise the importance of resource trade to countries' development trajectories.

CARBON DIOXIDE

Embodied carbon dioxide volumes are calculated by multiplying trade volumes by product-level carbon intensity factors. The emission factors employed are from Sato (2014)[19]. They are world-average, cradle-to-gate factors, defined in physical terms (kg CO_2/kg product). Sato presents a detailed discussion, and sensitivity test, of the advantages and disadvantages of using world average factors relative to country-specific factors and finds, on balance, that country-adjusted factors can be unreliable and introduce further errors into the analysis unless there are very specific and reliable data available with which to make the adjustments.

The cradle-to-gate system boundary accounts for emissions generated throughout the production phase of a product's lifecycle, including the production of inputs, up until the factory gate, i.e. before the product is transported to the

(9) http://www.oecd.org/sti/ind/measuringtradeinvalue-addedanoecd-wtojointinitiative.htm
(10) http://www.wiod.org
(11) http://worldmrio.com/
(12) http://www.exiobase.eu/
(13) https://www.gtap.agecon.purdue.edu/
(14) http://dx.doi.org/10.1016/j.ecolecon.2015.02.003
(15) http://unstats.un.org/unsd/trade/events/2014/mexico/Asymmetries in official ITS and analysis of globalization - V Markhonko - 18 Sep 2014.pdf
(16) https://doi.org/10.1016/j.ecolecon.2011.01.012
(17) http://unstats.un.org/unsd/trade/events/2014/mexico/Asymmetries in official ITS and analysis of globalization - V Markhonko - 18 Sep 2014.pdf
(18) http://unstats.un.org/unsd/trade/events/2014/mexico/Asymmetries in official ITS and analysis of globalization - V Markhonko - 18 Sep 2014.pdf p5, Quoting OECD-WTO
(19) https://doi.org/10.1016/j.ecolecon.2014.05.006

consumer. This contrasts with alternative system boundaries such as gate-to-gate, cradle-to-grave (including the use and disposal phases of the product) and cradle-to-cradle (including recycling).

The cradle-to-gate carbon intensity factors assume that all production inputs are sourced domestically, i.e. they consider only domestic supply chains and exogenously include trade in intermediate and final products. This system boundary results in issues of double-counting emissions at aggregated levels, since emissions associated with relatively unprocessed materials will also be recorded against products that have the original materials as inputs. For aggregate national emissions inventories, double-counting is more of an issue for countries with significant trade volumes relative to the size of their economy, and for countries engaged in significant processing, with large import contents in their exports. This cradle-to-gate approach, however, is well-suited for comparing trade-adjusted emission inventories at a more detailed product-level. As such, to avoid double-counting and over-representing emissions, resourcetrade.earth reports embodied CO_2 emissions only at the individual resource product level rather than for categories of aggregation[(20)]. Nonetheless, especially in the context of nurturing circular economy approaches, and to optimise performance and reduce resource requirements, this needs to be augmented with more complete life cycle assessments (LCA) that track embedded resources used throughout a product's lifecycle from manufacture, to use, through to disposal or repurposing. Typically these cradle-to-grave LCAs are most suited to assessing the impacts of specific manufactured products under specific use cases and are less amenable to generalisation given the many factors that can influence resource use throughout the lifecycle.

LAND AND WATER

In the food system, the embodied resource that has received the most attention is water, where it is sometimes termed "virtual water". To produce a green bean requires about a gallon of water, and a kilo of beef requires about 10-11 tonnes[(21)]. Clearly, it therefore makes an important difference whether water used to produce crops (including forage) is rain water or irrigated water extracted from rivers or wells, and whether the real cost of the water is included in the price.

There is an active debate about whether water footprints should be weighted according to catchment-specific water availability, or water scarcity, or not at all. While the former may have some utility for product-specific LCA, Hoekstra (2016)[(22)] makes a convincing case for the latter when it comes to broader water footprint assessments, to maintain physical meaning and consistency with land and carbon footprint approaches.

The importance of "virtual water" is increasingly being highlighted by changes in water availability, driven by over-use depleting reserves and climate change. A recent study shows that about 11 per cent of food trade – mostly exports from Pakistan, the US and India – has embodied non-renewable groundwater used in irrigation, providing some long-term food security risks for those countries that rely on the trade[(23)]. The recent growth in the export of a fodder crop, alfalfa, from the US to China is an example of where these issues have come to the fore. This trade growth is partly taking advantage of cheap transport - it is very cheap to ship from the US to China due to the imbalance of trade: the bulk of trade is going in the other direction[(24)]. While it might make economic sense for Californian farmers to export their hay to China, the recent Californian drought brought with it restrictions on domestic water consumption, yet at the same time 100 billion gallons of embodied water used in the production of alfalfa was being exported[(25)].

Countries with less access to water can make it go further by importing goods from countries that have greater access to water for production purposes. A good example of this occurs in the Middle East, with countries like Israel[(26)]. Israel uses its water to produce high value crops for export, particularly fruit and vegetables, and

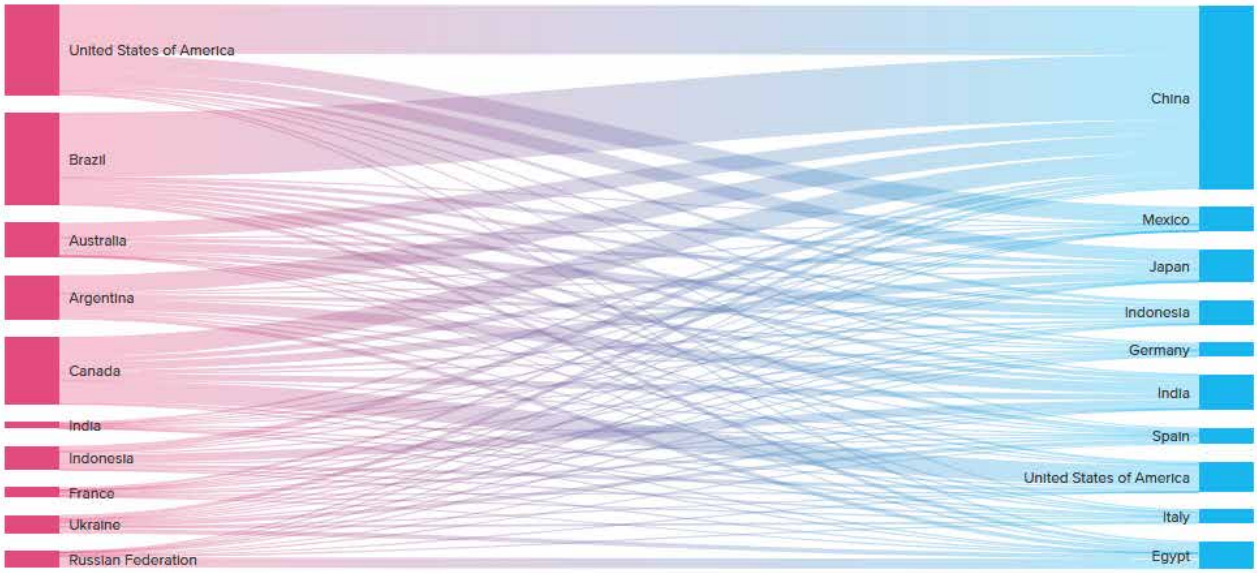
([20]) The carbon intensity factors provided by Sato (2014) are recorded against Standard International Trade Classification (SITC) revision 3, 4 digit resolution product codes. These were converted to the HS codes used by resourcetrade.earth using UNSD correspondence tables. Carbon intensity factors are available for 93 per cent of the HS product codes included within resourcetrade.earth.
([21]) Hess, T., Lankford, B., Lillywhite, R., Cooper, R., Challinor, A., Sutton, P., Brown, C., Meacham, T., Benton, T., Noble, A. (2015). Water Use in our Food Imports. Farming and Water Report 3. Global Food Security programme.
([22]) Hoekstra, A. (2016) A critique on the water-scarcity weighted water footprint in LCA, Ecological Indicators, 66, pp564-573, https://doi.org/10.1016/j.ecolind.2016.02.026
([23]) Dalin, C., Wada, Y., Kastner, T., and Puma, M. J. (2017). Groundwater depletion embedded in international food trade. Nature 543(7647), 700-704.
([24]) Pierson, D. (2014). U.S. farmers making hay with alfalfa exports to China, Los Angeles Times, 8 June 2014.
([25]) Leithead, A. (2014). California drought: Why farmers are 'exporting water' to China, BBC, 19 February 2014.
([26]) Allan, A. 'Virtual water': a long term solution for water short Middle Eastern economies?

relies to a large extent on importing rain-fed cereal crops that it is less able to produce.

Embodied land area and green and blue water volumes were calculated for a sub-set of agricultural products included in resourcetrade.earth by the Global Landscapes Initiative of the Institute on the Environment at the University of Minnesota, building on analysis they previously published (MacDonald *et al.* 2015)[27]. This is a refinement of the approach developed by Kastner *et al.*[28], which uses caloric equivalence to relate processed goods to their root crop. As such it is only possible to employ this methodology for commodities with a caloric value. resourcetrade.earth trade data for 2000-15 replace FAO trade data as the input trade data, other input values, for example caloric equivalence factors, production volumes, area harvested, and water productivity are derived from the same sources specified in MacDonald *et al.* (2015).

The analysis using the resourcetrade.earth trade data is innovative as it produces estimates of embodied resource volumes on each bilateral product flow, as opposed to previous estimates that considered the resources embodied on the overarching transfer of root crops between country of origin and the target country of final consumption (this is also considered in the most recent analysis). The embodied land and water volumes reported are those associated with producing the root crop from which the traded commodity is derived, not with further processing stages. Because calculations are based on the root crop, unlike the embodied carbon dioxide calculations, which relate to the traded product, it is possible to aggregate embodied land areas and water volumes across different products derived from the same root crop. As alluded to above, a number of assumptions are required to permit global analysis of national-level data:

- Export commodities are sourced evenly throughout the exporting country;
- For calculation of re-exported crops there is no differentiation between imported and domestically-produced crop products;
- Trades that have more than one intermediary between source and target can be neglected. (This assumption is consistent with the MacDonald *et al.* (2015) and Kastner *et al.* (2011) methods);
- All commodities from a given root crop are fungible. For example, if the US exports soy cake to the UK and the UK only exports soybeans to France; the soy cake is considered part of the total soy volume that can be exported from the UK. In other words, there is no tracking of which commodities can be converted into which other commodities;
- Commodities for which FAOSTAT only reports a single value for wet and dried production are excluded.



Flows illustrated are those between the 10 largest producer- and consumer-nations of embodied land in global trade in non-livestock agriculture. This is 32 per cent of the total embodied land traded. Source: resourcetrade.earth

([27]) https://doi.org/10.1016/j.ecolecon.2014.05.006
([28]) http://dx.doi.org/10.1016/j.ecolecon.2011.01.012

DATA INNOVATION OPPORTUNITIES

Innovations in data science will continue to significantly affect the quality and real-world applicability of analytic techniques. Real-time or high temporal resolution (as well as high spatial resolution) remote sensing of environmental outcomes (such as those employed by World Resources Institute's Global Forest Watch[29] and the EU's Copernicus programme[30]) may be combined with higher temporal resolution commodity trade data (e.g. weekly or real-time tracking of cargos as opposed to more temporally aggregated data). Developments in blockchain technologies promise a dramatic improvement in supply chain transparency and traceability, which could make the origins and chain of custody of goods irrefutable and significantly augment our ability to ascribe environmental impacts to discrete products and supply chain actors. Consumers may one day have access to the actual, product-specific, environmental and social footprints of the items they are sold, which could exert greater influence over their consumption choices than today's limited information using aggregate estimates and certification schema.

In this evolving landscape, official data providers and statistical agencies have a role to play in setting open data standards and transparency protocols, in providing quality assurance, and in harnessing and integrating data from disparate sources with more traditional official statistics. Increasing demand for data that are less laggy, more reliable, and higher resolution, means providers will have to consider how current official statistics release cycles can be shortened and augmented with new data sources that are policy-relevant and provide enhanced decision support without sacrificing data integrity.

CONCLUSIONS

Over the coming decades the nature of resource trade will become subject to ever-more scrutiny. As climate change alters the geographic distribution and economic availability of some resources, new patterns and trading relationships will emerge and international trade will increasingly be required to substitute ecologically inefficient resource-uses with those with more benign ecological footprints. Areas of relative resource scarcity may become increasingly dependent on the transfer of natural capital from more abundant areas, especially as the decreasing accessibility and increasing cost of resource inputs progressively constrain future production. Concerted efforts to improve resource efficiency and address climate change could, according to UNEP analysis, reduce extraction by as much as 28 per cent relative to the 2050 baseline, and cut greenhouse gasemissions by 60 per cent relative to 2015 levels[31]. This will require significantly more efficient use of primary raw materials and increasingly replacing them with secondary raw materials - those that are reused or recycled after their initial use, for example scrap metals, spent plastics, and biomass.

To effectively serve and scrutinise dematerialisation efforts, continued innovation in the quality and transparency of embodied environmental data will be required. Here we have briefly sketched three approaches to this nascent field. The most appropriate approach in any given circumstance will continue to depend on the circumstances in which they are being deployed and the decisions they are informing. For example, the most appropriate tool to support investment decisions with regard to company-specific deforestation exposure may look very different to that employed to assess the global material footprint, and different again to understanding the global carbon footprint of a specific commodity. As these approaches are developed and refined and as better and more voluminous data become available, official data providers will need to adapt to ensure social, environmental, and economic policy decisions are informed by state of the art data regarding resource trade's hidden but significant footprints.

([29]) http://www.globalforestwatch.org/
([30]) http://www.copernicus.eu/
([31]) UNEP (2016) Resource Efficiency: Potential and Economic Implications. A report of the International Resource Panel. Ekins, P., Hughes, N., et al. Paris: United Nations Environment Programme.

B6 Data for action; data & dissemination; data and decisions

Alexandra Silfverstolpe[*]

Introduction

Data are fundamental for effective decision-making. Without proper knowledge about who is poor and not; how many people know how to read and write, who still lacks basic education; how many women and girls are in need of improved health care; who is still outside the job market: and if public resources are being spent effectively in providing services to the public, policy makers are flying blind. Data could potentially help us see linkages between resources spent, project results and development outcomes. It could help us maximise impact, reduce costs and identify areas where resources could make a difference in people's lives.

Still research shows that often decisions are being made in isolation of evidence and facts. Policy makers tend to make quick decision based on ideology, rather than data and insights. The route between making information available and improving outcomes is not as short as one would imagine. This paper aims to highlight some of the pitfalls along this journey and what can be done to increase the likelihood that data is turned into action and improved development outcomes.

MORE AND BETTER DATA

Over the past decade, there has been a great shift in the world's capacity to produce data to monitor progress and inform action on sustainable development (United Nations, 2014). The monitoring of the Millennium Development Goals (MDGs) lead to an important increase in investment to improve data for monitoring and accountability. As a result, we know more about the state of the world today than we did at the turn of this millennium[(1)].

However, despite this significant progress, huge data and knowledge gaps still remain about some of the biggest challenges we face. Many people and groups still go uncounted[(2)]. The Interagency and Expert Group on the SDG Indicators (IAEG-SDG) assessed the availability of data to track the 241 indicators to monitor the 169 targets under the 17 Global Sustainable Development Goals. The picture is not very promising. Just 42% of all indicators have an established methodology and regularly accessible data, according to the IAEG-SDG[(3)]. And worse, only 25% of all indicators – can be found online in a publicly accessible format[(4)].

In 2013, the United Nations Secretary General's High Level Panel on the Post-2015 Development Agenda called for a 'data revolution' in order to reduce current data gaps[(5)]. The cost and effort required to fill those gaps are however substantial. Morten Jerven, Associate Professor at the School of International Studies at Simon Fraser University, argues that it would cost around $254 billion to fill the gaps to track progress on the sustainable development goals and its 169 targets. It equals almost twice the total annual spent on official development assistance globally and questions if this is justifiable[(6)].

It is possible that the costs and time required to fill current gaps could be reduced by the volumes of new forms and sources of data that

(*) Data Act Lab
(1) http://www.un.org/millenniumgoals/2015_MDG_Report/pdf/MDG%202015%20Summary%20web_english.pdf
(2) http://www.undatarevolution.org/wp-content/uploads/2014/11/A-World-That-Counts.pdf
(3) https://unstats.un.org/sdgs/files/report/2017/secretary-general-sdg-report-2017--EN.pdf
(4) https://www.cgdev.org/blog/sdg-indicators-serious-gaps-abound-data-availability
(5) https://www.un.org/sg/sites/www.un.org.sg/files/files/HLP_P2015_Report.pdf
(6) http://www.copenhagenconsensus.com/sites/default/files/data_assessment_-_jerven.pdf

are being produced – through social media, mobile mapping, geo-sensing and citizens. But it will require a substantial effort and leadership of the global community to overcome the current information deficit. Current data gaps do limit governments' ability to act and to communicate honestly with the public[7] and needs to be addressed. Without publicly accessible data, citizens and external groups cannot keep their governments accountable for their progress in implementing each of the goals[8].

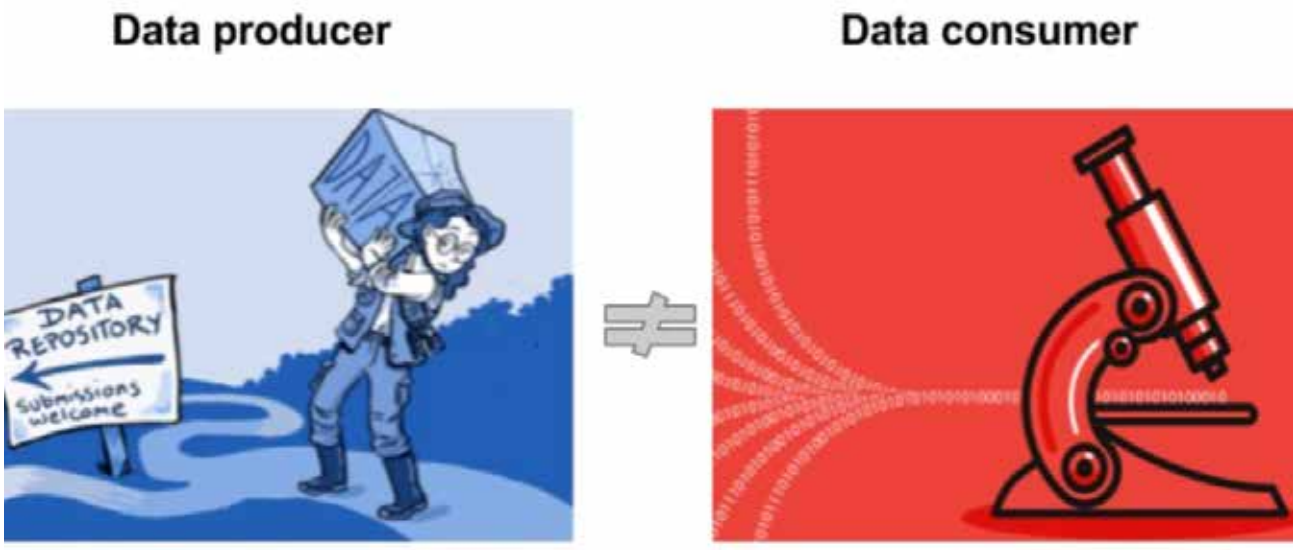
MAKING DATA ACCESSIBLE

The second hurdle to overcome is to make *existing* data accessible. The World Wide Web Foundation assessed in its 2017 report, 1,725 datasets from 15 different sectors across 115 countries and found out that only seven governments include a statement on open data by default in their current policies. Only 7% of the data is fully open. Only half of the datasets is machine-readable and one in four datasets has an open licence. While more data have become available in a machine-readable format and under an open licence over the past years, the number of global truly open datasets remains at a standstill[9].

The power of data to change development outcomes ultimately rests on its ability to *inform policymakers* as they allocate resources, evaluate results, and make course corrections. Unfortunately, this often does not happen, even when data is available and accessible.

"Too often data is presented in ways that cannot be understood by most people", concluded the authors of the report "A World that Counts – Mobilising the Data Revolution for Sustainable Development"[10]. If people do not understand data, they will certainly not act upon it.

The main reason is that there often is a strong disconnect between those that supply data and the potential users of that data. Agencies with a mandate to collect public information are not always well suited to ensuring their information is user-friendly and presented in ways that are easy to understand[11]. As a result data lays idle in databases across national statistical offices, international agencies and research institutions without potential users' awareness of its existence.



(7) A World that Counts
(8) https://www.cgdev.org/blog/sdg-indicators-serious-gaps-abound-data-availability
(9) http://opendatabarometer.org/doc/4thEdition/ODB-4thEdition-GlobalReport.pdf
(10) http://www.undatarevolution.org/wp-content/uploads/2014/11/A-World-That-Counts.pdf
(11) http://www.undatarevolution.org/report/

Unless data producers start to talk to their potential users, we risk ending up creating data graveyards, where data 'goes to die', instead of being used to further global development argues the authors of the recently published report, Avoiding Data Graveyards[12]. Data need to be generated with the end users in mind along the entire continuum of collecting, aggregating, publishing, and interpreting data (Khan and Foti, 2015). Preferably, those in a position to use data to drive action should be part of this process. In order to narrow the gap between the producers of data and their consumers, civil society, media and the private sector could play a critical role as infomediaries turning vast amounts of data into meaning and then package and deliver this information to ordinary citizens and decision-makers in an understandable way.

OVERCOME POLITICAL BARRIERS

Still high quality, accessible data won't have any impact if prospective users lack the confidence and *desire* to use the data. According to Read and Atinc (2016) we tend to believe the world is made up of 'superbureaucrats' who have the time, ability, and incentive to make evidence-informed decisions and the super-citizens who use data to hold service providers accountable for service delivery. The reality is a different story[13].

Under extreme time pressure, many staff feel unable to properly draw lessons from evidence, relying instead on their own past experience. Time pressure is not, of itself, a reason to drop any one activity in favour of another, but it reveals the underlying values placed on different activities, and the most powerful incentives in play[14].

We can bring the data to decision makers, but cannot force them to use it. Efforts to turn data into action will fail if we fail to understand how the policy process works, argues Paul Cairney, professor of politics and public policy at the University of Stirling. In his book, 'The Politics of Evidence Based Policymaking', he urges us to drop two romantic notions: that policymakers will ever think like scientists; and that there is a clearly identifiable point of decision at which scientists can contribute evidence to make a demonstrable impact. Rather than a straightforward 'policy cycle' in which to inject facts and evidence at the point of decision, the policy process is messy and often unpredictable. The same injection of evidence can have no effect, or a major effect depending on timing[15].

([12]) http://aiddata.org/avoiding-data-graveyards-report-download
([13]) Read, L., & Atinc, T. (2016, December 21). From data to learning: the role of social accountability in education systems. [Web log post] Brookings Institution. Retrieved from: https://www.brookings.edu/blog/education-plus-development/2016/12/21/from-data-to-learning-the-role-of-social-accountability-in-education-systems/
([14]) https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/7575.pdf
([15]) https://www.theguardian.com/science/political-science/2016/mar/10/the-politics-of-evidence-based-policymaking

We need to pay more attention to the *demand* for evidence and take more account of lurches of policymaker attention, which is often driven by quick and emotional decisions. There is no point in making the effort to make evidence-based solutions easier to understand if policymakers are no longer interested. Successful advocates recognise the value of emotional appeals and simple stories to draw attention to a problem[16].

GOING THE LAST MILE

Being able to capture someone's attention at the right time is hard. And this is where *good* data visualization comes in. And there are a lot of bad examples around. Thanks to the internet and a growing number of affordable tools, translating information into visuals is nowadays easy and cheap for everyone, regardless of data skills or design skills. Within a few clicks, you can create your own pie chart or line chart. This could potentially be a good thing[17].

However, developing *effective*, yet user-friendly, data-driven communication is hard. Research shows that many data portals and dash boards that were developed over the past 15 - 20 years were not used effectively by policy makers and key stakeholders. The main reason for this is that data systems and solutions have been "monolithic" and have not been designed with the end user in mind[18]. As a result the potential user do not interact with the data and the whole purpose to produce data, for increased transparency and accountability and more effective decision making, is lost.

"Numbers have an important story to tell. They rely on you to give them a clear and convincing voice", data visualization expert Stephen Few argues. "An excellent visualization, according to, Edward Tufte, expresses "complex ideas communicated with clarity, precision and efficiency"[19]. Unless we can improve the communication of insights, we are missing the point. If an insight isn't understood and isn't compelling, no one will act on it and no change will occur[20].

Few forms of communication are as persuasive as a compelling narrative. In order to break through the information overload we should not simply *show* data to the audience, but rather tell a *story* with it.

When I founded Data Act Lab four years ago, I was lucky to have Professor Hans Rosling as my mentor. Rosling managed to bring data to life in an extraordinary manner. Through a combination of motion charts, creativity and a big dose of personal engagement, he mesmerised his audience. In 4 minutes he could sum up otherwise poorly understood economic and demographic data covering 200 hundred years, breaking myths about poverty in the world.

(16) https://www.theguardian.com/science/political-science/2016/mar/10/the-politics-of-evidence-based-policymaking
(17) https://hbr.org/2016/06/visualizations-that-really-work
(18)
(19)https://hbr.org/2013/04/how-to-tell-a-story-with-data
(20) https://www.forbes.com/sites/brentdykes/2016/03/31/data-storytelling-the-essential-data-science-skill-everyone-needs/#2fca03c852ad

His recipe? He made data extremely clear, found the story in the data and presented it in a way that engaged his audience. In doing so key questions needs to be answered (which often are overlooked):

- Understand the questions you want to answer with the data
- Understand the actions and change that you hope the answer will drive
- Understand your target audience - for whom are we creating the visualization and for what?
- Decide what data to use – and what data not to use – be selective
- Explore the data and construct a storyline.
- Merge the narrative with the right visuals

Iterate, iterate, iterate!

Turning data into action, means walking the extra mile. A lot of resources are invested in collecting data, far less is spent on making it understandable.

CONCLUSIONS

The power of data to change development outcomes ultimately rests on its ability to *inform policymakers* as they allocate resources, evaluate results, and make course corrections.

Turning data into action is not an easy task, but necessary. Governments need data for planning and monitoring what they do, and people need data to hold those governments, and other institutions, to account. The challenges ahead to reduce current gaps in data and between data users and consumers are huge. The data revolution could, if managed well, succeed in closing these gaps but it will require political will and global commitment to do so. We need to shift the focus from the supply of data, to the demand side of potential users of the data. Only when properly understanding the needs and behaviours of decision makers, journalists, citizens, parliamentarians and the general public can we in meaningful ways collect and turn those data into important and inspiring insights that can drive action and change.

C Statistics in the digital era

C1 Uncertainty and graphicacy: How should statisticians, journalists, and designers reveal uncertainty in graphics for public consumption?

Alberto Cairo(*)

Introduction

In January 2012, I moved to Florida to teach at the University of Miami. One of the first recommendations I got from local friends was to always pay attention to forecasts during hurricane season.

Hurricane forecasts are often shown to the public with a map tracking the likely path of the storm, surrounding the point estimates with a 'cone of uncertainty' of increasing width, based on a decade of past forecast error. For the sake of clarity and to explain some crucial challenges, I designed a fictional Category 5 hurricane and the corresponding map (**Figure 1**).

Hurricane maps are often accompanied by a caption that says, 'the cone contains the probable path of the storm centre, but does not show the size of the storm. Hazardous conditions can occur outside of the cone'.

Apparently, many people either don't read or don't understand such an explanation. Scientists have described the many ways that common readers misinterpret the map (Broad *et at.*, 2007). For instance, some see the cone of uncertainty as the actual size and scope of the storm, the 'cone of death'(sic). People living in Pensacola who read **Figure 2** might decide to take limited protection measures because they think, wrongly, that they are outside the predicted reach of the hurricane.

Moreover, even if someone familiar with elementary principles of uncertainty, error, and risk interprets the map correctly, there are essential elements that aren't disclosed. The first time I saw a cone of uncertainty, I immediately assumed that it represented a 95% confidence level: I guessed that, based on previous hurricane paths, scientists were telling me that 95 out of

Figure 1: A fictional hurricane and its cone of uncertainty

(*) University of Miami

Figure 2: When presented with the cone of uncertainty, some readers see the boundaries of a storm.

100 times, the path of my namesake hurricane would be within the boundaries of the cone of uncertainty.

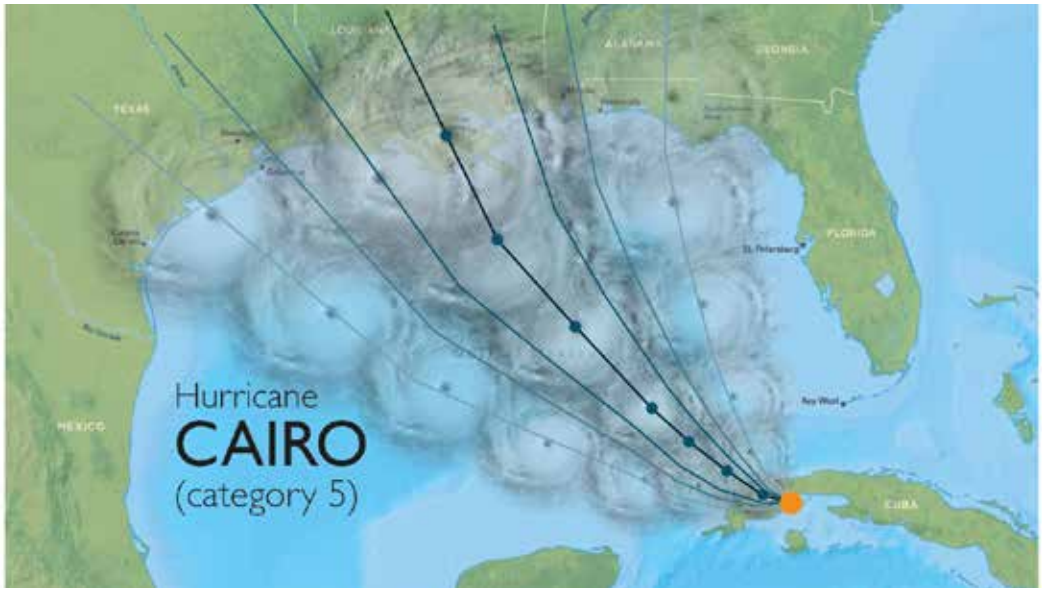
I was shocked when I discovered my mistake. The confidence level of the cone of uncertainty is *just 66%*. Translated to language that normal human beings like me can understand, this means that 1 out of 3 times the path of the hurricane could be outside of the cone. That's a lot. I can't help but connect this 1/3 forecast to Donald Trump's victory in the 2016 presidential election. Many models had given him exactly that chance (others gave him 15%, which is also quite high, roughly like rolling any single number on a 6-sided dice), but many Americans were surprised anyway.

I began thinking about how we could better convey the uncertainty without using the cone. **Figure 3** is based on a series of lines showing different possible paths, coloured with a darker-lighter gradient proportional to higher and lower probabilities.

Then I realized that this didn't address one of the challenges of the original map: It does show possible paths the hurricane could take, but it doesn't say anything about its possible *diameter*, which is something that can also be estimated. The problem? If we overlay the storm itself over its possible paths, we may experience a strong backfire effect in the form of "scientists know nothing! This thing could go anywhere!" (**Figure**

Figure 3: An alternative map of the hurricane path forecast

Figure 4: Overlaying the possible size of the storm may be more confusing than helpful



4), *even if this is exactly the reality of the forecast model.*

Being incapable of creating anything helpful, I concluded that sometimes it might be better to just communicate a clear message to people, like in **Figure 5**, edited to make it appropriate for audiences of all ages (Saunders and Senkbeil).

THE BIG CONUNDRUM: GRAPHICACY AND UNCERTAINTY

This personal story illustrates the main problem I see in communicating uncertainty to the public, particularly through visual means like charts, graphs, or data maps. On one hand, representing the fuzziness of data is essential, the ethical thing to do for scientists, designers, and journalists. On the other hand, we may be doing it for audiences who don't really grasp what they are seeing, either because they don't understand uncertainty or because they have little knowledge of the grammar and vocabulary of visualization.

They lack 'graphicacy', the term I favour to refer to graphical literacy.

In the past decade, there has been an ongoing debate in the visualization community about the best ways to visualize uncertainty. In a broad overview of the discussion, Bonneau *et.al.* (3) defined uncertainty as the 'lack of information' due to factors like randomness (aleatoric

Figure 5: A clearer message to the public?

uncertainty) or lack of knowledge (epistemic uncertainty) and described three sources of it: the sampling of the data, the models based on it, and the visualization process itself. They then described several popular methods of revealing uncertainty. Being a visualization professional and scholar myself, I'm an advocate for using these methods and inventing others.

However, the second part of the aforementioned problem worries me much more: Most people can't wrap their head around elementary notions of uncertainty and visualization.

MISUNDERSTANDING UNCERTAINTY

On April 28, 2017, Bret Stephens, a conservative writer notorious for his denialist positions on climate change, published his first column in *The New York Times*. It was titled "Climate of Complete Certainty" (4) and its main point was that because all forecast models are faulty, we should hold judgment about what measures to implement now to prepare for a future in which temperatures may be higher and sea levels may rise.

Here's a representative paragraph:

Anyone who has read the 2014 report of the Intergovernmental Panel on Climate Change knows that, while the modest (0.85 degrees Celsius, or about 1.5 degrees Fahrenheit) warming of the earth since 1880 is indisputable, as is the human influence on that warming, much else that passes as accepted fact is really a matter of probabilities. That's especially true of the sophisticated but fallible models and simulations by which scientists attempt to peer into the climate future. To say this isn't to deny science. It's to acknowledge it honestly.

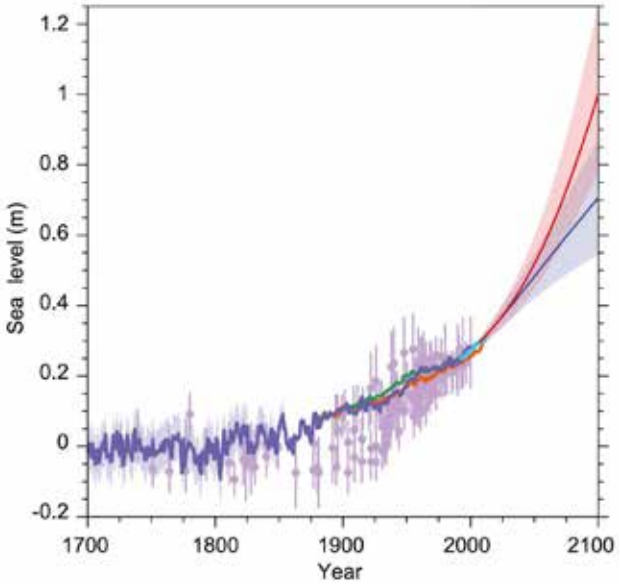
The *Times* received complaints about the first half of this paragraph. Stephens' 'modest' increase of 0.85 degrees in average temperature is likely the largest and fastest – it happened in little more than a century – in the past 10,000 years (Marcott, 2013) (5).

The second half of the paragraph got less attention, though, perhaps because it sounds reasonable to uninformed ears, even being misleading, too. What Stephens conveniently forgot to mention is that, with no exceptions I'm aware of, all models predicting climate change-related variables such as CO2 concentrations, global temperatures, and sea level rise have indeed large degrees of uncertainty, but *they all also point in the same direction*: upward (**Figure 6**). Another convenient omission is that uncertainty cuts both ways: future sea level rise, temperatures, or CO2 emissions could be lower than predicted but, with equal probability, they could be *higher*.

Stephens' column illustrates the fact that a good chunk of the general public – this includes journalists – sees science as either 'indisputable' facts or 'fallible' probabilistic models that aren't better than mere opinions.

That kind of binary thinking is pervasive, and it needs to be addressed at all educational levels: How do we teach people from a younger age that science is *always* a probabilistic work in progress but, as faulty and limited as it is, it's also by far the best set of methods we have to fathom

Figure 6: **Sea level rise according to the IPCC report of 2013. Two scenarios, called RCP8.5 and RCP2.6, are shown in red and blue, with their corresponding uncertainty (66% confidence).**



reality? How do we make the public accept at last that any assertion in science is always imperfect, incomplete, and likely to evolve – but also that a scientific theory is *never* a 'theory' in the common sense of the word, equal to mere 'opinion'?

Sometimes, uncertainty is completely overlooked, even if people are aware of its existence. The following is a case I discuss in one of my books about data visualization (6). On December 19, 2014, the front page of Spanish national newspaper *El País* read "Catalan public opinion swings toward 'no' for independence, says survey" (7).

Historically, the population of Catalonia has been more or less evenly divided between those who want the region to become a new country and those who don't, with a slight majority of the former. For the first time in many years, *El País* said, the 'no' surpassed the 'yes' in the periodical opinion survey conducted by the Centre d'Estudis d'Opinió (CEO), run by the government of Catalonia.

The data, though, revealed a different picture. Out of a random sample of 1,100 people, 45.3% said indeed that they opposed independence, and 44.5% said that they favoured it. However, the margin of error was quite large (+/-2.95), enormous in comparison to the tiny difference between those percentages, so the journalists who wrote that story shouldn't have said that Catalonia swung toward 'no'. All they could have said is that the 'yes' to independence lost support in the past five or six years and that 'yes' and 'no' *were tied*.

MISREPRESENTING UNCERTAINTY

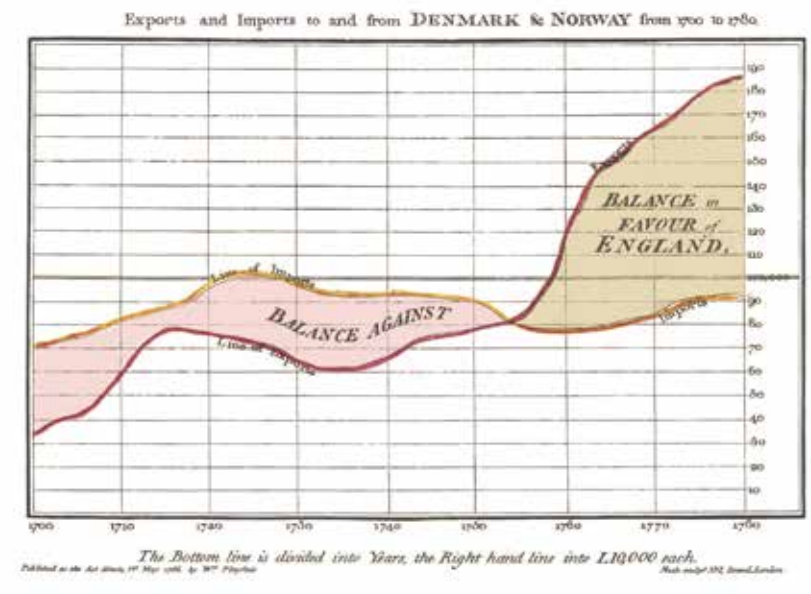
A common misconception about visualization is that it consists of pictures that can be interpreted intuitively. Many believe this because they conceive of visualizations as mere decorative *illustrations* and are used to seeing just bar graphs, time-series line graphs, pie charts, choropleth maps, and proportional symbol maps. They consider them 'easy to read' because they are graphic forms with a history of hundreds of years.

My guess is that the process of widespread adoption of graphic forms follows a trickle-down process: (a) a pioneer invents a way of encoding and showing data, (b) a small community of experts adopts it, (c) eventually the media tentatively tries to use it as well, (d) by being constantly exposed to the new graphic form, the general public begins seeing it as 'intuitive'.

The first maps representing data appeared around the 17th Century (Robinson, 1982) (8), and between 1786 and 1801 William Playfair published his foundational *Commercial and Political Atlas* and *Statistical Breviary*, the first books to systematically use – and explain – visuals such as the time-series line graph, the bar graph, the pie chart, and the bubble chart (Spence, 2006) (9) (**Figure 7**).

Reading graphs and charts is far from intuitive. Visualizations are based on a grammar and an ever-expanding vocabulary (Wilkinson) (10). Decoding them requires at least a basic grasp of their components, such as axes and labels, and their conventions, like the fact that data is mapped onto spatial properties of objects – their height,

Figure 7: A graph from William Playfair's Commercial and Political Atlas, 1786



length, size, angle, or colour. Borrowing from cartographer Mark Monmonier, who has written extensively about visual communication, I like to call this skill 'graphicacy', as a fourth component of a well-rounded education, alongside literacy, articulacy, and numeracy.

Learning to read graphics is, in this sense, akin to learning how to read written language: the first time anyone faced a time-series line graph – a graphic that contemporary middle school students see and draw on a regular basis – she was probably puzzled. That's why Playfair himself, quite wisely, wrote explanations of *how to read* his inventions in his books. He knew people at the time were used to seeing data depicted just as numerical tables.

This is an example of Playfair defending the time-series line graph against potential skeptical readers:

The advantage proposed by this method, is not that of giving a more accurate statement than byFigures, but it is to give a more simple and permanent idea of the gradual progress and comparative amounts, at different periods, by representing to the eye aFigure, the proportions of which correspond with the amount of the sums intended to be expressed.

The vocabulary of visualization has increased mightily since the early data maps and Playfair's books. Michael Friendly talks of a first "Golden Age" of statistical graphics (Friendly) (11), which spanned roughly between 1850 and 1900. This was the time of Florence Nightingale's polar-area diagrams, Charles Joseph Minard's famous maps (**Figure 8**), or Francis Galton's multiple inventions, the scatter plot among them.

According to Friendly, this 'Golden Age' was followed by a 'Dark Age', in which graphics were abandoned by statisticians and researchers as mere ornaments.

I'd argue that a second Golden Age of visualization began in the 1960s and 1970s, with the work of people such as Jacques Bertin, author of *The Semiology of Graphics* (1967), and John W. Tukey, author of *Exploratory Data Analysis* (1977). The timeline on **Figure 9** is a rough summary of these ages.

After five decades, we still live in this second Golden Age. Websites like the Data Visualization Catalogue (http://www.datavizcatalogue.com/) list more than 60 different charts and graphs, and this is with no intention of being comprehensive: Some recent inventions, such as the funnel plot (created in 1984), the lollipop graph (a variation of the bar graph), the horizon graph (a time-series graphic concocted for data sets with high variation), or the cartogram (a data map in which regions are distorted and scale according to variables like population) are missing.

But this second Golden Age has two classes of citizens: experts and the rest of the population. Experts like statisticians, scientists of all kinds, data journalists, business analysts, etc., are reasonably well acquainted with the visualization vocabulary. The general public isn't.

Figure 8: **An 1858 map by Charles Joseph Minard showing cattle sent to Paris from the rest of France.**

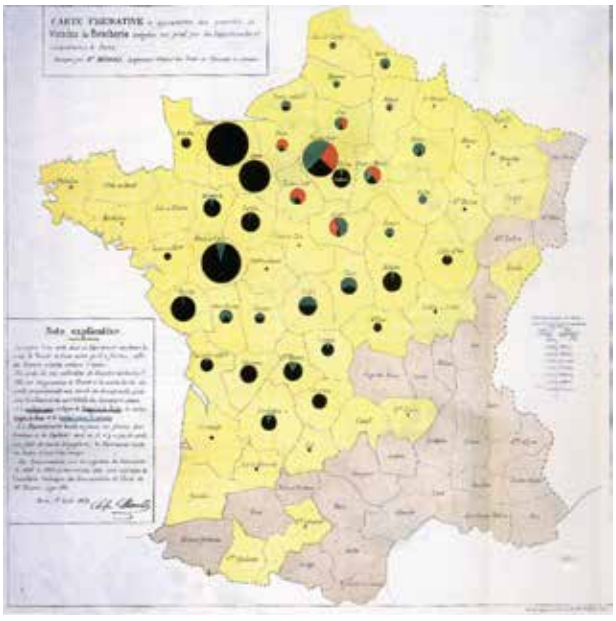
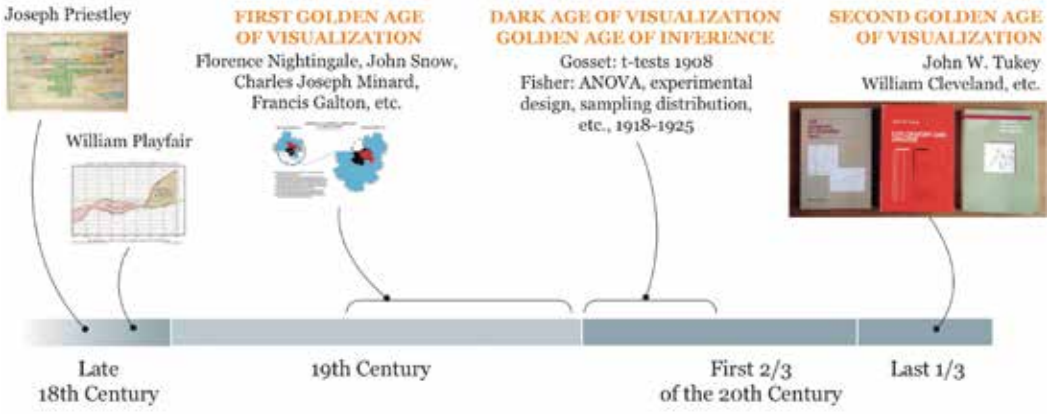


Figure 9: A timeline of the two Golden Ages and the Dark Age of visualization



A survey by the Pew Research Center revealed that around six in ten of American adults could interpret a scatter plot correctly (12). That leaves four out of ten people who have trouble decoding a graphic that has been around at least since Sir Francis Galton decided to display the relationship between head circumference and height (Friendly and Denis) (13) in the context of his studies about heritability and regression. This happened almost *a century and a half ago*, but the ability to read a scatter plot doesn't seem to have trickled down completely yet.

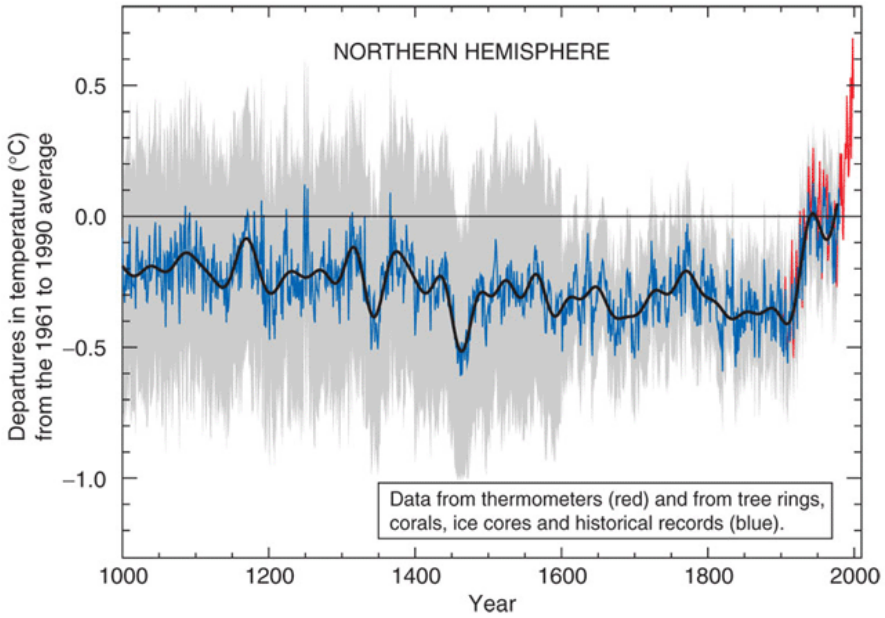
Why is this relevant? Because the methods to represent uncertainty graphically – error bars, gray backgrounds, color gradients, etc. – are much more modern than the scatter plot, so they have had not centuries, *but just a few decades*, to become popularized.

The sixty-year gap between Friendly's first Golden Age (1850-1900) and my proposed second Golden Age (from 1960 on, roughly) is crucial to understand my argument. Friendly's "Dark Age" of statistical graphics (1900-1960) coincided with the golden age of inferential statistics, to which the study of uncertainty is closely tied. As a matter of mere coincidence perhaps, Sir Ronald Fisher was born in 1890 and died in 1962. His *The Design of Experiments* was published in 1935.

This may explain the troubles that people have interpreting bread-and-butter visual depictions of uncertainty like error bars (Correll and Gleicher, 2014) (14) or gray areas behind line charts, like the one on the famous "hockey-stick" chart of average global temperatures between the years 1000 and 2000 (Yoo) (15) (**Figure 10**).

When seeing graphs and charts like this, too many readers don't see standard deviations (two, in the case of the hockey stick chart), confidence

Figure 10: The 'hockey stick' chart, by Michael E. Mann, Raymond S. Bradley, and Malcolm K. Hughes, appeared in the IPCC Third Assessment Report (2001)



intervals, or probability distributions, but an either-or illustration: the "true" – whatever that means – value is inside the error area, with equal chances of being *anywhere* within its boundaries, and no chance that it may lie beyond them.

Are non-specialised readers stupid? No, they aren't. That's *exactly* what these graphics suggest, visually speaking. The only reason some of us know better, and can often (not always) read them properly, may be that we grasp what someone means when discussing uncertainty. We can see *more than what graphics show* because our pre-existing knowledge allows us to.

We may be trying to convey a 20th Century message with 19th Century tools to minds that are stuck in earlier centuries. What to do, then?

WHAT CAN STATISTICIANS, JOURNALISTS, OR DESIGNERS DO TO BETTER CONVEY UNCERTAINTY AND INCREASE GRAPHICACY?

Here are some tentative and preliminary suggestions of what communities interested in the proper depiction of data and evidence can do:

1. Discuss and visualise uncertainty when uncertainty is a crucial component of a truthful and informative message

When is uncertainty informative? It always is, of course. When communicating any message based on data to the general public, it is paramount to be transparent about all sources of uncertainty listed at the beginning of this chapter, regardless of whether they can be quantified or not.

However, the place for this discussion may change depending on the relevance of uncertainty to preserve the truthfulness of the message: If it is essential, it ought to be shown clearly and prominently; if it doesn't affect the message much, it can be relegated to an appendix or footnote.

Go back to the example from *El País* discussed above. Imagine that we displayed the values on a graph. Should we add error bars or any other way of showing the 95% confidence intervals? I believe we should, as only then would readers be able to see how much the "Yes" and the "No" overlap and the fact that the slight difference between the two is likely just due to sampling error, which could be explained textually (**Figure 11**).

Imagine that in the story this graphic belongs to we added a couple of paragraphs like this:

When conducting surveys, researchers randomly select a sample of the population they want to study, 1,100 people in this case. If the sample is correctly designed, it'll be representative of the population as a whole, but never *perfectly* representative. There will always be some level of uncertainty, or 'sampling error', often expressed as "the margin of error at the 95% confidence level is +/-2.95, which we can round to +/- 3."

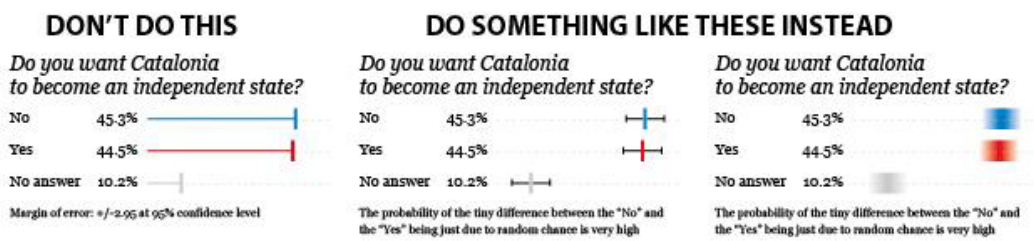
This sounds like a word salad, but it's actually easy to understand: What researchers are telling you is that they estimate that if they could conduct the same survey 100 times with different samples of exactly the same size, in 95 of them the actual percentages for the 'Yes' and the 'no' in the Catalonian population would be between a range of roughly 3 percentage points higher or lower than those 44.5% and 45.3% .

In other words, in 95 surveys out of 100, the 'Yes' is between 41.5% and 47.5%, and the 'No' is between 42.3% and 48.3%. The researchers can't say anything about the other imaginary 5 surveys. In those, the values for 'Yes' and 'No' could be above or beyond those ranges.

As you'll notice in the chart, the difference between the percentages for 'No' and 'Yes' is much smaller than the margin of error. In cases like this, often (not always) the difference may be simply non-existent.

Clunky and cumbersome? Perhaps. It could use some serious editing. But this is exactly what news organisations, which best use data in

Figure 11: Charts showing the uncertainty of El Paìs's story



their reporting, – places like *The New York Times*, FiveThirtyEight, or ProPublica – are doing in their stories. They don't just report point estimates and uncertainty, but *they explain how to interpret them*.

This has two main benefits: First, it fits into the narrative. It's a crucial piece in *El País* story, as sampling error renders the differences almost meaningless. Second, it increases numeracy among the general public. I still remember the first time I grasped concepts like the standard deviation or statistical significance. It was thanks to non-technical explanations in popular outlets, not in textbooks.

Now let's think of the opposite case: Imagine that in *El País* story, the difference between both percentages was much larger and statistically significant, like 45.3% 'No' and 30% 'Yes'. Would visualising the uncertainty or explaining what a margin of error is add anything to the story? I'd argue that not much.

It's in cases like this when we can relegate these elements to a secondary space, like a footnote, an appendix, or a methodology section written in fine print. We ought not to conceal uncertainty completely, but we shouldn't gratuitously let it interfere with the flow of a story or clutter a graph for no good reason.

2. Use modern methods of representation of uncertainty but include little explanations of how to read them and interpret them

During my career as a journalist in Spain, Brazil, and the U.S., one of the objections I've faced more often when trying to employ unusual graphic forms in newspapers or magazines was that "our reader" would have a hard time understanding them.

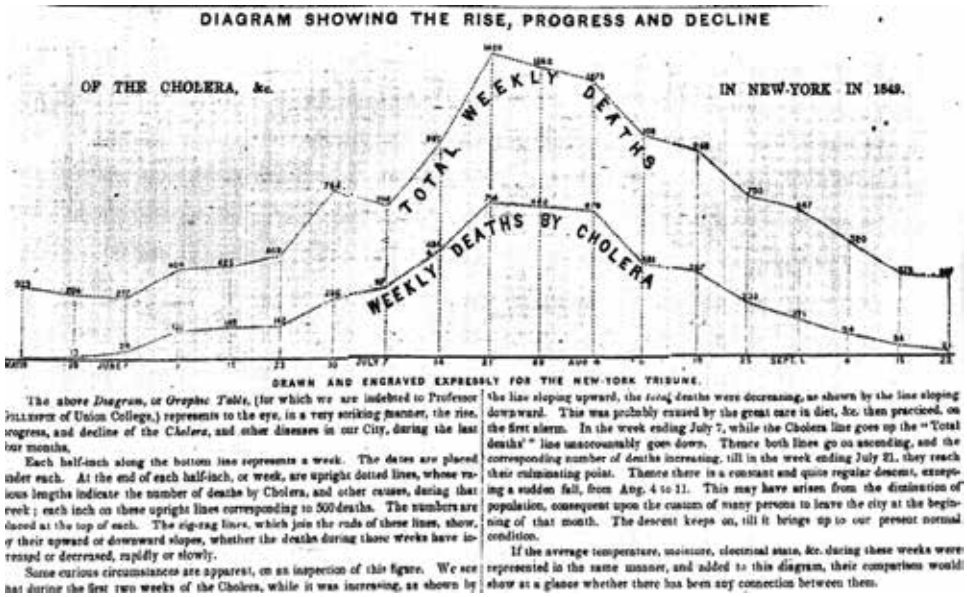
This is a legitimate concern. As discussed above, the first time we see a novel graph, chart, or map, it's unlikely that we'll know how to read it at a glance. Before we can decode a graphic, we need to understand its logic, grammar, and conventions.

William Playfair added written explanations to his graphs, the same way that the anonymous author of **Figure 12**, published in 1849 by *The New York Daily News*, wisely wrote a caption describing exactly what the graph already shows.

Why did the designer feel the need to be that redundant? Because he knew that most of his readers would probably had never seen a time-series graph before. Sometimes, how-to-read explanations can combine textual and visual elements, like on **Figure 13**, a graphic on air quality levels by visualization designer Andy Kriebel.

The same way that explaining uncertainty helps increase numeracy among the public, verbalizing how to read a graph, chart, or map, as redundant as it may sound, can increase graphicacy. The first time readers face a complex-looking new graphic, they will surely feel puzzled but if someone explains it to them, next time they will be able to read it 'intuitively'. This is applicable to methods of representing point estimates and

Figure 12: Source: Scott Klein https://www.propublica.org/nerds/item/infographics-in-the-time-of-choleray



The above *Diagram*, or *Graphic Table*, (for which we are indebted to Professor [illegible] of Union College,) represents to the eye, in a very striking manner, the rise, progress, and decline of the *Cholera*, and other diseases in our City, during the last four months.

Each half-inch along the bottom line represents a week. The dates are placed under each. At the end of each half-inch, or week, are upright dotted lines, whose various lengths indicate the number of deaths by Cholera, and other causes, during that week; each inch on these upright lines corresponding to 500 deaths. The numbers are placed at the top of each. The zig-zag lines, which join the ends of these lines, show, by their upward or downward slopes, whether the deaths during those weeks have increased or decreased, rapidly or slowly.

Some curious circumstances are apparent, on an inspection of this figure. We see that during the first two weeks of the Cholera, while it was increasing, as shown by the line sloping upward, the *total* deaths were decreasing, as shown by the line sloping downward. This was probably caused by the great care in diet, &c. then practiced, on the first alarm. In the week ending July 7, while the Cholera line goes up the "Total deaths" line unaccountably goes down. Thence both lines go on ascending, and the corresponding number of deaths increasing, till in the week ending July 21, they reach their culminating point. Thence there is a constant and quite regular descent, excepting a sudden fall, from Aug. 4 to 11. This may have arisen from the diminution of population, consequent upon the custom of many persons to leave the city at the beginning of that month. The descent keeps on, till it brings up to our present normal condition.

If the average temperature, moisture, electrical state, &c. during these weeks were represented in the same manner, and added to this diagram, their comparison would show at a glance whether there has been any connection between them.

uncertainty, summarized by authors like Pew Research Center's Diana Yoo (**Figure 14-15**). We should use them, but also tell the public what it is that they are seeing.

3. Embrace simplicity

Increasing graphicacy among the public and communicating uncertainty will require scientists and designers to be clear without being simplistic. Conveying complex ideas is always based on a trade-off between simplicity and depth. We can follow Albert Einstein's classic dictum "Everything should be made as simple as possible, but not simpler," which apparently derived from this longer quote:

It can scarcely be denied that the supreme goal of all theory is to make the irreducible basic elements as simple and as few as possible without having to surrender the adequate representation of a single datum of experience.

Einstein was referring to science, but I believe that this can be repurposed as a rule for visual design or written communication: Strive to be concise, but not to the point that the act of reducing complexity compromises the integrity of your message.

In my books, inspired by designer Nigel Holmes, I wrote that I prefer the verb "to clarify" instead of "to simplify", as simplification is commonly equated to gross reduction of complexity. To clarify, sometimes we need to indeed *reduce* the amount of information we show, but very often we need to *increase* it instead, to put data in its proper context. Remember, for instance, how inadequate averages like the mean or the median can be to represent their underlying data sets. If a distribution has a very wide range, or if its shape is skewed or bimodal, an average alone can be a very misleading means to represent it.

In his book *Risk Savvy* (2014) psychologist Gerd Gigerenzer asks us to read the following hypothetical statistics and then infer the probability of your having breast cancer if you test positive in a mammography:

Around 1% of women who are 50 or older have breast cancer.

You are a woman in that age group and you take a mammography that has an effectiveness of 90% if you have cancer.

If you don't have breast cancer, the mammography will still yield a positive result 10% of the time. These are false positives.

You get a positive in the mammography. What is the probability that you have breast cancer?

Go ahead, try to solve that. It's hard, isn't it? Many people say that the probability is 90%, as they stick to the effectiveness of the test alone. Again: Are people stupid? No. The problem isn't them, but the *design* of the message itself. Humans evolved to count things, not to engage in probabilistic reasoning.

Gigerenzer then suggests we use natural frequencies – "a 1 out of 5 chance" rather than

Figure 13: Air quality levels by state, by Andy Kriebely

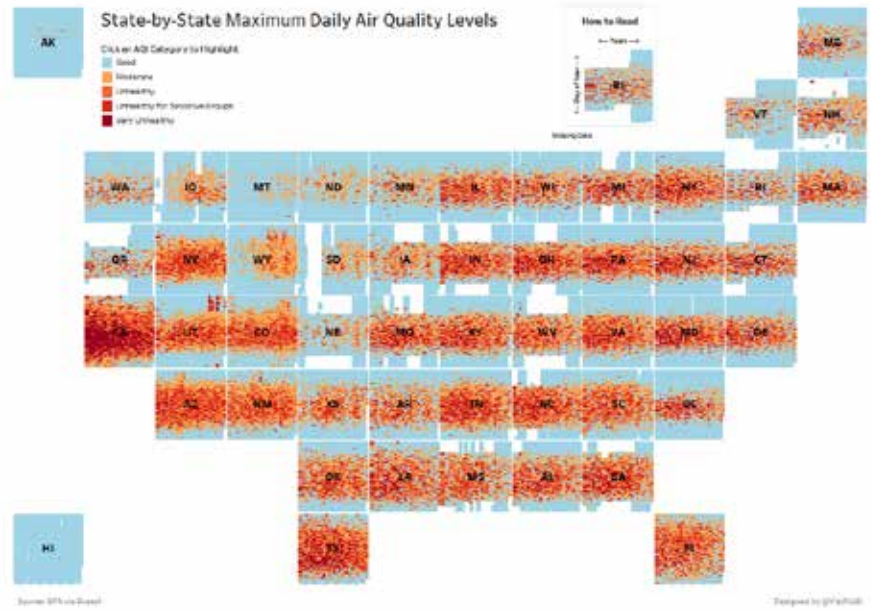
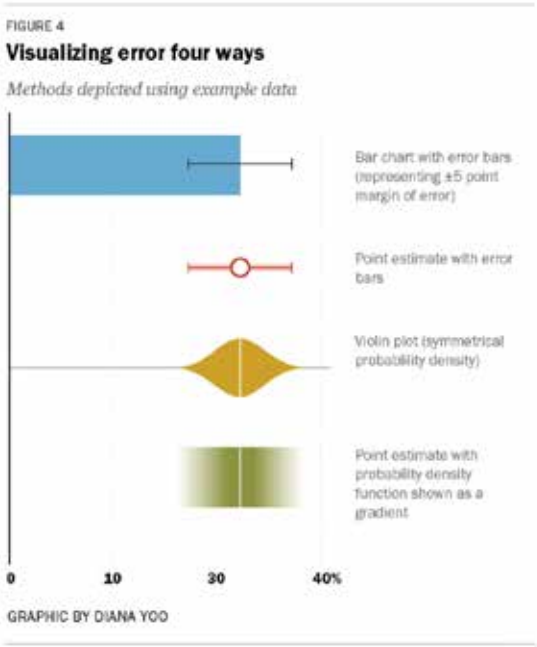


Figure 14: 4 Ways of showing error. Graphic by Diana Yoo



"a 20% chance" – and proposes presenting the same problem translating the percentages above into counts. In parentheses below I put the original percentages:

In any group of 1,000 women 50 or older, roughly 10 have breast cancer, and 990 don't (prevalence is 1%).

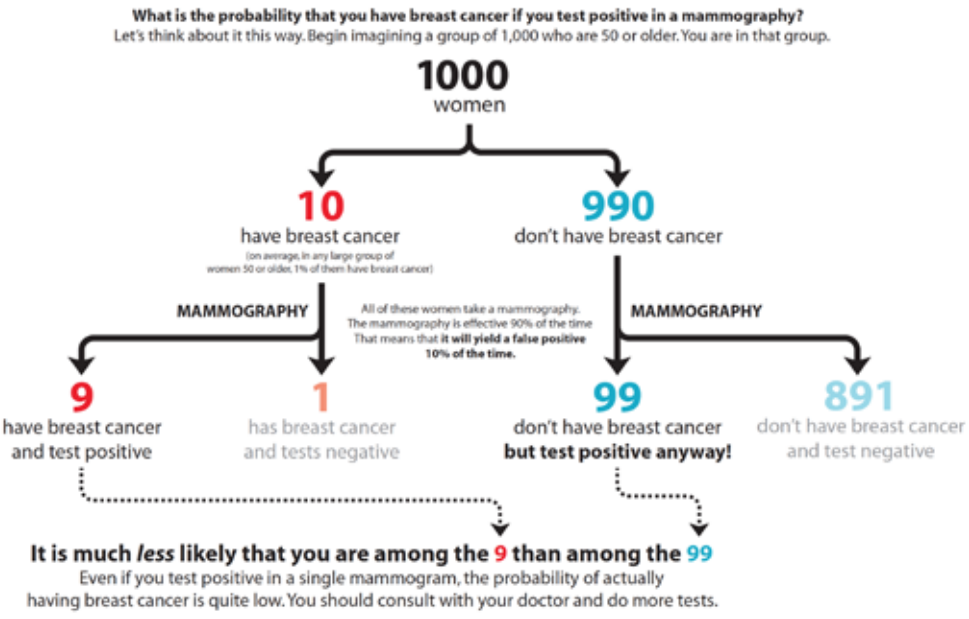
Of the 10 who do have breast cancer, 9 will get a positive in a mammography, and one will test negative (this is the 90% effectiveness of the test).

Of the 990 who don't have breast cancer, 99 *will also* test positive anyway (10% of tests are false positives).

It is much more likely that you are among the 99 who tested positive *without having cancer* than among the 9 who also tested positive and *have* cancer. The probability of your having cancer even after getting a positive in a test is quite low: 9 out of 108 (this 108 is the result of adding up all women who tested positive, both those who *do have* cancer and those who *don't*).

Both messages require readers to pay attention,

Figure 15: Based on "Visualizing Uncertainty About the Future" by David Spiegelhalter, Mike Pearson, and Ian Short: http://science.sciencemag.org/content/333/6048/1393



but the second one is more attuned to what normal human brains can do, particularly if we do it graphically, as in **Figure 15**. The most effective messages are often those that combine the verbal – someone *explaining* the information to you with patience and care – and the visual, an aid that takes care of part of the mental effort of picturing all thoseFigures and memorizing them. A visualisation, after all, is a tool that expands both our perception and our cognition (Spiegelhalter *et al.*) (16). Take advantage of it.

Acknowledgements

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- Many authors are working on new methods to address this challenge. See, for instance "Perceptions of hurricane hazards in the mid-Atlantic region" by Michelle E. Saunders and Jason C. Senkbeil: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKEwiYzv73xe3UAhWhwVQKHQ_gA0cQFggoMAA&url=http%3A%2F%2Fonlinelibrary.wiley.com%2Fdoi%2F10.1002%2Fmet.1611%2Fpdf&usg=AFQjCNEkLbEYNw2u1zh4o-EdJ6QHpjjcfw
- A good Introduction is "Overview and State-of-the-Art of Uncertainty Visualization": http://www.sci.utah.edu/publications/Bon2014a/Overview-Uncertainty-Visualization-2015.pdf
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- The diagram is based on "Visualizing uncertainty about the future" by David Spiegelhalter, Mike Pearson, and Ian Short: http://science.sciencemag.org/content/333/6048/1393

C2

Stakeholder involvement in the statistical value chain: Bridging the gap between citizens and official statistics

Corine Eyraud[(*)]

Introduction

One of the starting points of our round table was the citizens' growing suspicion vis-à-vis the official statistics, suspicion which would be in line with our 'post-truth' and anti-intellectualist era. It is not sure that this scepticism is a new and growing phenomenon among the citizens, but what is quite sure is that the distrust with regard to expertise is more and more developed by politicians all over the world and more and more mediatised. It can be acknowledged that statistics have regularly been used by politicians or managers (from public and private sectors) to mislead people, to justify political and economic decisions pretending them to be evidence-based, or to make them so difficult to understand that non-expert people will not be able to question the choices and decisions which are made. Hence, statistics have been part of the system of domination. The first thing to do to bridge the gap between citizens and statistics will be to stop using them in that way and for that kind of purpose. However, this is far beyond the control of the official statistics in themselves. This paper, based on the works on quantification done by French social scientists, discusses what Eurostat is able to do to reduce this gap.

STAKEHOLDERS INVOLVEMENT IN THE DESIGN PROCESS: TOWARDS A CO-CONSTRUCTION APPROACH

From its beginning[(1)], Sociology has been using statistics to analyse and understand society. However, till very recently, very few studies have questioned theFigures they used, as if theseFigures were simply measuring a pre-existing reality. To prevent this 'realist epistemology', Alain Desrosières, who is the founder of a new way of thinking about statistics[(2)], proposed to talk not about 'measurement" but about "quantifying process': 'The use of the verb 'to measure' is misleading because it overshadows the conventions at the foundation of quantification. The verb 'quantify', in its transitive form ('make into a number', 'put a Figure on', 'numericize'), presupposes that a series of prior equivalence conventions has been developed and made explicit [. . .]. Measurement, strictly understood, comes afterwards [. . .]. From this viewpoint, quantification splits into two moments: convention and measurement'. (Desrosières 2008a, p. 10-11). The first part of this paper will focus on that convention moment and will examine its implications for the design process of official statistics.

STATISTICS, DEFINITIONS, VALUES AND LOCAL REALITIES

Statistics are based on a definition of the population expected to be counted or a definition of the phenomena planned to be measured. These definitions are the bedrock of the conventions mentioned above, and they have been built through a social and historical process[(3)]. The works of the Stiglitz Commission have, for example, showed that GDP is based on a very restricted conception of wealth. While it accurately captures the growth or contraction of the overall economy, it is a crude tool for describing social health and for grasping

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(1) See for example E. Durkheim, Le Suicide, Paris, Félix Alcan, 1897.
(2) Most of his papers are gathered in two books: Pour une sociologie historique de la quantification, Paris, Presses de l'École des mines, 2008a, et Gouverner par les nombres, Paris, Presses de l'École des mines, 2008b.
(3) C. Eyraud, Les données chiffrées en sciences sociales, Paris, A. Colin, 2008.

environmental issues. GDP was particularly relevant when environment did not seem to be such an important issue and when economic growth was quite in line with social progress. But nowadays alternative indicators seem to be needed and new conventions are emerging.

This can be briefly illustrated by two other examples from the Europe 2020 strategy. One of the headline indicators is the employment rate for the age group 20 to 64; this rate was of 70.3% in 2008, the target for 2020 is to increase it at least to 75%. But what is 'employment'? 'Persons in employment are those who, during the reference week, did any work for pay or profit, or were not working but had a job from which they were temporarily absent. 'Work' means any work for pay or profit during the reference week, even for as little as one hour[4]. It is a very extensive conception of what a job is. Many people would not consider they have a job because they have worked one hour during some week. The age limits are also part of the conventions. The possibility of raising the upper age limit has been considered in 2009-2010 during the setting process of a new overall employment rate target for 2020: 'Consideration was given to possibly extending the upper age range slightly, by one or two years (e.g. to 65 or 66 years), (…) to reinforce the policy message of the importance of active ageing[5].

This example clearly shows that statistics are built on a specific conception of the phenomena referred to, and are the bearer of choices for society and hence of values. Choosing and designing indicators are not at all technical decisions but very political issues. It is the reason why the involvement of a wide range of stakeholders, within the EU's institutions (including the Parliament) and beyond, is so important. All the more so as statistics are not inert objects; statistics can act, in the sense that social actors partly orient their action in relation to them[6].

The last example will show the importance of including stakeholders from 'civil society'. Poverty reduction is a key policy component of the Europe 2020 strategy. The poverty strategy target is monitored with the headline indicator 'people at risk of poverty or social exclusion'. This indicator is based on a multidimensional concept, incorporating three sub-indicators on monetary poverty ('People at risk of poverty after social transfers'), material deprivation ('Severely materially deprived people') and low work intensity ('People living in households with very low work intensity')[7]. Although proclaimed as multidimensional, this concept of poverty is mainly based on material and economic criteria. Some immaterial poverties are not considered, for example the lack of education or the insufficient schooling. Furthermore, even if some immaterial goods like education were taken into account, the perspective would still be based on resources and lacks of these resources. Amartya Sen's works have questioned this conception of poverty that ignores the conditions for one to be able to convert resources into capabilities[8]. For example, in order to have a capability/capacity to vote, citizens first need some 'functionings'. These 'functionings' can range from the very broad, such as the availability of education, to the very specific, such as transportation to the polls. Who knows what are the most significant problems for 'poor people' and what are the barriers and impediments to the transformation of their rights into real capacities? The people who have experienced these barriers and impediments directly (people who are living or have lived in poor conditions) or indirectly (people who work with people who are living in poor conditions, especially people from NGOs, or people who are doing research and especially qualitative research, that is the social scientists working on the domain).

As Robert Salais puts it, the conventions underlying statistics are profoundly marked by historical, institutional and national idiosyncrasies. (…) This dimension is completely neglected when doing international comparisons[9], and, I will add, when designing indicators down to their minor details. Statistics are about social reality; it is what is expected from them. To construct them relevantly, local knowledge is

(4) Eurostat, Smarter, greener, more inclusive? Indicators to support the Europe 2020 Strategy, 2015 Edition, p.28.
(5) J. Medeiros & P. Minty, Analytical support in the setting of EU employment rate targets for 2020, Working Paper 1/2012, Brussels: European Commission (Directorate-General for Employment, Social Affairs & Inclusion), 2012, p. 15.
(6) Desrosières analysed these "retroaction" phenomena especially in his last writings, brought together in a book published posthumously: Prouver et gouverner. Une analyse politique des statistiques publiques, Paris, La Découverte, 2014.
(7) Eurostat, op. cit., p. 136-145.
(8) A. Sen, Commodities and Capabilities (1st ed.). New York, NY: North-Holland Sole distributors for the U.S.A. and Canada, Elsevier Science Publishing Co, 1985; (2004), "Capability and well-being", in Nussbaum, Martha; Sen, Amartya, The quality of life, New York: Routledge, pp. 30–53; "Equality of what?", in MacMurrin, Sterling M., The Tanner lectures on human values, 4 (2nd ed.), Cambridge: Cambridge University Press, 2010, pp. 195–220.
(9) R. Salais, "On the Correct (and Incorrect) Use of Indicators in Public Action", Comparative Labor Law & Policy Journal, vol. 27, 2006, p. 237-256 (quotation from p. 238).

needed. This can be clearly seen in the case of the discussions between the French Treasury and the Ministry of Education about the delimitations of the indicator measuring the results of doctoral studies[10]. The two ministries agreed on measuring this result using the rate of PhD students defending their thesis within 3 years. But the Treasury planned to calculate it strictly confining it to three academic years, so from the 1st September of year n to the 31st August of year n+3. They were unaware that, in France, a great majority of PhD viva take place from October to December. The Ministry of Education hence proposed to calculate the rate from the 1st September of year n to the 31st December of year n+3. The proposition of the Treasury would have reduced the result by more than 20 percentage points for irrelevant reasons[11].

HOW TO DO IT?

Including stakeholders in the design of indicators is a demanding process. It can only be organised through working groups on specific issues, such as migrations, poverty, employment and unemployment. The basic idea is to bring together representatives of Eurostat's relevant directorates and units, representatives of EU's relevant DGs and committees (Employment Committee, Social Protection Committee) and of their indicators sub-groups, European MPs, NGO's and/or (depending on the subjects) trade unions' representatives (possibly chosen through the European Economic and Social Committee), and some academics experts on the field[12]. The meetings minutes of the working groups should be, at least, publicised. NGOs and trade unions could be involved in working with people who have experienced the phenomenon that is to be analysed: poverty, migration, unemployment; as the European Anti Poverty Network (EAPN), including for example the European Federation of National Organisations Working with the Homeless (FEANTSA) and ATD Fourth World, sponsored by the European Commission, tried to do at the European Economic and Social Committee in 2002[13]. The working groups could work on different scenarios, proposing to European political levels different indicators potentially differently designed, since, as was pointed out earlier, choosing and designing indicators are highly political issues.

Building statistics in this way would allow official statistics to be both recognised and relevant, be meaningful to people, and help to bridge the gap between citizens and statistics. The people working in NGOs and trade unions and the academics doing research on the field are particularly aware of emerging problems and phenomena. Involving them in the process is therefore a way of keeping official statistics relevant to social reality and useful for public policies.

STAKEHOLDERS INVOLVEMENT IN THE COMMUNICATION AND DISSEMINATION PROCESS

COMMUNICATION: PUBLISHING AN EASY-TO-READ SERIES TRANSLATED IN ALL EUROPEAN LANGUAGES

Most of the documents using statistics in a rigorous and meticulous way are very complicated to understand. Alongside with complex and comprehensive documents and reports, Eurostat could present accessible format, brief (6 pages?) and easy-to-read analysis on some important issues (migrations, poverty, employment and unemployment, education, etc.). These documents should be publicised in all European languages and put on the most visible webpages. Eurostat provides the series of 'Statistics explained' which are very useful, but which are still complicated, quite technical and available either in three languages (English, French and German) or, for most of them, only in English; their translation into all European languages is a crucial issue. There is also a scope for improving their comprehensibility; as experts on statistics cannot possess every talents, the production of these documents could be given to external services or Eurostat could try to develop teaching and pedagogy skills internally. Finally, groups of users and stakeholders

([10]) I analysed the controversies between these two ministries during the designing process of performance indicators for higher education and research in : C. Eyraud, « Reforming under Pressure : Governing and Funding French Higher Education by Performance Indicators (2006-2012) », in Mattéi P. (Ed.), University Adaptation in Difficult Economic Times, Oxford University Press, 2014, p. 75-88; "Archeology of a Quantification Device. Quantification, Policies and Politics" in Mennicken A. and Salais R., Power through Numbers. Quantification and Democracy, Oxford University Press, Forthcoming.

([11]) This example also shows the absolute need, if one wants to understand statisticalFigures, to go into details of definitions, delimitations and methods of calculation (Eyraud, 2008). It is one of the reasons why international comparisons using statistical data are so difficult to handle properly.

([12]) The working groups of the Conseil National de l'Information statistique (CNIS) have been in France very efficient for producing relevant statistics and knowledge on, for example, poor housing and homelessness issues.

([13]) Revue Quart Monde. Dossiers et documents, n°10, 2002 :http://www.editionsquartmonde.org/rqm/sommaire.php?id=4365

could be involved in a positive critique of the documents produced to check and improve their understandability. The documents could also be produced by the working groups in charge of designing the indicators, as users and stakeholders are already included in them.

These documents should explain the conventions which the statistics are based on, showing that different conceptions of the phenomenon would be possible. They also should clearly explain the strengths and weaknesses of the statistics used, their limits and the challenges of interpreting them[14] especially in a cross-national perspective. It is about improving pedagogy, including that of international comparisons. By clearly explaining all this, one appeals to the intelligence of citizens, empowering them, strengthening their confidence in official statistics and developing their acceptance of complexity.

IMPROVING STATISTICAL LITERACY

This is the last issue to complete the process of production and dissemination of official statistics. I will be very brief on that, since several other papers deal with the subject. It could be done by building on and supporting current programs, initiatives and networks as the International Statistical Literacy Project (ISLP) initiated by the International Association for Statistical Education (IASE), as the Steering Group on Statistical Dissemination and Communication of the United Nations Economic Commission for Europe (UNECE), and obviously by building on the project for Digital communication, User analytics and Innovative products (DIGICOM).

([14]) For example explaining that an increase in the number of accidents at work may mean an increase of accidents at work reported (which is quite positive) rather than an increase of accidents at work which really happened.

C3 The future role of official statistics[(1)]

Walter J. Radermacher[(*)]

Introduction

In recent years, the quantity of digital data created, stored and processed in the world has grown exponentially. The demand for statistical information has never been so apparent. In order for Official Statistics to continue to function as a universal language for all kinds of societal interactions and decision-making, it is essential that the product 'information' is fit for purpose. Quality of statistics needs to be seen with a much wider scope, going beyond the side of production, including the use side and analysing scientifically how these two sides are interacting in a dynamic relationship. The main challenges are to position the Official Statistics on the information market and to establish a fruitful cooperation with new partners, in particular from data sciences, which offers opportunities for the use of new 'Big Data' sources. To understand the DNA, the 'Brand Essence' of 'Official Statistics' is a precondition for that.

STATISTICS COUNT

The need for statistics has never been so apparent. Data requests cover a wide range of aspects of society, including relatively new fields such as wellbeing, climate change or the 4.0 economy. The last financial and economic crisis led to stronger economic governance of the European Union and highlighted its need for reliable, trustworthy statistics in order to be successful.

Official Statistics play a fundamental role in modern societies, guiding public policies, supporting business decisions and allowing citizens to assess the progress achieved and compare themselves with their neighbours.

Statistics count more and more: by giving understanding, they allow for more effective action, and they facilitate assessments, which improve how we react. However, the wonderful power of statistical knowledge also has dangers. (Fukuda-Parr, Ely Yamin, and Greenstein 2014).

From a cognitive instrument, which is emancipating and participative, it can turn into a veritable technocratic tyrant which is, to varying degrees, hidden. (Davis et al. 2012) Statistics are and must remain a way to impart knowledge about our societies, an instrument of rationality, a tool to enhance decision-making and effectiveness. In the context of the post-truth politics, they must not be perceived as leaving society behind! Moreover, confronted with data coming from private sources, produced in anonymity and secrecy, without a public scrutiny (Davies 2017), Official Statistics will necessarily have to make their voice heard in post-truth controversies (UK Statistics Authority 2016; Pullinger 2017). They must inspire confidence, not suspicion. They must convince, not pressurise. They must aid, not enslave. They must emancipate, not subjugate. They must reveal, not mislead.

Official Statistics are a marker, a reference point for what we are and where we come from, a compass allowing us to observe, assess and find our bearings. In this sense, official statistics must be considered only as proof, evidence or an indication, and never as an end in themselves, a decision in essence, or an automatic law (decisions to be augmented, not automated). They must clarify and facilitate choice, rather than impose the approach to be taken. They are a policy element, not a policy in themselves (Turnpenny et al. 2015) They must rationalise

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(1) The final version of this paper benefited significantly from comments of Marie Bohatá and Pierre Bischoff

debate rather than instrumentalise it. Yet the temptation is strong and the attraction almost magnetic. Therefore, so as not to lose our bearings, the statistical compass must not be the preserve of technicians. Statisticians must engage with the public and cooperate even more intensively and regularly with the various users and stakeholders, whether they are public or private decision-makers, journalists, researchers or citizens. The aim is to better understand their needs (as users of statistics) and their constraints (as sources of statistics) in order to offer them appropriate information - what they need to know and what it is good to understand - in a suitable manner. To do this, official statisticians must both adopt a new pedagogy and create a real data culture, becoming more flexible and reactive, to ensure that Official Statistics are well received and understood.

This necessary statistical pedagogy must strike a balance between disseminating intelligible messages as widely as possible and adhering strictly to precision, between excessive simplification and needless complexity, between vulgarisation and overly scientific methods and results. It must also clearly draw the boundaries between objective truths and subjective reality.

It is necessary today for statistical work to start examining phenomena from various, wider angles. Official Statistics has been doing this for several years already, particularly as regards the measurement of economic and social progress. (Eurostat 2016; Radermacher 1999) It cannot limit itself only to the angle of Gross Domestic Product (GDP). It must go beyond the essential GDP data, and draw in particular on environmental and social indicators, in terms of quality of life and wellbeing.

This short summary explains the particular role and function that Official Statistics has for policy making (Desrosières 1998; Porter 1995). It also allows us to better understand its mandate, which is wider than the application of statistical methods for social sciences[2]:

- Firstly, Official Statistics provides a public information infrastructure, a system of statistical products, all 'stamped' and certified, thus being able to fulfil the requirement of scientific quality and excellence. European Statistics, as produced by Eurostat with its partners at national level, are independent and based on common principles, standards, methodologies and technologies established in accordance with a professional code of ethics. That is mainly what differentiates them from the other information available online today that purports to be relevant or reliable statistical information.
- A second element of the 'Markenkern' is related to the subjects of observation, which are closely related to policy making and what is called 'society'. 'Variables' like GDP, employment, income or inflation, reflect both in concepts and in reality, highly aggregated artefacts. These variables need to be designed and developed in order to make them quantifiable (Desrosières 2010). The process of design is naturally oriented towards an optimal use of available statistical methods. Nevertheless, these variables contain essential conventions and choices, which – in order to justify their 'authority' - have to be embedded in democratic and participative processes. This set of statistical standards (including the statistical program) is a service that Official Statistics provides for societies.

In summary, it is important to stress that Official Statistics is the outcome of a process that is scientific by nature (thus meeting the essential criteria of science). Official Statistics can be seen as a subcategory of 'scientific data', that more precisely help to understand how the societies functions and evolve. Equally important is however to highlight the fact that the categories and variables used in Official Statistics reflect and represent societal conventions, *"decided upon by a common agreement that aims at creating a common language between the distinct actors."* (Desrosières 2010: 126) and: *'To surpass the great divide between knowledge and politics means to take the tools of knowledge seriously politically."*(Desrosières 2010: 127).

MAKING A DIFFERENCE IN AN OCEAN OF INFORMATION

Zettabytes and yottabytes:

In recent years, the quantity of digital data created, stored and processed in the world has grown exponentially. The world can now be considered as an immense source of data,

(2) As Desrosières explains: "Almost since it origin statistics has had two different but intertwinded meanings: on the one hand denoting quantitative information, collected by the state, ..., and, on the other, mathematical techniques for treatment of and argument over facts based on large numbers…" (Desrosières 2010: 112).

and broad consensus reigns with regard to the wonderful opportunities which the 'Big Data' phenomenon can bring in relation to the statistics acquired from traditional sources such as administrative records and surveys. Much faster and more frequent dissemination of data; responses of greater relevance to the specific requests of users since the gaps left by traditional statistical production are filled; better targeted policies and refinement of existing measures, development of new indicators and the opening of new avenues for research; a substantial reduction in the burden on persons or businesses approached and a decrease in the non-response rate are all possibilities potentially offered by 'Big Data'. Last but not least, access to 'Big Data' could considerably reduce the costs of statistical production, at a time of severe cutbacks in resources and expenditure.

However, the 'Big Data' phenomenon also poses a certain number of challenges: These data are not the result of a statistical production process designed in accordance with standard practice. They do not fit the methodologies, classifications and definitions, and are therefore difficult to harmonise and convey in statistical structures. Complex variables, such as the GDP or the Consumer Price Index aim at quantifying macro-economic indicators (Lehtonen 2015) for the nation as a whole; their substitution by big data sources seems to be out or reach. In addition to this, 'Big Data' raise many major legal issues: security and confidentiality of data, respect for private life, data ownership, sustainability of the access, etc. All of the above means that, at least for now, 'Big Data' can be used only to a limited degree to supplement rather than replace sources of traditional data in certain statistical fields.

Ethics and governance:

In the age of Big Data, Artificial Intelligence and Algorithms a need for ethical guidance and legal frameworks is revitalized under new conditions: "*In the world being opened up by data science and artificial intelligence, a version of the basic principle of the partnership between humans and technology still holds. Be guided by the technology, not ruled by it.*" (Lohr 2016).

What might facilitate the (perceived new) search for orientation and balance is the stock of ethical and governance principles that are available, emerging from two hundred years of history in statistics.

- Firstly, the community of statisticians has agreed on a Declaration of Professional Ethics, which "consists of a statement of Shared Professional Values and a set of Ethical Principles that derive from these values."(ISI 2010) It is the individual professional statistician that is in the focus of the declaration, aiming at giving orientation and protection by setting professional standards.
- Secondly, different Codes of Conduct have been developed for the statistical institutes and authorities. The most influential and politically important ones are the UN Fundamental Principles of Official Statistics (United Nations 2014) and the European Statistics Code of Practice.(Eurostat 2011) The latter one is embedded in European legislation, such as the Treaties (European Commission 2012) (Art 338) and the European Statistics Regulation 223 (Eurostat 2015).

GUIDING PRINCIPLES (RADERMACHER AND BALDACCI 2016):

Statistics is a key for people empowerment:

High-quality statistics strengthen democracy by allowing citizen access to key information that enhances accountability. Access to solid statistics is a fundamental 'right' that permits choices and decision based on information. Without statistics there cannot be a well-grounded and participated democracy. *Statisticians should be aware of the power of data which lies in their transformation of information services for knowledge.*

Open data are fundamental for open societies

Statistics are the cornerstone of public open data. They are the basis of open government. In the EU Open Data Data Portal, Eurostat statistical database accounts for the bulk of data offered. Enhancing access to statistics in open formats enables the free use of data, its interoperability and consumption in integrated modalities. Open statistics as a result allow to make sense of complex phenomena and help in their interpretation without borders and limits.

As such open statistics are key sources of free dialogue in our societies. *Statisticians should ensure open and transparent access to data and metadata and measure their actual use for information and knowledge.*

Datacy is a key enabler for citizens:

Statistical literacy is critical to ensure that individuals can benefit from the power of data

and can make use of open access to statistical information and its associated services. Data literacy is not limited to knowledge of basic statistical information, it entails knowing the limit of statistics and their use/misuse. Capabilities to understand statistics and how they are produced are a fundamental skill for a whole individual and an aware citizen. *Statisticians should proactively invest in datacy capabilities in society at large and measure the results of statistical literacy.*

The future is smart statistics:

The value of data is in the statistical methods which ensure quality services. In the digital ecosystem where data are abundant and a commodity, the value of information is increasingly based on algorithms that generate tailored insights for users. *Statisticians should continue to invest in methods and algorithms that enhance the quality of data for statistical services tailored to users' needs.*

More influence means more responsibilities:

As statistical information is increasingly used for policy decisions, statisticians need to investigate how their services are used, the ethical implications and the impact of evidence use on the policy cycle. *It is a duty of statisticians to explore the link between statistics, science and society and lead intellectual reflections on the possible risk of reliance on data-centrism.*

GOVERNANCE: ACHIEVING GOALS, PREVENTING RISKS

Trust!

This is the main and overarching goal of statistical governance. Once trust in Official Statistics is lost, it takes years or even decades to rebuild it (HM Treasury 1998; Thomas 2007; Sangolt 2010). To sustain the capacity of the statistical authority to provide trustworthy and relevant statistical information is therefore the bottom line of reviews or revisions of existing statistical governance for future improvements. It is also clear that the issue of trust goes much beyond the issue of trust in statistics; ultimately trustworthy statistics (alongside with fundamental rights or civil liberties) are necessary for the society itself to be trustworthy (with trust being at the core of the social contract underpinning human society).

- Independence, Strength, Innovativeness!
- Democratic participation (design process) and control (of the execution)
- National, supranational, international governance have to be consistent

Four dimensions relevant for statistical governance

In the following, a checklist of points reflects the main aspects, which have to be addressed in any informational governance (Soma et al. 2016) for Official Statistics.

WHO: ACTORS AND ROLES

Producers

- **Three roles, possibly merged in one post/person, possibly separated with distinctive mandates**
  - Statistical Authority: political responsibility and accountability
  - Director General / President: personal responsibility for the production process
  - Chief Statistician: coordinator of the statistical system
- **Administrative responsibility and power to overcome resistance/ reluctance by other producers in the system**
- **Place in the political ecosystem concerning reputation, salaries, official rank, title, direct access to political level in administration etc.**
- **Partners**
  - National producers of statistics, national statistical system
  - International producers

Stakeholders

- **Respondents: rights and obligations**
  - Statistical confidentiality, privacy of information
  - (Legal) obligation to respond; a two-sided sword
- **Users**
  - User needs
  - User classification
  - Access to statistical information and statistical (micro-)data according to user classification
  - Civil society-advocacy role

Political participation, decision and control

- **Institutions**
  - Parliament
  - Government

- Audit authorities
- Courts

- **Civil Society - watch dog role**

4.2 WHAT: STATISTICAL PROGRAMME AND PRODUCTS, SERVICES

- Design of statistical products and programme, including participation of stakeholders
- Planning cycles, administrative roles, statistical programme/budget
- Decision, different levels of standardisation with adequate democratic participation
- Accountability, transparency and control of execution concerning programme and budget

4.3 HOW: QUALITY ASSURANCE

- Ethical codes, good governance principles
- Scientific approach at all levels
- Cooperation with and reviews by the peers/ counterparts in the statistical community
- Efficiency criteria
- Principles and guidelines concerning statistical confidentiality and data protection
- Legal basis for collection or (re-)use of individual data

- **Quality Management**
  - Management approaches, e.g. EFQM
  - Quality control, proportional to political impact of statistics (e.g. EDP)
  - Reporting on quality (e.g. Commitment on Confidence in the ESS, quality reports)
  - Communication of quality assurance, branding (e.g. quality declaration of the ESS), labelling

4.4 INTERNATIONAL COOPERATION; STANDARDS; GOVERNANCE

- European Statistics
- UN, OECD, UN-ECE
- IMF, World Bank, Institutions of the UN (e.g. FAO, ILO, UNEP, UNICEF)

CONCLUSIONS: THE FUTURE DATA-INFORMATION-KNOWLEDGE-LANDSCAPE AND OFFICIAL STATISTICS

In essence, the 'salvation' for Official Statistics will continue to come from techniques (problems of tools), ethics (problems of behaviour), and politics (problems of institutional setup or communication).

Under the rapidly changing circumstances, it will however be essential to enable Official Statistics to play their important societal role through appropriate adaptation of the rules, the principles and resources, which frame their working conditions. Questions, which need to be addressed are the following:

- Statistics and data-science in public administration: who is responsible for what?
- Professional values and ethics, revision of the ES Code of Practice,
- Evaluation of the status quo; analysis, gaps, recommendations
  - **a.** Segmentation of statistical products (Indicators, accounts, statistics and their quality profiles), branding, labelling
  - **b.** Ethics for all three key statistical processes: design, production, communication
  - **c.** Ethics for decision makers and policy maker
- Statistical literacy: intensified cooperation between the education system (incl. vocational training) and Official Statistics
- International statistical governance
  - Global Conventions needed, which are going beyond the recommendations of today
- Need for a new regulatory framework on the access to machine-generated data for Official Statistics.

  - Official Statistics has demonstrated an excellent record in playing the role of a trusted authority at the crossroads of three fundamental rights: data protection (a person's right to privacy), freedom of information (a person's right to be governed in an open and transparent manner) and Official Statistics (a person's right to live in an informed society). Ensuring common European Union rules on access to privately-held data for statistical purposes will allow the European Statistical System to successfully continue to play its role in the current challenging times.

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C4 New trends in communication: Branding and content marketing

Sibylle von Oppeln-Bronikowski, Susanne Hagenkort-Rieger and Maria João Santos(*)

Introduction

In the era of data overload, authoritative facts, and the ways in which they are communicated, are becoming increasingly important. The authority and credibility of statistics has become a main issue. Official statistics need to stand out from others as being a guaranty for quality statistics.

Statistical organizations should develop promotion strategies to advertise their strengths, ensuring that they connect effectively and efficiently with their users and building their reputation as providers of trustworthy data. In this article, authors will make the case for statistical offices to make more use of marketing tools to get the brand official statistics known as a trustworthy source of information, getting out the message about the value(1) (quality) of their data by using different communication channels and technics; also by using tools available to bring statistics to life.

BRANDING

To deal with the increasing amounts of data, people need to be more aware about the quality and reliability of data. Quality should become the decisive factor when choosing a data source. That's where official statistics can stand out of the piles and piles of other data. National Statistical Offices (NSOs) produce official statistics and strive for accuracy, reliability and uncompromised objectivity using the best methods, as enshrined in the Fundamental Principles of Official Statistics(2). NSOs should therefore work towards strengthening the brand of "official statistics" vis a vis other data producers by emphasizing the quality aspects of their data (main competitive advantage).

It is thus necessary to clearly explain in the institution's website the quality framework/ guidelines and all the measures that are put in place to ensure the quality of the data. NSOs should make a clear and concise quality statement that summarizes how they implement the Fundamental Principles of Official Statistics, thus guaranteeing the reliability, objectivity and high quality of the products they produce, in distinction from other data providers that do not apply the Fundamental Principles rigorously.

This alone does not convince our users of the quality of our data. In Europe we have put in place the European Statistical System statistics code of practice(3) as a guarantor for quality and have recently adopted a quality declaration(4), these are important cornerstones but we have to transmit these values to our users. This is branding: we have to raise the awareness of our users of the quality of our data and thus improve the trust in our institutions.

COMMUNICATION STRATEGY

Statistical offices have to first internally position themselves on how they would like to be perceived by the users (NSO's key message: you can trust our institution and our data). Second, develop a communication strategy stating the goals to reach. This provides the basic frame for action. Destatis has developed a communication strategy(5) based on 5 pillars: strengthen the

(*) German Federal Statistical Office (DESTATIS)
(1) https://www.unece.org/fileadmin/DAM/stats/documents/ece/ces/2017/CES_4_E_Value_of_official_stats.pdf
(2) https://unstats.un.org/unsd/dnss/gp/FP-New-E.pdf
(3) http://ec.europa.eu/eurostat/web/products-manuals-and-guidelines/-/KS-32-11-955
(4) http://ec.europa.eu/eurostat/documents/64157/4392716/quality-declaration-ESS.pdf
(5) https://www.destatis.de/EN/AboutUs/CommunicationStrategy/CommunicationStrategy.html

brand of 'official statistics', improved access, meet the needs of target groups, expand the dialog and improve understandability. Third, choose a marketing approach.

Which set of marketing and communication methods could we use to distinguish the NSOs and official statistics from competitors and create a lasting impression in the minds of our users?

GETTING THE BRAND KNOWN: 'OPEN COPYRIGHT'

A first step to start to build the brand is to use 'Open Copyright' as an incentive for users to refer to official statistics and by making sure that the source is always present and correctly quoted.

It is important to provide products displaying a clear copyright and that can be used by different media (ready to use graphs, info graphics and interactive maps). The trade mark 'official statistics' should be perceived as a seal of quality for the users increasing the trust in statistical offices institutions and ultimately in their data.

In Germany the trade mark of the NSO refers to 'Statistisches Bundesamt (Destatis)', to make clear that we are talking about a sole institution. In this effort to make their trademark known, Destatis has started to clearly display it in graphs and ready to make tables that can be used by newspapers and magazines and other sources. These ready to use interactive graphs can be used in different internet platforms making the official statistics brand known.

BUILDING THE TRUST IN 'OFFICIAL STATISTICS'

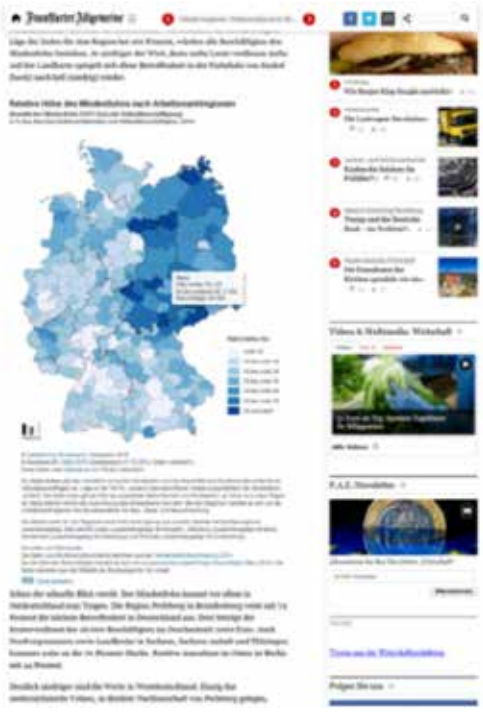
How to make sure that the brand 'official statistics' is associated to high quality statistics and NSOs are considered as trustworthy sources?

In this section we will list some tools that can be used by NSOs to increase trust of users by improving user engagement and user focus. We will illustrate this with examples based in our experience at Destatis.

DATA WITH PERSONAL RELEVANCE FOR USERS

Statistics frequently use concepts that are meaningless to the majority of the persons; these are complex and abstract artifacts that need to be translated to be meaningful to people. An everyday example is the inflation rate – it needs to be disaggregated to be understandable. Users need to find and identify themselves in the data NSOs produce: an average alone is most of the time meaningless. It is necessary to provide the context and to communicate the range so

Figure 1:



http://www.faz.net/aktuell/wirtschaft/arm-und-reich/gehaltsvergleich-ostdeutschland-ist-mindestlohnland-14266207.html

that persons find themselves reflected in the numbers. This increases the trust of the users in the data. Statistical offices need to develop the ability to put themselves in the place of the users.

TRANSPARENCY

Another measure to ensure trust is to be transparent about the methods that the NSOs use and clearly state divergences in numbers.

A recent example of transparent reporting in Destatis was the way we published the differences in the different calculations behind the number of citizens with double citizenship.

Transparently explaining the strengths and weaknesses of particular statistics is an essential part of the communication to users as is providing impartial interpretation of what underlies trends and comparisons.

Figure 2:

„Wir müssen viel daransetzen, dass Menschen nicht nur die Durchschnittswerte wahrnehmen"

Sibylle von Oppeln-Bronikowski, Destatis

Extract WirtschaftsWoche 24.03.2012

Figure 3:

IN FOCUS / 2017-03-16

Holders of dual citizenship: differences between microcensus and population census results

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Against the background of recent developments in Turkey, politicians in Germany are currently debating the issue of dual citizenship again. The results of the microcensus show that roughly 1.8 million people with dual citizenship were living in Germany in 2015.

1.7 million people with dual citizenship were holders of both the German and another foreign citizenship, while 107,000 people had two foreign citizenships. Among the German people with dual citizenship those with a Turkish passport formed the largest group (246,000). They were followed by people from the Russian Federation (228,000) and Poland (220,000).

These results differ widely from the data obtained in the 2011 Census. According to the population census results, the number of people with dual citizenship was roughly 4.3 million on the Census reference day (9 May 2011). Approximately 690,000 people with German citizenship had an additional Polish passport, 570,000 a Russian passport and 530,000 a Turkish passport.

While there is a trend towards undercoverage of people with dual citizenship in the microcensus data, it can be assumed that the relevant number in the population census is too high. Please see the article on "Wie viele Menschen in Deutschland besitzen eine doppelte Staatsbürgerschaft?" for more information on the reasons for these differences.

→ Archive "IN FOCUS"

https://www.destatis.de/EN/FactsFigures/InFocus/Population/DualCitizenshipHolders.html

DIALOG WITH USERS

Statistical offices can also increase trust by engaging in constant dialog with their users, which can take many forms such as showing that their feedback on issues such as new graphics, is taken seriously; all this builds up the trust and enhances the reputation of the institution and ultimately of the data produced. Effective user engagement should be a continuous dialogue, not just a series of one off consultations.

NSOs need to make an extensive analysis of what is being said about them in social media and react when needed. It is necessary to respond to what is being said in the different platforms, show that they are listening and handle important issues in the platforms where the users are active i.e. by going to their meeting place (e.g. Twitter, instagram). Talk with the network and spread the statistical office brand. Actively participate. It is not a question of how many there are, but who they are and of what the NSO has to communicate.

In Destatis we received positive feedback in Twitter after we changed our press releases in order to clearly state the methods and data sources used as a reaction to previous criticism by journalists. This contributes to establishing our brand as an institution that people can trust thus also bringing them to trust our data.

PUBLIC RELATIONS: INFLUENCERS

NSOs can also resort to advertise their message by making use of influencers: identifying individuals that have influence over potential users and orient marketing activities around these influencers. NSOs can resort to having their messages repeated by 'influencers' that have a clear reputation that gives weight to their message and expanding its publicity. In its 2015 annual report, Destatis included an interview with a State Minister:

CONTENT MARKETING- FROM THE GET TO THE TARGETED DELIVERY CULTURE

The majority of the public, however, will never directly consult a statistical office or look to it as a source of news. For most citizens, it was the news media itself – newspapers, radio and television – that provided their exposure to official statistics. As the 'gatekeepers' to the public, the news media gave statistical offices a powerful tool to fulfill a critical part of their mandate. But many statistical offices have already done a step further pursuing a new goal- starting to act as news agents themselves by publishing news themselves via social media channels (e.g. Twitter) or by developing products that can be easily used by the media (e.g. interactive info

Figure 4:

Figure 5:

https://www.destatis.de/EN/AboutUs/OurMission/AnnualReport/AnnualReport2015.pdf?__blob=publicationFile

graphics, videos). Two examples in this domain are the case of Netherland's[6] and Mexico's Statistical offices[7] both producing videos for the media.

Still the extent to which statistical offices can collaborate with the news media, and communicate effectively through them, has an enormous impact on how well they can inform the general population. A good example is the relation that the UK Statistical Office (ONS) has developed with BBC. The BBC has recently commissioned an independent study 'Making sense of statistics[8] to analyze how statistics are being reported, it concludes by highlighting the importance of data journalists for successful communication. Destatis has for instance held recently a special workshop for data journalists.

CONTENT MARKETING

Destatis has also started take its first steps in another front in the efforts to establish their brand through content marketing. This is a new trend in leading German enterprises like Daimler[9] and Telekom[10] as well. At Destatis this is done by using software to research which topics are being discussed in different websites, which ones have a high relevance and in which statistics are not well represented, and analyze how to bring statistics into these sites. It can be through making new statistical contents available or just by making aware to the website owner of already existing products, highlighting the advantages of having this statistical information. When this happens we have succeeded in our marketing campaign.

This is associated to a change in our institutional culture, it is no longer enough to produce statistical products that answers to user needs and wait for them to come and get it from our website; we need to place this products in the relevant platforms and formats to increase the impact.

STATISTICAL LITERACY

In view to produce high quality statistics and to communicate with users, the promotion of statistical literacy and culture, as basic pillar of statistics use in the benefit of citizens and of the

(6) https://www.cbs.nl/en-gb
(7) http://en.www.inegi.org.mx/
(8) http://downloads.bbc.co.uk/bbctrust/assets/files/pdf/our_work/stats_impartiality/report.pdf
(9) https://www.destatis.de/DE/PresseService/StatistikCampus/ELearning/Module/Modul14/MittelwerteDurchschnitte.html
(10) https://sustainabledevelopment.un.org/post2015/transformingourworld

Figure 6:

https://www.destatis.de/DE/Meta/Gebaerdensprache/Gebaerdensprache_.html

society is highly important and constitutes a major task of the statistical institutions. There is a need for enhancing statistical literacy among all segments of current and potential users.

A statistical culture, promoted by the national statistical institutions among the large public should lead to a diminution of misunderstandings and to an increased capability of properly catching the significance and meaning of statistical information, of analyzing and using the data provided to the public.

Destatis has invested in visualization tools, invested in e-learning modules aiming to improve statistical literacy; one of the more useful is the module that helps to avoid the common pitfalls of statistical interpretation[11]. Whilst enhancing the statistical literacy of user these measures also contribute to increase trust.

Finally and to make use of the Agenda 2030 motto, we need as NSOs to leave no one behind thus effectively reaching all users: in Destatis this is also done by having contents in sign language. This increases our understandability, increases trust and establishes our brand.

CONCLUSIONS

Statistical offices main message: their reliability based on quality data and transparent methods should be conveyed through an effective communication strategy thus building a specific brand. To this end, NSOs can resort to marketing techniques, production of statistical products tailored to users' needs, measures to increase statistical literacy and by being transparent. This is of strategic importance for increasing the appreciation of official statistics, leading users to perceive the statistical offices as trustworthy.

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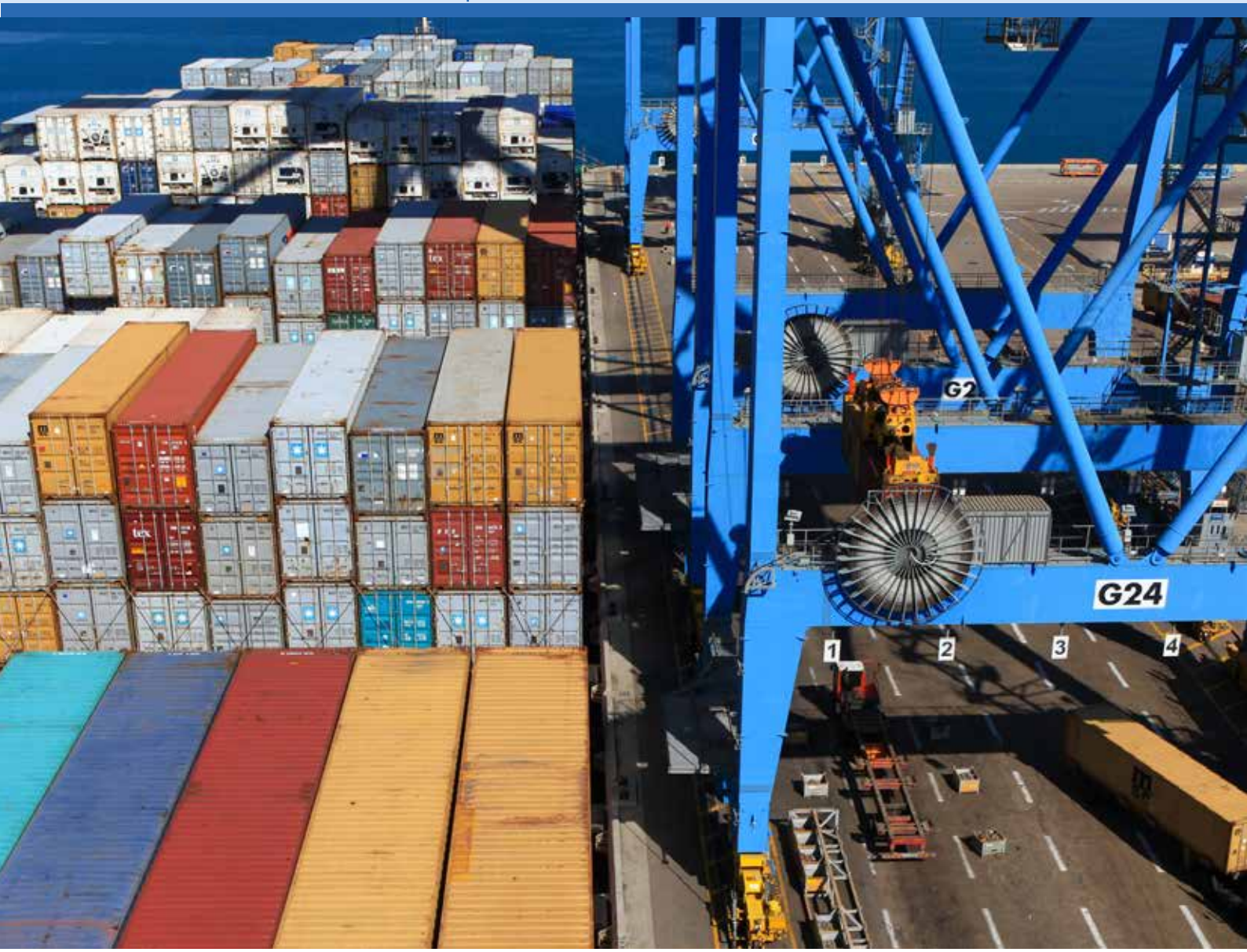
D Depicting globalisation



D1 New data sources and the integration of existing data

Jyrki Ali-Yrkkö(*)

Introduction

Globalization and digitalization have challenged a number of phenomena that were previously well described by national statistics. Notwithstanding statistical offices have responded these challenges by collecting new data, there exists trends that are not yet comprehensively captured.

There exists several means that can be used to respond the statistical challenges raised by globalization and digitalization. In some cases, national statistical authorities have to collect new data by using surveys and other traditional types of methods but there exists also other ways such as new and previously unused data sources as well as the integration of existing data to generate new information and insights.

In this paper, I highlight some new data needs and also alternatives to respond these requirements.

NEW DATA SOURCES

E-commerce and trade of digital services

Consumers are buying an increasing amount of goods and services from online shops. The ever growing share is potentially purchased from international or global e-shops, and consumers don't even know from where their orders are delivered. This is a fundamental change because previously the retail business has been completely local business with local competition. As a result of international e-commerce, this competition has suddenly transformed to global.

In most countries, the retail and wholesale trade has been an important contributor to the national economy but this is not necessarily the case in the future. For that reason, the first step would be to obtain reliable figures concerning the current value of online shopping.

In the case of tangible goods, the transactions or flows are observed when goods cross the national borders. From the viewpoint of statistics, the e-commerce of digital services is more challenging. As mentioned before, individuals and consumers buy an increasing amount of digital services including, for instance, applications to their mobile devices and cloud storage for their pictures and other data. First time in the world history, individuals can trade internationally.

Also companies purchase increasingly digital services. They use, for instance, digital platforms to advertise their offerings. It is questionable, how well that kind of international trade is captured by trade statistics.

Suggestion #1: To measure the consumption of digital services of consumers, one potential data source is payment data by credit card companies. This data is in the transaction level and can be used in multiple ways. For instance, it can be used to measure the amount of e-shopping, to use in travel statistics and probably also in statistics that measure the consumer confidence.

Suggestion #2*:* As mentioned before, companies increasingly use international digital platforms and channels in their businesses. The platform providers certainly know the country breakdown of their revenue but it is an open question whether this data is available to statistical offices. In spite of this, these platform providers are

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attractive sources to obtain the data.

Integration of existing data

An increasing number of companies do not operate only in one country but also have units abroad. These multinational enterprises (MNEs) have potentially a large impact to aggregate economic figures. On that account, it would important to understand more deeply the role of these enterprises in the EU area.

OVERSEAS OPERATIONS OF EU BASED COMPANIES

The national statistical offices of EU member states produce information concerning the foreign-owned companies operating in the compiling country. This inward FATS (inward Foreign Affiliates Statistics) as well as outward FATS data have been collected for a number of years.

Suggestion #3: National inward and outward FATS datasets could be combined with business registers in order to create group register in the EU-level. That kind of group-level information could be used, for instance, to analyse the structure of both EU and non-EU based groups in the entire EU area. If income statement type of data would also be combined to the same dataset, it would expand considerably the potential utilization of the database. For instance, the database could be used to analyse the geographical breakdown of value added.

Suggestion #4: International trade statistics should distinguish intra-group trade and trade between unrelated parties. This is important because an increasing share of the world trade is trade between companies belonging to the same group. However, little attention has been paid to this kind of intra-group trade. Thus, most trade statistics do not separate intra-group trade and trade between unrelated parties. This kind of information is relevant for policymakers from the viewpoints of corporate taxes and competition policy. Moreover, the transfer pricing of MNEs also affect to the levels of exports and imports which, in turn, are important components of gross domestic product (GDP). The recent report by BEA (United States) highlights the growing importance of MNEs in international trade (Hossiso, 2017). The report provides an ownership-based framework of the U.S. current account.

GROUP LEVEL DATA WITHIN NATIONAL ECONOMIES

Both at the national and at the EU-level, policymakers often make the difference between SMEs (small and medium sized enterprises) and large enterprises. For instance, some policy instruments could be targeted only for SMEs.

In practice, however, almost all statistics concerning the role of different sized firms are done in firm-level without taking into account they potentially belong to large group. This means, for instance, that a firm with 10 employees is classified as a small company notwithstanding it belongs to a group having 100 000 employees. Thus, from the policymakers' perspective these breakdowns by firm-size are potentially misleading.

Suggestion #5: A number of statistical offices in EU member states already have group register including the group structures within the country. It would be relatively easy to use this register to form new breakdowns by firm size but using the group level figures to define the size.

The need for more updated figures

Many statistics suffer from significant lags between their publishing year and the most recent year they cover. In some cases, these lags may lead to the situation where these statistics become almost useless for policymakers and other users. For this reason, it is essential to find solutions and new courses of action that enable more updated data. There exists a number of potential ways to shorten the lags.

In some cases, this could be done by changing the process of data collecting. In many other cases, digitalization provides new alternative ways to collect data. In the near future, the majority of transactions between business partners, consumers and public sector are in digital format enabling so called real time economy where transactions are increasingly completed in real time without delays. This is a huge potential also from the perspective of statistics. In some statistics, it could mean the automated collection of raw data through on-line data transmissions from systems to systems.

Suggestion #6: in some statistics, this could mean to move from annual data collection to continuous (e.g., monthly) data collection. This could shorten time lags significantly. For instance, nowadays many firm-level data are collected yearly but the collection is done after 18 months

of the turn of year. And because data needs to be checked and verified, there could be a lag of 2-3 years. Monthly or quarterly data collection would shorten this lag significantly.

Suggestion #7: An increasing amount of efforts should be make to utilise existing data that is already in digital format. These include, for instance, the following:

- Phone call information by telecom operators. This data can be used for instance in developing travel statistics.
- Prices of different products in e-shops. This can be used in developing price indexes.
- Transaction level data by credit companies. This data can be used, for instance, in consumer confidence statistics, international trade (by consumers) statistics, and statistics measuring the amount of e-commerce.

Suggestion #8: National statistical offices as well as Eurostat could be one of the driving forces in developing standards for exchanging information in digital format. One example of those standards is XBRL (eXtensible Business Reporting Language). XBRL is a freely available standard for exchanging business information such as items of financial statement.

Standardised data in digital format would be very useful also from the perspective of efforts by respondents. A number of current reporting systems and surveys are resource consuming to respondents, and digital standards have a great potential to reduce these efforts.

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D2

Perspectives on the future of globalisation: How can official statistics keep up with changing global value chains?[(1)]

Ricardo Borges de Castro[(*)] and Kristel Van der Elst[(**)]

Introduction

The tide of popular opinion seems to be turning against globalisation, as many in Europe and the United States perceive that gains from trade and investment in recent decades have not been fairly distributed. Ignoring these concerns is at our peril: on the road to inclusive growth and social empowerment, there is still a long way left to travel.

We know that the global circulation of goods, services, money, people and ideas is making the world wealthier, healthier and more educated than ever before. So how can we address concerns about globalisation while continuing to harness its benefits?

We need evidence-based policymaking, which relies on credible, timely and comprehensive data. Providing such data to inform policy development will require official statistics agencies to stay abreast of the changing nature of global value chains, with a particular focus on future evolutions in seven areas.

MORE LOCALISED PRODUCTION

In the future, production is likely to occur closer to consumption. This is driven by factors such as automation making production less labour-intensive and advances in techniques such as additive manufacturing. Demand will grow for products that are more individualised or customised, as well as for faster delivery.

GEO-POLITICAL AND ECONOMIC UNCERTAINTY

The rise of protectionism and economic nationalism will further impact this. The future configuration of global value chains is sure to be affected by trends in insecurity and conflict, the use of economic tools to settle geopolitical disputes, the growing importance of state capitalism in some corners of the world, and eroding strategic trust among world powers.

SMES VS BIG BUSINESS

The future evolution of technology could plausibly lead to a business ecosystem heavily populated by SMEs, start-ups and self-employed workers. Alternatively, we could see greater consolidation and even monopolisation of business activities: large organisations can invest more in technology infrastructure; they have greater access to data, which they can use to optimise production systems and improve products and services; and, as their value chains become more networked, they may be reluctant to transmit 'business secrets' to outsiders. We will need better official statistics on smaller economic structures to understand how the structure of our economies is evolving.

NEW PRODUCTS AND SERVICES

New categories of products and services will emerge along existing global value chains, and statistical offices will need to keep abreast of

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(1) This contribution aims to underpin forward-looking policy-making by highlighting trends that impact the development of the evidence base on the nature and geography of value chains, as discussed in the "Power from Statistics – Round Table on Globalisation" meeting organized by Eurostat. It is not the outcome of a specific analysis, or intended to be a comprehensive study on all plausible future evolutions in globalisation and trends impacting global value chain assessment. The views expressed are those of the authors and do not necessarily correspond to those of the European Commission.

them and understand how to accommodate them in their measurements and analysis of value creation. Significant examples are likely to include more trade in 'digital product templates' for local 3D-printing, as opposed to physical products themselves; and Uber-like sharing models reaching more parts of the economy, such as manufacturers leasing time in factories rather than owning them outright.

E-COMMERCE WILL KEEP INCREASING

E-commerce is here to stay, and will only become more generalised as consumers use mobile devices more frequently to buy online. But there is surprisingly little evidence about its global implications. Official statistics will need to find better ways to collect data about the buying and selling of goods and services, and the transmission of funds and data, over electronic networks.

AVAILABILITY OF MORE REAL-TIME DATA

As they become more highly networked, global value chains will produce massive amounts of data, creating more transparency and flexibility for the actors involved. This opens potential opportunities for official statistics agencies to collect more data, in a more timely way.

DECREASING TRUST IN GOVERNMENTS

However, given decreasing levels of trust in governments, any proposals to make more business data accessible to national and European statistical offices could be controversial. With different governmental agencies increasingly connecting their data systems, companies and individuals will worry that data provided for statistical purposes might end up being used for other purposes, such as taxation. Collecting more data to inform better policy development will require safeguards about how that data will be used.

D3 Beyond international trade in services: From input-output to modes of supply and firm-level databases

Lucian Cernat and Zornitsa Kutlina-Dimitrova(*)

We are experiencing a moment in time where international trade and global production patterns are changing rapidly in a diversified and divided trade policy environment. The importance of being able to provide policy advice rooted in sound statistical and analytical evidence is growing. Services trade will be one area where the impact of fast technological change (e.g. digitalization, internet of things, artificial intelligence, etc.) will lead to new economic outcomes. International statistics are expected to provide answers to 'real' and pertinent trade policy issues, such as the link between services trade and jobs, the value-added share of services in international exports, the importance of small and medium enterprises (SMEs) in international trade or the split of services in modes of supply, to name just a few.

Against this challenging policy background, the recent advances in building multi-regional input-output (MRIO) databases such as TiVA (Trade in Value Added) and WIOD (World Input-Output Database) have enabled researchers and policy makers to examine international trade along the value chain of downstream and upstream industries. Furthermore, the European Commission-sponsored WIOD database has been the basis for documenting the important link between trade and jobs. Such analytical advances provided evidence for the role of international trade in EU policy: President Juncker in his ***State of the Union*** speech (14 September 2016) conveyed a very powerful political message when he said (based on WIOD-related research) that more than 30 million jobs (1 in 7 of all jobs in the EU) depend on exports to the rest of the world (Rueda-Cantuche and Sousa, 2016). Moreover, on average, export-related jobs in the EU are better paid than jobs in the rest of the economy. In 2009 the labour compensation premium for export-supported jobs was apparent across the full spectrum of skills: ranging from 5 percent for low-skilled jobs and 9 percent for medium-skilled jobs, to 16 percent for high-skilled jobs.

Out of all these export-supported jobs, a growing number of jobs in the EU are supported by 'traditional' GATS services exports to the rest of the world: from almost 5 million in 1995 to over 11 million in 2011. But what it is even more interesting is that, value-added trade databases allowed us to quantify and analyse more thoroughly the role of services along global supply chains and new concepts such as servicification and mode 5 services. Servicification is a recently documented trend (National Board of Trade, 2012) of manufacturers buying, producing and selling more and more services and mode 5 services refer to the value of services exported as part of manufactured products (Cernat and Kutlina-Dimitrova, 2014). It is well known that containers revolutionised shipping and reduced international trade costs for merchandise trade but statistics also altered our view of how value-added trade is carried out. Now we also know that containers also facilitated services exports 'in a box'. With the help of the TiVA and WIOD databases we were able to quantify these important phenomena and to provide evidence on the growing importance of mode 5 services inputs for manufacturing sector export performance.

This makes mode 5 services an important driver for job creation in Europe: 8 million jobs (1 out of 4 in total EU export-supported) are mode 5 jobs (Cernat and Sousa, 2015). Along these lines, the importance of further investing in trade in value-added databases is indispensable for providing sound statistical and analytical advice on global value chains and services trade. Finding ways to increase the sectoral details and timeliness of the

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available data remains key for responding quickly to pressing trade policy priorities.

But while data on mode 5 services exported in containers is a recent concept in trade policy debates, the traditional GATS modes of supply were a cornerstone element in all services trade negotiations. Hence, the availability of statistics on services by modes of supply has been a longstanding priority for trade negotiators. Despite their importance, until recently, modes of supply were not properly accounted for in services statistics. Mindful of their growing policy importance, Eurostat has taken a groundbreaking initiative and successfully completed a pilot project to estimate services trade flows by modes of supply (Eurostat, 2016). DG TRADE acknowledged this important contribution by Eurostat and we encourage further work in this very important policy area, particularly in respect to mode 3 where data breakdown by EU Member States is still needed, as well as a further breakdown by major trading partner and modes of supply.

To support this Eurostat initiative, and with the aim to create a global database in trade in services by modes of supply for future use in trade negotiations, the European Commission has launched a new initiative, in cooperation with the WTO and the wider research community. This new initiative will build on recent successful experiences, such as the ones carried out by Eurostat.

Beyond better input-output databases and services by modes of supply, another important recent statistical advancement is the creation of firm-level trade statistics. Two Eurostat databases offer a wealth of information in this regard: the Trade by Enterprise Characteristics (TEC) and the Services Trade by Enterprise Characteristics (STEC). These databases provide information on international trade by company's size classes in respect to goods (TEC) and services trade (STEC). This data provides answers to questions in respect to the relative importance of SMEs when it comes to international trade in respect to number of companies and trade values. Thanks to these databases we know that over 600'000 goods-exporting SMEs account for an overwhelming share of EU exporting companies in terms of total number of exporting firms and also for a considerable share (more than a third) in terms of total value of EU exports. Thanks to Eurostat's TEC database now we know that SMEs are more important than we previously thought for EU trade performance (Cernat et al, 2014) and this new finding led to a renewed commitment in the current EU "Trade for All" Strategy to prioritise SME-related issues in our future trade policy initiatives (European Commission, 2015).

Due to data limitations, we know less about the performance of EU SMEs in services exports (either as part of traditional GATS four modes of supply or under the new mode 5 service concept). Given the importance of the digital economy and the clear priority for the European Commission to support innovative SMEs across all digitally-enabled services areas, having such more SME-specific services statistics would be a great input for many policy areas, beyond trade. Expanding the coverage of these databases through adding additional information on partner breakdown and improving the country coverage in the STEC database are crucial steps in order to provide sound analytical advice on the impact of trade policy initiatives on the number of exporting SMEs across EU Member States.

Collecting more and more detailed official statistics requires resources and the cooperation of national statistical institutes. Often such data-collection efforts are thwarted by many conflicting policy priorities. But, fortunately, statisticians can also tap into a growing number of free, 'unofficial', publicly available data. The recent launch of a 'Big Data' taskforce by Eurostat is an encouraging development, including in the area of trade policy. More and more data is being made public by firms managing supply chains. Such detailed databases could considerably transform the way trade policy analysis is conducted. In "Trade Policy 2.0" the unit of analysis shifts from countries and sectors to exporting and importing firms (Cernat, 2014). In doing so, people can relate more directly to trade policy when "trade comes to your town". DG Trade recently launched such a tool in the case of EU-US trade (European Commission, 2016). For the time being such data is available only for trade in goods but eventually trade in services can also follow a similar path.

When looking forward, all these new initiatives offer great hope for the services trade agenda. Having better services statistics (e.g. by firm characteristics and modes of supply) will not only improve the negotiating process, but also other critical trade policy priorities, such as monitoring and implementation of existing trade agreements, ex post evaluations, and so on. Providing clear evidence that trade agreements not only work well in terms of boosting trade in goods but that they are also beneficial for services companies, their customers and consumers is of paramount importance, at a time where many sceptical voices call into question the benefits of trade liberalisation.

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D4 Globalisation and trust

William Hoffman(*)

OBJECTIVES

This positioning document will outline some of the key issues shaping the need for strengthened trust in the use of networked information and communications technologies (ICT) in the context of globalization and enabling inclusive socio-economic value creation.

While much potential exists, a more defined set of principles and risk taxonomies are needed to ensure a more trustworthy and stable digital ecology can emerge. In particular, clarity on the data ethics, accountability of all stakeholders and local information ecosystem knowledge are all needed.

TOWARDS A TRUSTWORTHY GLOBAL DIGITAL ECOLOGY

The ways in which ICT can be leveraged to positively impact socio-economic gain are just beginning to emerge. Because of its detail, timeliness, ability to be utilised for multiple purposes (at scale) and to connect the unconnected the global economy, the potential for networked information technologies to enable a robust global economy is unprecedented.

Yet despite this promise, a set of interrelated questions is evolving over the regulatory requirements, policies, ethics and norms that guide the use of ICT in the context of the global economy. Many of the existing approaches that guide the creation, collection, storage and use of ICTs were based upon decades-old policies of developed economies first established in the era of mainframe (un-networked) computing. While many of the underlying principles that currently guide technology policymakers in various jurisdictions and sectors are still relevant and important, some need to be updated and refreshed to address the new challenges of networked systems and also to suit the unique needs of individuals and marginalised communities (such as engagement of the individual, use limitations and purpose specification).

Easy answers do not work as they simply mask the deeper complexity of today's interrelated and global challenges which need to be continuously managed and rebalanced. For example, legacy privacy guidelines and data protection mechanisms were largely based on the presumption that data are actively collected from the individual with some level of their direct awareness. However, as billions of sensors come online and passively collect data (without individuals' awareness) and as computer analytics generate and synthesise more 'bits about bits' (or 'meta-data'), understanding how to effectively frame this systemic complexity and balance competing interests will be essential for effective data governance.

To address this uncertainty, it is important to build the underlying legal, regulatory, ethical, technological and economic infrastructures necessary to enable the balancing of competing interests. Balance will require addressing multiple concerns about the secondary use and leverage of digital services on issues such as privacy, human rights, property rights, and inclusive growth. The approaches will need to be meaningful, pragmatic, adaptive and proportional. Achieving a balanced ecosystem – which is not to dismiss the strong incentives for incumbents to maintain power differentials and imbalance – will also require political will and leadership. More substantially, it will require the establishment of structures that can normalise risk and create unique risk reduction and leverage

(*) World Economic Forum

benefits. It will require innovation in hybrid technology and policy architectures by private enterprise, governments, legal experts, ethicists and citizens.

Building trust in this new hyper-connected world of global technology will require approaches from both the 'bottom up' and 'top down' to ensure that shared principles and norms are upheld. There is a need to ensure that the ways the global digital infrastructure is used – particularly the use of Artificial Intelligence and the algorithms driving proactive and anticipatory decisions – can be explained intelligibly 'and meaningful responses given when individuals are singled out to receive differentiated treatment by an automated recommendation system[1].

Transparency is needed not just on the measurements of impact but also on "how and why" the results were achieved and if they were presented in a meaningful manner. In the near future when machine learning, the Internet of Things (IoT) and ambient intelligence reach scale these environments will rely upon proactive computing[2] that diminishes the need for human-intervention. Stakeholders must enter new forms of dialogue and coordination (both informal and formal and across multiple sectors), and create new policy frameworks, supplemental institutional structures (such as public-private partnerships) and incentive structures.

A core tension framing the narrative of ICT and globalization relates to the incentives of maintaining power and control. The pervasiveness of hierarchical institutions, governments and political institutions raises questions on the institutional appetite for a genuinely transformative "digital revolution". Reliance by stakeholders on existing hierarchical institutions is understandable but it is not clear that the mere combination of existing public and private institutions (with their centralised power structures) will capture the benefits and have aligned incentive structures for change.

Overcoming these challenges will require a comprehensive revision of policy frameworks that were based upon legacy information flows within hierarchical, industrialised institutions relying on centralised information distribution systems in which data and their applications were defined and limited.

There is a need to develop systems and legal frameworks that recognise context and do so in a way that simplifies rather than adds to the complexity of the environment. In this light, the dimension of accountability holds unique challenges where outdated policies, limited technological capacities and competing power dynamics can create an unstable environment.

The construct of transparent accountability – currently oriented towards strengthening externally-facing "front door" relationships with individuals – will require a greater focus on 'back door' transparency. Educating stakeholders on the ways that data flows within the supply chain of industrial relationships is urgently needed to avoid "transparency-washing." It is also important to anticipate that the proportion of personal data that is either passively observed about individuals or computationally inferred about them is growing at an ever-increasing rate. By 2020, an estimated 50 billion devices will be wirelessly connected to the internet. Because of this global change, the guidelines and protection mechanisms for governing the use of high-frequency and high-resolution data in both the Global South and North need to adapt.

ETHICS

Realizing the promise of ICT for sustainable and global socio-economic gain will also require addressing an entangled set of risks, uncertainties and competing interests. Along with the accelerating velocity of change, 'top down' power asymmetries and data literacy constraints, an array of ethical harms and risks are destabilizing the global ICT landscape.

The ethics of ICT, and in particular how Artificial Intelligence and Machine Learning will be used, focus on how the dimensions of fairness, agency, consent, social justice and participation will be addressed. By more effectively embracing these dimensions and the ethical practices in the advanced use of ICT, individuals and community leaders can more effectively engage in how, where and for what intended purposes technology is being used. With a focus on ethics and digital inclusion, both the short and long term impacts can be better understood.

The applied use of ethics in the use of technology (particularly as they relate to

(1) Morozov, Evgeny. "The Real Privacy Problem". MIT Technology Review, 22 October 2013.
(2) Tennenhouse, David. "Proactive Computing". Communications of the ACM, May 2000.

globalization) will be most effective when anchored on the principles of respect, autonomy and enhancing agency. That means giving local communities and affected individuals the opportunity to understand the intentions of those using advanced technologies, the ability to co-create those interventions, the means to audit the data and the ability to opt out[3].

In the context of increasing globalization, the ethical uncertainties for using advanced technology needs to be more precisely defined. The ambiguity surrounding the measurable (and perceived) benefits and harms of globalization, need to be demystified and placed into a real-world context. With stronger ethics in place, the capacity for individuals and communities to be better informed and make decisions about how, where, why technology is impacting them can be made. With a better understanding of the risks associated in using ICT for the social good, policy makers can develop frameworks which are outcome based, proportionate and that strengthen socio-economic benefits while protecting fundamental rights.

Risk management tools and approaches can be used to enable businesses to move beyond the uncertainty about legal and regulatory environments, operational barriers, and intellectual capital and privacy concerns, to fully harness the advanced power of ICT to drive socio-economic development. Privacy continues to be a central concern but is too narrow to fully encapsulate the potential harms – short and long term – of how data can be used to analyse and instrument individual, community and societal behaviours. Data harms at the group/community level can result in discrimination causing individuals to be deprived of basic rights such as housing, access to finance, employment, healthcare or education.

To get through the complexity of interconnected concerns, a meaningful and pragmatic way forward is needed. The discipline of risk management – a tool familiar to most businesses – can provide the means for progress. There is an opportunity to provide decision makers from industry, civil society, government and the data science communities with a more focused and normalised set of ethical decision making processes which balance competing concerns in a more adaptive, contextual and inclusive way. Anchored within the discipline of adaptive risk management, a series of 'smart questions' can be field tested and made available for guidance so that stakeholders can collectively (and iteratively) navigate a shared set of emerging ethical challenges in leveraging technology for the common good. By clarifying both the ethical uncertainties, a more granular understanding of how to catalyse private sector engagement can be gained.

With a more widely embraced use of adaptive risk management practices, some of the core underlying ethical dilemmas decision makers face in the use of ICT and globalization can be addressed. As projects are scoped, insights discovered, plans implemented and impacts assessed, a new set of tools can be created to aid decision makers in balancing emerging and intangible impacts at multiple scales (the individual, community, institutional and societal levels of impact). In particular a set of "smart questions" can be adopted which can be embraced by practitioners and refined over time. As the work progresses, ethical decision making processes can be formalised and a shared set of use cases can be more widely shared. Along with providing practitioners with actionable guidance, these approaches for balancing ethical dilemmas will inform the larger global dialogue on policies related to privacy, data protection and the "Fourth Industrial Revolution".

Risk-based approaches will also address the need for a richer understanding of local context and feedback loops. One of the largest gaps impacting the ability to balance ethical concerns in the use of data, AI and ICT is the lack of meaningful engagement at the individual and community levels. By providing meaningful ways of engaging local communities and individuals, a set of more inclusive, trustworthy and equitable decision making processes can emerge in the balancing of ethical concerns.

CONCLUSIONS

The call-to-action for all stakeholders therefore is to raise awareness among senior leaders and executives on practical ways that intangible ethical uncertainties can be identified and managed. If leaders within the official statistics community could establish inclusive and "safe spaces" for ethical-related conversations to occur (both within institutions and across them) it would be an important first step. Additionally, by creating an informal multi-stakeholder

(3) Crawford, Kate 2015 "Is Data a Danger to the Developing World?" World Economic Forum Blog (https://agenda.weforum.org/2015/11/is-data-a-danger-to-the-developing-world/)

community of practitioners to explore ways to design and deploy implementable protocols which address these ethical challenges, progress could be made in identifying ways of balancing competing interests in an iterative and adaptive manner. Progress in these areas would address the inherent complexities and nuances of the issue. To address the coordination and accountability of various stakeholders, trust frameworks – which document the specifications established by a particular community – can serve as an effective means to govern the laws, contracts and policies of the system. It is in this capacity where the ability for actors to not only prevent but to respond (and provide restitution for the impacted individuals) can be strengthened. The need for continuous experimentation, learning and sharing is paramount. Investing in small-scale pilots that bring together the private sector, regulators, civil society and local communities will provide the insights and local knowledge critical for long-term resilience and adaptation.

Establishing an ecosystem that is sustainable, balanced and principled will require approaches that account for the complex and dynamic relationships and movement of data and information among multiple entities (i.e. infrastructure and tool providers, producers, consumers, processors, curators, auditors, etc.). Taking account of the local context is key. Attitudes and tolerance for how ICT is used and what is legitimate, fair or ethical vary greatly among different geographic and social groups. By addressing the issue of how all stakeholders can more effectively listen, learn and adapt as a design challenge, new ways of thinking, seeing and behaving can emerge to help address the significant power dynamics, velocity of change and lack of trust.

Addressing the concerns of globalization will require a renewed commitment for incorporating an appreciation of social relationships, human context and social network dynamics. If leaders within the official statistics community could collaborate with academia, researchers, civil society and designers to develop small scale pilots to more effectively understand local community dynamics through deep human-centred research, new approaches could emerge which provide insights and impact at both the individual and community levels. It also provides a holistic lens for understanding how to inclusively design and co-create approaches for marginalised communities. As a result, we can discover and implement innovative solutions to previously perplexing challenges in a more networked and inclusive process, where all actors and elements of the system are engaged and interconnected – especially the most vulnerable individuals and communities.

D5 Measuring the 'new' digital economy[(1)]

Timothy J. Sturgeon[(*)]

Introduction

Change is in the air. Recent public debate has become focused, with increasing frequency, urgency, excitement, and more than a bit of trepidation, on the imminent arrival of a '4th Industrial Revolution' which will create a 'new' digital economy (NDE) powered by advanced 'cyber-physical' systems spanning 'advanced' manufacturing, transportation, services, and even biological systems (Rose, 2016; Schwab, 2015, 2017).

The 'New' Digital Economy (NDE) as most prominently includes: 1) advanced manufacturing, robotics and factory automation, 2) new sources of data from mobile and ubiquitous Internet connectivity, 3) cloud computing, 4) big data analytics, and 5) artificial intelligence (AI)[(2)].

The main driver of the NDE is the continued exponential improvement in the cost performance of information and communications technology (ICT), mainly microelectronics, following Moore's Law. This is not new. The digitization of design, advanced manufacturing, robotics, communications, and distributed computer networking (e.g. the Internet) have been altering the processes of innovation, the content of tasks, and the possibilities relocation of work for decades.

However, three trends within the NDE are relatively novel. First, there are new sources of data, from smart phones to factory sensors, resulting in the accumulation of vast quantities of data in the 'cloud' creating information pools that can be used to generate new insights, products, services – and risks to society. Second, new business models based on technology and product platforms – platform innovation, platform ownership, and platform complimenting – are, in a range of industries and product areas, significantly altering the organization of industries and the terms of competition. Third, the quantitative advancement in semiconductor technology has, in some areas advanced to the point where qualitative changes have begun to occur in the practical applications of artificial intelligence and machine learning.

What these novel trends share is reliance on very advanced and nearly ubiquitous ICT, embedded in a growing platform ecosystem characterised by open innovation and standards and high levels of modularity.

The emergent features of the NDE appear poised to extend the organizational and geographical fragmentation of work into new realms, including formerly indivisible and geographically rooted activities that reside at the front end of global value chains, especially R&D, product design, and other knowledge-intensive and innovation-related business functions. While the full impact of the NDE on jobs, international competition, and the location of production is unknown, outcomes will crucially depend on the pace of change and the ability of organizations and societies – including regulators and the producers of economic statistics – to understand it, measure it, and manage it.

(*) MIT Industrial Performance Center

(1) This material is drawn from UNCTAD Technical Note on IT for Development (ICT4D) No. 8., Prepared for UNCTAD ICT Analysis Section, prepared by Timothy J. Sturgeon, MIT Industrial Performance Center

(2) For a full description of these five elements of the NDE, with examples, along with the key NDE business model and industry organization features (platforms, open innovation, and modularity), and its likely implications for the dynamics and location of innovation and manufacturing, see UNCTAD, 2017.

This chapter is meant to contribute to a dialogue on how the Digital Economy can be better measured statistically. Because many of the transactions and interactions in the NDE will be electronic, and cross borders without easy detection or characterization, the ability of official statistics to measure basic economic indicators such as investment, trade, and profits could be hampered. On the other hand, 'big' economic data might help data agencies overcome some of these problems. The issues that arise include classification, data access, coverage, and representativeness.

WINNERS AND LOSERS, OPPORTUNITIES AND RISKS

Being transformational, the NDE will likely create both winners and losers, both opportunities and risks. A positive, if somewhat utopian vision of the NDE might centere on the ubiquity and democratization of information – not hard to envision nearly twenty years after the introduction of Google search and ten years into the smart phone era – and the decoupling of economic growth from natural resource constraints enabled in part by the shortening of supply chains with the advent of on-demand manufacturing (e.g. 3D printing) and super-efficient containerised urban agriculture (Chambers and Elfrink, 2014). The NDE, therefore, could usher in a newly equitable and environmentally sustainable growth model based on the maximization of human empowerment and wellbeing rather than maximization of profits and resource extraction and utilization (Erkoskun, 2011). Personal robots may certainty be helpful to the infirm and disabled, and be flexible enough to become well integrated into everyday life (Rus, 2015).

However, there are legitimate worries that the NDE will introduce frightening new risks, and that not everyone will prosper from its evolution. For workers, large and sudden productivity increases enabled by the NDE could shorten the employment adjustment period that has softened the impact of earlier rounds of automation. The penetration of computerization and AI into knowledge-intensive services could mean that many more jobs will be at risk of disappearing, even as output and productivity rise (McAfee and Brynjolfsson, 2016).

On the other hand, advanced economies have been remarkable in their ability to create new industries, demand new skills, and create new and different jobs (Autor ,2015).

Nevertheless, the disruption from automation and globalization tends to be experienced unevenly, and at the very least, it is all but assumed that a new class of super intelligent and dexterous robots will cause direct labour in factories to fall further in the coming decades (McAfee, Brynjolfsson, and Spence, 2014), driving 'employment polarization at the level of industries, localities, and national labour markets' (Autor, 2015, p. 12), and especially in places that are highly dependent on manufacturing, even if temporarily.

Moreover, the economic and social effects of the NDE are expected to be broader than job loss from factory automation. Ride sharing is already revolutionizing individual mobility and autonomous road vehicles, especially freight trucks, seem to be knocking on the door of mainstream deployment (Vincent, 2016). Services from help desks to education and training to payments and banking are increasingly delivered with automated help-desk systems that include voice recognition and AI features. The 'gig economy' (De Stafano, 2015) may be creating a precarious class of "on demand" workers, or 'dependent contractors' (Smith and Leberstein, 2015), including knowledge workers, that are part of a broadly emergent 'precariat' without any clear institutional means for organizing (Standing, 2016). While ride sharing and apartment rental platforms tend to receive a lot of press attention, platforms to connect home care workers to clients (e.g. Care.com), and those that connect clients to an "on demand" workforce through platforms[3], involve much larger numbers of workers, on the order of millions per platform, rather than the hundreds of thousands working for ride sharing platforms (Smith and Leberstein, 2015).

Regardless of these uncertainties, it appears that we could be at the beginning of a new and disruptive technological wave. In prior technological disruptions, from steam engines to electric power to digital computing, the logic of efficiency has often run ahead of the capacities of organizations and society at large to absorb and adapt to them, requiring significant reshaping

(3) Examples include Crowdflower, Crowdsource, Clickworker, and Mechanical Turk, or MTurk, a crowdsourcing site operated by Amazon Web Services that connects researchers to individuals that help with scientific experiments and tedious data analysis tasks in exchange for small payments.

and accommodation in order to reach a more mature and humane footing (Bodrozic and Adler, 2017).

MEASURING THE NDE

How might the activities and economic impact of the various actors in the NDE be adequately captured in economic statistics? How can the NDE be discerned in economic output, employment, trade and investment and how can its effects on productivity, earning, and income distribution be evaluated? This section takes a cursory look at a few of the approaches that have been used and identifies some of the main issues raised.

One starting point is to attempt to measure the size of the market, e.g., in terms of sales revenues from the largest providers of items such as web services (e.g. search), cloud services (UNCTAD, 2013) and AI software. Such numbers are likely to vastly favour the world's most advanced ICT knowledge clusters, notably in the United States. But this does not provide information on where these revenues are generated or about players other than dominant platform owners. The contributions made by lower level technology platforms, higher level and specialised platforms, platform complementors, as well as the data flowing from the crowds of individual contributors (Lanier, 2014), could all be included in reasonable measures of the NDE. Obtaining such measures, even as estimates, is difficult.

There are at least two approaches to consider. The first is to explore the usefulness of existing statistics and statistical categories for the measurement of the NDE. The second, non-mutually exclusive approach is to use data produced by the NDE itself (e.g. data traffic, web searches, browser clickstreams, etc.) to aid in the production of economic statistics. There is an ongoing debate about if and how to use data from private and novel sources in the 'official' statistics offered up to policymakers.

This section touches on both topics, and is not meant to be exhaustive. Experimental definitions of the NDE need to be further developed. The resources of the NDE need to be explored and tested for their usefulness, and experiments need to be conducted. The results of these experiments need to be summarised and put forward for debate among data produces and users. This work is already underway.

Defining the NDE using existing statistics and classifications

Jorgenson and his colleagues (2011), as pioneers of finding uses for input-output statistics beyond national accounting, extract information about the share of IT-producing industry outputs consumed as intermediate inputs by each 3-digit NAICS industry in a measure the authors call an information intensity index (III). This produces a split the US economy according to IT-producing, IT using, and non-IT-using industries. The results are shown in **Table 1**. While identifying where the outputs of 'IT-producing' industries are consumed in the broader economy produces a useful estimate of information intensity, more detailed industry breakdowns, especially of information producing industries, and a more objective way of identifying them, would be an important improvement. The IT-producing industries are highly aggregated, made up of just three services-producing and three goods-producing industries, and were arrived at subjectively by the authors.

Van De Marel (2015) adds more detail to the approach used by Jorgenson and his colleagues, identifying, also subjectively, eight data producing service industries, selected (as industries assumed to be most likely to produce data as an output) from the more detailed six-digit NAICS classification. Again, data usage is pried by the share of inputs than come from industries deemed to be data producing. The results are broadly similar to Jorgenson et al (see **Figure 1**)[(4)]**.** For example, data producing industries such as telecommunications were also found to be the most important data users. Van De Marel notes that high volumes of data are consumed for the purpose of management of companies (only slightly less than what is consumed by data producing industries), and traded with related parties (i.e. within the MNE), rather than produced for embodiment in downstream goods and services or for consumption by end users. Using an econometric model, Van de Marel goes on to estimate the main traders of data-intensive services and their revealed comparative advantages. Still, the data producing categories in the left portion of **Figure 1**, in light of the characterizations of the NDE made in this study, could easily be characterised as incomplete or anachronistic.

(4) However, because the aggregation of data using sectors into 2-digit using industries required the use of unweighted averages, the share of data intermediates in each 2-diget industry is significantly lower than what is shown in Table 1

A new internationally agreed-upon complementary grouping of indicators recently proposed by the Partnership on Measuring ICT for Development and its Task Group on Measuring Trade in ICT Services and ICT-enabled Services (TGServ)[5] and taken up by the UN Statistics Commission, might be useful for capturing trade related to the NDE (UNCTAD, 2015). Because the main international classification for trade in services lacks sufficient appropriate detail for the purpose of identifying flows in ICT-enabled services, the indicators rely on detail from the services products in the UN's Central Product Classification (CPC Rev.2.1). From this detail TGServ members agreed upon which CPC services products have the potential for being delivered electronically (see **Table 3**).

Two categories were constructed for traditional ICT services products including telecommunications, computer services, and software (complementary groupings 1.1 and 1.2), along with seven categories for ICT-enabled services, including business functions that have been outsourced and offshored in GVCs (complementary groupings 1.3 - 1.9). This framework has been used by the US Bureau of Economic Analysis to estimate trade in ICT-enabled services (US BEA, 2016), and is being deployed in surveys by the statistical offices of Costa Rica, India, and Thailand. As useful as these new data might be, the categories in **Table 3** seem poorly aligned with the products of the NDE (cloud services, big data analysis, and AI software and services), most of which reside within the traditional ICT-services sections.

Following a similar, subjective approach to defining the NDE using existing classifications, **Table 2** experiments with assigning three NDE-related data producer categories (cloud computing-CC, Big Data analysis-BDA, and artificial intelligence-AI) to the services products defined in the Central Product Classification (CPC Rev.2.1). In order to demonstrate the usefulness (or lack thereof) of these categories in terms of the international trade in services data that is typically collected, correspondences are provided for the less detailed Extended Balance of Payments (EBOPS 2010) product classification and International Standard Industrial Classification (ISIC Rev.4).

On the goods side, definitions of IT industries using official classifications suffer from similar problems. For example, Miroudot *et al* (2013) use ICT-related industry categories covered by the World Trade Organization's Information Technology Agreement (ITA) to examine the effects of trade agreements on ICT-related trade in GVCs. ITA categories include 'Radio, television and communication equipment' (ISIC 32), 'Medical, precision and optical instruments' (ISIC 33), 'Office, accounting and computing machinery' (ISIC 30), 'Machinery and equipment not elsewhere classified' (ISIC 29) and 'Electrical machinery and apparatus not elsewhere classified' (ISIC 31). It seems obvious enough that these industry categories are of limited use in defining hardware related to the NDE, since there is no way to separate out advanced industry segments from more traditional activities within each industry. Once way to start would be to identify existing CPC classifications for NDE-rated goods, similar to how this is done for services in **Table 2**, and if gaps exist, propose new categories for NDE-relevant goods (e.g. 3D printers, advanced industrial robots, drones of 50kg or less) to be included in next CPC revision.

While international classifications are regularly updated to include new product and industry categories to reflect changes in technologies and markets, the process is necessarily slow and conservative and therefore categories can rapidly become anachronistic in fast-moving product, industry, and job categories. Given that technologies such as AI have only recently been moving outside of the laboratory and into the market, it is understandable that there is currently no specific category within computer services for AI software and services, even in the most detailed international product classification (CPC).

More to the point, digital technologies are already in wide use across all economic sectors, and the tools of the NDE are expected to become increasingly pervasive, so the lens must be expanded for the progress and impact of the NDE to be measured. This notion of data pervasiveness in the broader economy, spreading across upstream (inputs) and downstream (output) segments of the value chain across goods and services, is well captured by Van de Marel (2015), and shown in Figure 2. Given this situation, it seems reasonable to ask if the new tools being provided by the NDE could contribute to new and improved statistics.

Using NDE tools to improve economic statistics

Researchers are beginning to draw on the tools of the NDE to validate, improve, and even substitute for official statistics. One example is the use of price data from the Internet to improve

(5) TGServ members are UNCTAD, UNSD,

the accuracy and timeliness of price indices. The Billion Prices Project uses price data automatically collected, or "scraped," from websites selling products and services (Cavallo and Rigobon, 2016). These techniques have proven especially useful in countries with weak statistical systems. Others have supplemented these data with point-of-sale scanner data from supermarkets and other retail outlets (Krsinich, 2016).

Given the scale of e-commerce, web-sourced price data seem to be well-suited for use in economic statistics, but what about more challenging measurements of the output, productivity, employment, and trade being generated by the NDE? Nathan and Rosso (2015) set out to identify firms in the UK engaged in the digital economy. By combining contextual phrases related to digital services found on company websites with administrative data from the UK statistical agency (using the UK SIC classification), they estimate that about 70,000 companies were 'missing' from the UK's official classification of the ICT industry. In other words, the UK's digital economy was estimated to be about 42% larger than SIC-based estimates based on the activities of traditionally defined ICT producing industries. Based on this, employment in the UK's information economy was estimated to be 50% larger than suggested by official statistics.

Some important companies operating in the NDE, including Google (which dominates search), Cisco (which has a dominant global market share in Internet routers), Amazon (which dominates on-line retail and cloud services), and McAfee (a leader in computer security software), make some of their data available on line. According to Alveras and Martens (2015, p. 6), Cisco data can provide information on the geography of Internet protocol (IP) data flows, but these are distorted by the location of server farms and favour countries that serve as connection points for undersea cables, such as Canada. Since IP data is commonly split into "packages," sent along various routes, and then reassembled for end use, the real origin and destination of data are unclear. Data are also commonly replicated across various servers, leading to overestimates. Furthermore, data on IP package flows contain no information about the content, purpose, or usage of data.

For this reason, Alveras and Martens (2015) argue that it is better to use less comprehensive data collected at the level of Internet browsers. They describe the possible data sources and their limitations this way (p. 6):

Several companies collect Internet traffic statistics at the Internet application level between Internet users and websites. The simplest methods consist of tracking the IP address of incoming traffic by means of in-site tools. Website operators build these tools into their websites to enable them to track the origin of the incoming traffic. The Google Analytics and Amazon Alexa tools for example are widely used. Incoming traffic trackers can be mirrored in out-going traffic trackers built into the browsers of Internet users. The Alexa Toolbar for instance can be voluntarily installed by Internet users and collects data on their clickstream. Some companies manage online consumer panels of Internet users who agree to install an in-browser tracker to collect data on their online user patterns. Many marketing companies operate such panels, for instance Nielsen NetRatings, Comscore and TNS. Besides these software tools installed by users on the supply and demand side, a myriad of cookies enable third parties not directly involved in the exchange between users and websites to track activity on the Internet and collect this information, for advertising and other commercial purposes. More sophisticated methods have been developed in recent years that no longer rely on cookies and user-installed software. Some companies have made arrangements with ISP providers to harvest directly the clickstream generated by ISP clients.

All these data collection methods have pros and cons. Consumer panel data are very detailed and provide a consistent and continuous picture at the user level, together with socio-economic profile data of these users. That makes them suitable for consumer analysis. However, they usually cover no more than a few thousand Internet users per country. They are expensive to maintain and therefore limited to the most important Internet economies only. Less than half of all EU Member States have such online panel data. Data derived from website analytics, toolbars and cookies are more comprehensive in coverage, though they are still based on samples and do not cover the entire universe of Internet activity.

In their study of international trade in on-line services, Alveras and Martens (2015) use statistics obtained from Amazon Alexa Toolbar. The authors note that Alexa data do not cover all existing websites (651,000 out of an estimated 876 million registered websites in the world in 2015)[6], and that no measures of representativeness are provided. Since there is no officially recognised classification for on-line services, they analyze their data according to a commercial classification developed by McAfee, which offers a tool to classify web sites into 37 categories (see **Table 4**). Alveras and Martens then aggregate these into seven broad categories: commercial, media, news, personal, social, technical and other online services for some of the analysis.

It is clear that these categories bear little resemblance to the definitions of the digital economy derived from official classifications shown in the previous section. While there could be temptation to abandon official statistics for the rich data sources flowing from the NDE, measurement based on data from NDE sources lack the validity of official statistics, and come with limits, which Nathan and Rosso summarise as follows (2015, p. 1717):

- Access – limits on access to proprietary datasets
- Coverage – for instance, of companies not present in scraped/mined sources
- Reliability – when variables are probabilistic rather than directly observed, and when data is sampled
- Quality - proprietary datasets may not be validated to the standards of administrative sources, or at all.

The way forward seems clear, if arduous. Representative data sets need to be assembled from rich on-line sources, with the full participation of the core platform owners in the NDE, in cooperation with official national and international data agencies. Private and official classifications need to be reconciled though an open, transparent process involving multiple stakeholders. If benchmarks can be developed and validated over time in data-rich countries, then the techniques might inspire confidence even when applied in data poor countries. And because data from the NDE are by definition *big* data, coming with great frequency and huge sample sizes, imperfections in datasets can be more tolerable (Cukier and Mayer-Schoenberger, 2013).

Table 1: Share of intermediate inputs from information technology (IT) producing industries, United States, 2005

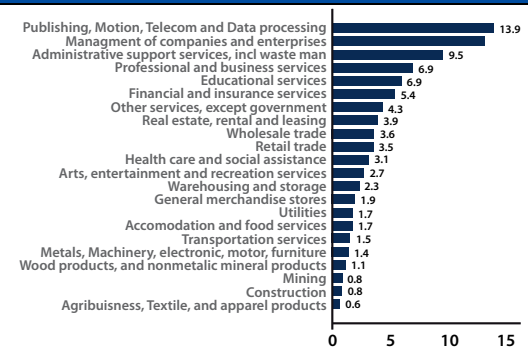
IT-Producing Industries	IT share	IT-intensive Using Industries	IT share	Non IT-intensive Using Industries	IT share
Computer systems design and related services	95.0%	Securities commodity contracts and investments	84.6%	Truck transportation	15.4%
Information and data processing services	79.3%	Air transportation	68.0%	Other services except government	15.0%
Software publishing	44.2%	Misc. professional scientific and technical services	63.3%	Furniture and related products	14.5%
Semiconductor and other electronic component mfg	41.1%	Broadcasting and telecommunications	57.0%	Warehousing and storage	14.4%
Communications equipment mfg	38.7%	Educational services	54.7%	Chemical products	14.1%
Computer and peripheral equipment mfg	35.7%	Newspaper; periodical; book publishers	54.6%	Motion picture and sound recording industries	13.8%
		Management of companies and enterprises	54.3%	Fabricated metal products	13.5%
		Administrative and support services	50.2%	S&L Government enterprises	12.3%
		Water transportation	47.9%	Ambulatory health care services	12.0%
		Other electronic products	44.5%	Paper products	12.0%
		Pipeline transportation	41.7%	Food services and drinking places	11.8%
		Hospitals Nursing and residential care facilities	37.2%	Food and beverage and tobacco products	11.5%

(6) The authors note that many of these are never used.

IT-Producing Industries	IT share	IT-intensive Using Industries	IT share	Non IT-intensive Using Industries	IT share
		Machinery	33.9%	Federal Government enterprises	11.2%
		Legal services	33.8%	Electrical equipment appliances and components	11.0%
		Rental & leasing, and lessors of intangible assets	32.2%	Support activities for mining	10.8%
		Transit and ground passenger transportation	31.8%	Mining except oil and gas	10.3%
		Insurance carriers and related activities	31.6%	Nonmetallic mineral products	10.2%
		Other transportation equipment	30.5%	Textile mills and textile product mills	9.7%
		Federal General government	30.5%	Apparel and leather and allied products	9.2%
		Motor vehicles bodies and trailers and parts	24.3%	Wood products	9.1%
		Performing arts, spectator sports & related activities	22.9%	Petroleum and coal products	9.0%
		Construction	22.7%	Primary metals	8.9%
		Fed. Res. banks, credit intermediation	22.3%	Plastics and rubber products	8.6%
		Wholesale Trade	21.9%	Rail transportation	8.2%
		Social assistance	21.3%	Amusements gambling and recreation industries	7.7%
		Printing and related support activities	20.2%	Funds trusts and other financial vehicles	7.7%
		Other transportation and support activities	17.9%	Utilities	7.4%
		Waste management and remediation services	17.6%	Accommodation	6.8%
		S&L General Government	16.7%	Forestry fishing and related activities	3.7%
		Miscellaneous mfg	16.3%	Oil and gas extraction	3.1%
		Retail Trade	15.7%	Real estate	1.4%
				Farms	1.4%

Notes: IT-Intensive industries are those with more than the median share of 15.4 per cent for III in 2005.
Source: Jorgenson et al, 2011, Tables 1 and 2.

Figure 1: Data production and usage in the United States, 2014

Data producing service sectors (6 digit NAICS)	Data usage by sector (2 digit NAICS)
• Software publishers • Wired telecommunications carriers • Wireless telecommunications carries (except satellite) • Data processing, hosting, and related services • Internet publishing and broadcasting and Web search portals • Custom computer programming services • Computer systems design services • Other computer related services, including facilities management	

Source: van de Marel, 2015, Table 1 and Fig. 2.

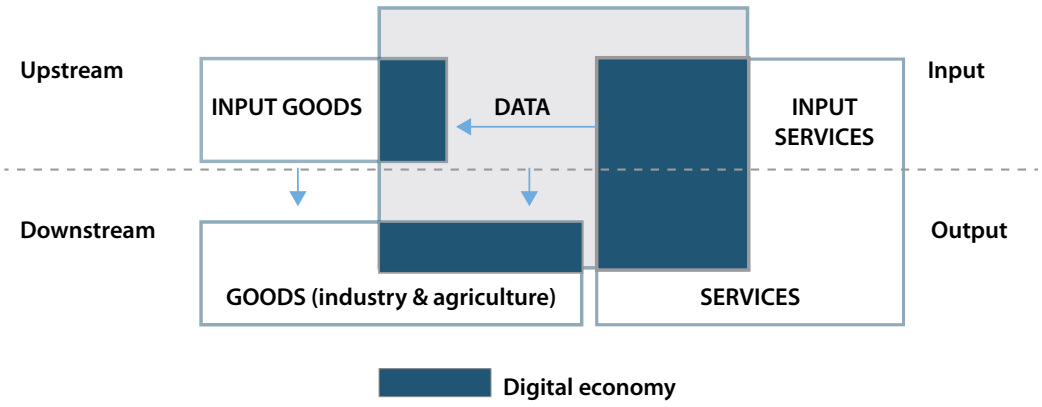
Table 2: Looking for New Digital Economy-related services in international classifications for services

NDE type*	CPC 2.1 Code	CPC description	EBOPS 2010 Code	EBOPS description	ISIC Rev. 4	ISIC description
AI	811	Research and experimental development services in natural sciences and engineering	10.1.1.1	Provision of customised and non-customised R&D services	7210	Research and experimental development on natural sciences and engineering
AI	7333	Licensing services for the right to use R&D products	8.2	Licenses for the use of outcomes of research and development	7740	Leasing of intellectual property and similar products, except copyrighted works
AI	83912	Industrial design services	10.1.1.1	Provision of customised and non-customised R&D services	7410	Specialised design activities
BDA	813	Interdisciplinary research and experimental development services	10.1.1.1	Provision of customised and non-customised R&D services	7210	Research and experimental development on natural sciences and engineering
BDA	814	Research and development originals	10.1.1.2	Sale of proprietary rights arising from research and development	7210	Research and experimental development on natural sciences and engineering
BDA	833	Engineering services	10.3.1.2	Engineering services	7110	Architectural and engineering activities and related technical consultancy
BDA	845	Library and archive services	9.3.2	Information services - Other information services	9101	Library and archives activities
BDA	852	Investigation and security services	10.3.5	Other business services n.i.e.	80	Security and investigation activities
BDA	8311	Management consulting and management services	10.2.1.3	Business and management consulting and public relations services	7020	Management consultancy activities
BDA	8312	Business consulting services	10.2.1.3	Business and management consulting and public relations services	7020	Management consultancy activities
BDA	8313	IT consulting and support services	9.2.2	Computer services - Other computer services	6202	Computer consultancy and computer facilities management activities
BDA	8319	Other management services, except construction project management services	10.2.1.3	Business and management consulting and public relations services	7020	Management consultancy activities
BDA	8344	Technical testing and analysis services	10.1.2	Other research and development services	7120	Technical testing and analysis
BDA	8392	Design originals	10.1.1.2	Sale of proprietary rights arising from research and development	7410	Specialised design activities
BDA	8393	Scientific and technical consulting services n.e.c.	10.3.1.3	Scientific and other technical services	7490	Other professional, scientific and technical activities n.e.c.

NDE type*	CPC 2.1 Code	CPC description	EBOPS 2010 Code	EBOPS description	ISIC Rev. 4	ISIC description
BDA	8394	Original compilations of facts/information	9.3.2	Information services - Other information services	5812	Publishing of directories and mailing lists
CC	842	Internet telecommunications services	9.1	Telecommunications services	61	Telecommunications
CC	7331	Licensing services for the right to use computer software and databases	8.3	Licenses to reproduce and/or distribute computer software	5820	Software publishing
CC	8315	Hosting and information technology (IT) infrastructure provisioning services	9.2.2	Computer services - Other computer services	6311	Data processing, hosting and related activities
CC	8316	IT infrastructure and network management services	9.2.2	Computer services - Other computer services	6202	Computer consultancy and computer facilities management activities
CC	8434	Software downloads	9.2.1	Computer services - Computer software	5820	Software publishing
CC	83141	IT design and development services for applications	9.2.2	Computer services - Other computer services	6201	Computer programming activities
CC	83142	IT design and development services for networks and systems	9.2.2	Computer services - Other computer services	6202	Computer consultancy and computer facilities management activities
CC	83143	Software originals	9.2.1	Computer services - Computer software	5820	Software publishing
CC	84392	On-line software	9.2.1	Computer services - Computer software	5820	Software publishing
CC	84394	Web search portal content	9.3.2	Information services - Other information services	6312	Web portals
CC	84399	Other on-line content n.e.c.	9.3.2	Information services - Other information services	5819	Other publishing activities

NDE type key: CC: Cloud Computing Software and Services; BDA: Big Data Analysis Software and
Source: AI: Artificial Intelligence Software and Services

Figure 2: Data production and usage in the United States, 2014



Source: van de Marel, 2015, p. 3.

Table 3: Complementary Grouping of ICT-Services and ICT-Enabled Services

1.1 ICT services - Telecommunications	ICT services
1.2 ICT services Computer services (including computer softwatre)	
1.3 Sales and marketing services, not incl. trade and leasing services	Other potentially ICT enabled services
1.4 Information services	
1.5 Insurance and financial servicesù	
1.6 Management, administration, and back office services	
1.7 Licensing services	
1.8 Engineering, related technical services research and development (R&D)	
1.9 Education and training services	

Potentially ICT-enabled services

Source: UNCTAD, 2015.

Table 4: McAfee on-line services categories and share of page views for 651,000 websites, 2014.

McAfee Category	Share of page views	McAfee Category (continues	Share of page views
Search Engines	22.2%	Sports	1.2%
Social Networking	8.9%	Technical Information	1.2%
Portal Sites	7.0%	Media Sharing	1.0%
Online Shopping	6.0%	Public Information	0.9%
Business	4.6%	Illegal Software	0.8%
Internet Services	4.4%	Fashion/Beauty	0.8%
Streaming/Downloading Media	3.8%	Web Applications	0.7%
Blogs/Wiki	3.8%	Real Estate	0.6%
General News	3.6%	Job Search	0.6%
Entertainment	3.1%	Health	0.6%
Pornography	2.9%	Web Ads	0.5%
Marketing/Merchandising	2.8%	Government/Military	0.5%
Auctions/Classifieds	2.8%	Recreation/Hobbies	0.4%
Education/Reference	2.1%	Dating/Personals	0.4%
Finance/Banking	2.1%	Motor Vehicles	0.4%
Software/Hardware	1.8%	Gambling Related	0.3%
Forum/Bulletin Boards	1.6%	Malicious Sites	0.3%
Games	1.5%	Parked Domain	0.3%
Travel	1.2%	Others	2.1%

Source: Alveras and Martens (2015, Table 5, p. 27

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E Capturing emerging phenomena

E1 Is digitalisation changing labour markets? And what statistics are needed to help policy makers?[1]

Neil Kay and Werner Vanborren[*]

Introduction

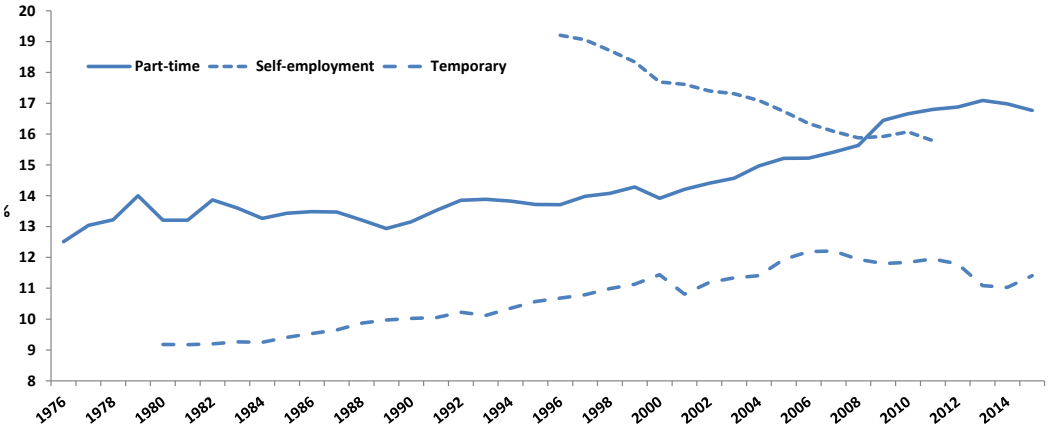
Digitalisation has been part of advanced economies for more than fifty years since the dawn of computers and telecommunications. Throughout this period there have been concerns that digitalisation separates and automates many tasks which, hitherto, made up full-time permanent employment. The rapid rise of the collaborative economy and new platform business models have reinforced concerns that full-time employment is being displaced by commoditising work into tasks crowdsourced via the internet (OECD 2016; ETUI 2016; EESC 2016).

We first use official statistics of labour market trends in order to estimate the impact of digitalisation on flexible types of employment within OCED economies. Secondly, against the findings of this analysis, we suggest a broader range of statistics that can help policy makers manage the changes in the labour market and in particular those arising from the collaborative economy.

TRENDS IN FLEXIBLE EMPLOYMENT

*B*ased on surveys, the collaborative economy is mainly creating flexible employment (part-time, temporary and self-employment) rather than permanent full-time jobs[2]. This finding is broadly in line with official statistics which show long term shifts in the labour market toward more part-time and temporary employment. On the other hand, self-employment in OECD economies[3] has been declining for many years (see **Figure 1**).

Figure 1: Flexible employment in OECD economies (average)



Note: Part-time employment measured as a percentage of total employment. Temporary employment measured as the percentage of dependent employees (i.e. wage and salary workers). Self-employment is measured as the percentage of employment.
Source: OECD

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(1) The information and views expressed in this article are solely those of the authors and do not represent the position of DG GROW or the European Commission.
(2) SWD(2016)184. European Commission Staff Working Document accompanying the Communication on the collaborative economy. Pages 36-38 include a summary of survey findings.
(3) This is the earliest available year in OECD data.

FACTORS WHICH INFLUENCE FLEXIBLE EMPLOYMENT

Whilst digitalisation may be partly associated with these trends, other relevant factors should also be taken into account. These include in particular structural change, demographics and cyclical developments.

As economies mature, there is a shift from agriculture and manufacturing toward services. This process is associated with more part-time and temporary work because these types of work are more prevalent in services. With respect to demographics, three quarters of part-time work is carried out by women hence the participation rate of female workers is likely to affect the proportion of part-time work. Population ageing may also have an effect, if older cohorts prefer flexible to full-time permanent employment. Finally, the amount of flexible employment may also be influenced by short-term cyclical factors. For example, when demand weakens, it is more economical for enterprises to release temporary employees before full-time workers.

ESTIMATION OF THE IMPACT OF DIGITALISATION ON FLEXIBLE EMPLOYMENT

As a proxy for digitalisation, the value added of the ICT sector in proportion to total output was selected. This indicator varies significantly between OECD economies with respect to current levels (2014) and change in level since the millennium *(**Figure 2**)*. Hence prima facie there is no obvious link between this indicator and the trends in flexible employment *(**Figure 1**)*.

The impact of the above mentioned factors was estimated in a panel regression model on a dataset of OECD economies.

The results in **Table 1** show that an increase in the proportion of ICT value added is associated with an increase in all three forms of flexible employment. The strongest effect is on temporary employment where a 1 percentage point (pp) increase in the proportion of ICT value added is associated with a 1.23pp increase in the proportion of temporary employment. An interesting finding is that although there is a long-term decline in the proportion of self-employment in OECD countries *(**Figure 1**)* on average, increasing digitalisation is associated with more self-employment after controlling for country specific factors.

The findings suggest that digitalisation is associated with an increase in flexible types of employment and that as digitalisation increases (as a proportion of economic activity), the proportion of flexible employment in the labour market can be expected to increase, ceteris paribus. However, the findings only go a short way to providing the statistical information that policy makers need to address changes in the labour market.

Table 1: Impact of digitalisation on flexible types of employment

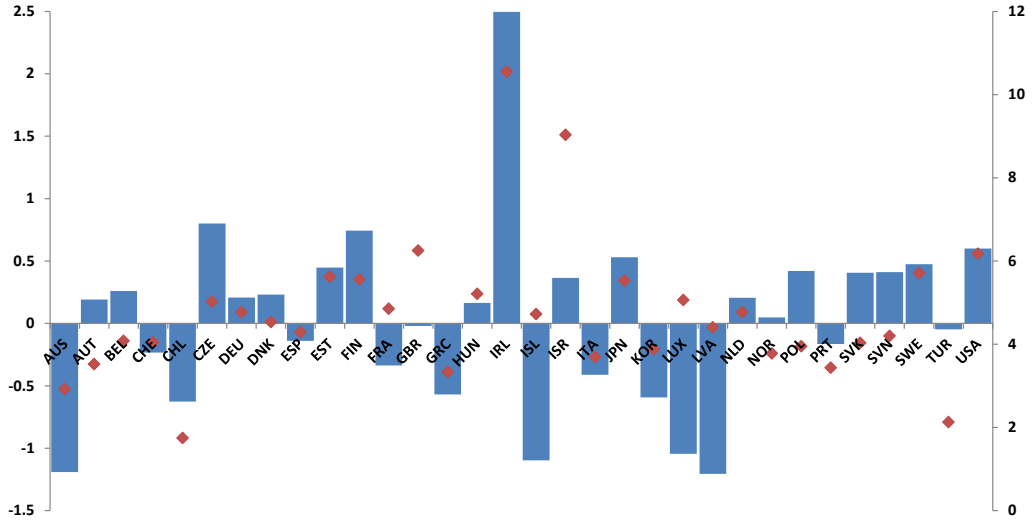
	GDP per capita	Manufacturing value added	Female participation rate	Demographic shift	Unemployment	Digitalisation[4]
Part-time	4.42E-05**	-2.68E-02	2.91E-01***	-2.01E-01**	3.38E-01***	1.83E-01.
Temporary	1.07E-04***	1.89E-01**	-4.88E-02	7.89E-02	-1.61E-01***	1.23***
Self-employed	-3.84E-05*	-1.93E-01***	-3.18E-01***	1.97E-01*	-1.29E-01***	3.47E-01*

Note: *The row variable show the increase in the three types of flexible employment associated with a one percentage point change in a column variable. Specifically, the model includes the following controls: GDP per capita, manufacturing valued added as a proportion of total value added, female workers as a proportion of the workforce, the proportion of working age people, and the level of total employment. The model was estimated using OLS regression with fixed effects for country/economy and year based on the result of a Haussmann test. The dataset and full results are available on request.*
*Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1*

Source: own calculations.

(4) As a robustness check on the results, ICT investment (as a percentage of total non-residential gross fixed capital formation) was also applied in the same model as a proxy for digitalisation. This had, similar, positive effects on part-time and self-employment, whilst there was no statistically significant relationship with temporary employment.

Figure 2: ICT value added in 2014 (%, rhs) and change between 2000-2014 (pp, lhs)



Source: OECD, own calculations

WHAT STATISTICS DO POLICY MAKERS NEED TO UNDERSTAND THE CHANGES IN THE LABOUR MARKET?

To properly understand and manage the effects of digitalisation on the labour market, policy makers require a wide range of statistics, aimed at both measuring developments in the collaborative economy and measuring changes in the labour market.

Enhanced statistics on measuring digitalisation and employment from official sources

Official statistical sources contain limited information on digitalisation. Statistical schemes, such as NACE, typically do not encode the method of production of manufactured goods, e.g. manual or automated, or means by which services are delivered. The description of NACE 2 includes a disclaimer to this effect on the classification of manufacturing activities[5] and in services only retail sales are sub-categorised as 'via mail order or internet' (Code: 47.91)'. NACE 2 was launched in 2002 when revenues from internet retail were becoming significant. Later NACE revisions could conceivably sub-categorise the delivery of services as via platforms or peer-to-peer, for sectors such as transport, accommodation and finance services.

In principle, supply and use tables could also help in assessing the impact of digitalisation on employment at a sector level by examining the impact of intermediate inputs on particular sectors. Eurostat supply and use tables provide information on, Telecommunications (J61) and Computer programming, consultancy, and information service activities (J62_63) which could serve as proxies for digitalisation[6] and provide a measure of intermediate inputs into various (use/output) industries. However, currently NACE only contains information on types of employment at the highest level of sectorial categories (1 digit level); hence some dis-aggregation would be required to directly observe or estimate the effect of intermediate inputs of digitalisation on employment. Also, data coverage across supply and use tables would have to be improved, in particular within the two sectors noted above.

Statistics from alternative sources to measure developments in real time

Most observers agree that the collaborative economy is significant and growing rapidly but there is a shortage of reliable statistics upon which to measure its development. This is due to several factors including the newness of many platforms, few publically accessible financial accounts of platforms, and a classification gap in official statistics as noted above. This leaves a gap that could potentially be filled by other sources.

Platforms offer a very rich source of statistical

(5) Nace Rev. 2. P.15 "The manufacturing activities are described independently of whether the work is performed by power-driven machinery or by hand, or whether it is done in a factory or in a household. Modern versus traditional is not a criterion for NACE". http://ec.europa.eu/eurostat/documents/3859598/5902521/KS-RA-07-015-EN.PDF.

(6) The OCED TIVA dataset has a more disaggregated level of categorisation (34 industrial sectors) but does not contain matching information on employment.

information due to their capture and storage of large amounts of data on services and providers. For example, in 2014, Airbnb reported over 30 million overnight stays globally[7] with half of guests staying in Europe. Platforms of this scale can provide a good indication of sector level developments that can't be gained from small ad hoc surveys. In addition, they can be a source of further information on employment, including average earnings, the frequency of services delivered by providers, and the distribution of earnings at a regional and local level, all of which are valuable to policy makers.

There is a growing amount of publically accessible data on the internet which offers the potential to estimate indirectly economic behaviour in real time. In this regard, there is a growing body of research on 'now-casting' value added and other economic variables from Google search histories (Google Trends) (Baldacci et al 2016; Matias 2013). This data has many benefits over survey data, e.g. in terms of immediacy, scale, breadth (e.g. country coverage) and greater flexibility/specificity compared to pre-classified statistical schemes. For example, Google search results offer the possibility to give clues to enterprise level developments that can be aggregated to provide a measure of sector level activity. This is particular useful where an emerging sector is not classified in official statistics such as the collaborative economy. However, there are important challenges in associating Google trend data or other web scraped data with economic variables such as revenue, value added or employment on a technological, statistical and institutional level (Baldacci 2014).

Crowdsourced datasets such as Numbeo offer another alternative to gather information that can be useful to policy makers, particularly on conditions of employment such as remuneration. Data on remuneration for various types of work provided via online platforms was gathered in this manner, as well as by web scraping individual platforms, to support the Commission communication on a European Agenda for the collaborative economy (EC 2016b; De Groen et al 2016). The data was used to compare remuneration levels via platforms with remuneration for similar jobs in the 'traditional' labour market.

Statistics on employment conditions from surveys

Current survey findings suggest that work undertaken in the collaborative economy is mainly additional to other employment (Berg 2016; Burston-Marsteller 2015). However, if flexible working becomes a replacement for permanent employment, it will have important implications for the broader economy. For example, more flexible work may imply lower levels of social contributions/protection, particularly if it is undertaken on a casual basis. In addition, there may be a reduction in the skills base as employers tend to invest more in employees on full-time permanent contracts (OECD 2016a). This in turn could negatively affect long-term productivity.

Regular targeted surveys may be one of the best sources of statistics for answering these more complex questions targeted at providers in the collaborative economy.

Statistics to assess the impact of the collaborative economy on taxation

As the collaborative economy may be driving a rise in informal work and self-employment, there is concern that it may have an effect on tax levels and compliance. This could arise from several effects. For example, salaried employment could be replaced by informal work carried out by several providers who each fall beneath the tax threshold. Secondly, salaried employment could be replaced by self-employed who pay less tax on the work undertaken. Thirdly, tax compliance may diminish due to the absence of a third party involved in tax collection (OECD 2016b) such as an employer. Finally, tax compliance may decline due to a lack of knowledge of the part of providers regarding tax obligations and the ease at which they are able to make payments (Finkelstein 2009).

The digital foundation of the collaborative economy can help mitigate some of these effects. Electronic payment systems increase tax salience by providing traceability and making it easier for payments to be made between consumers and providers (A.T. Kearney 2011). Collaborative platforms may also attract some activity from the informal sector that was erstwhile settled in cash. Current approaches to data collection may need to be revised to make use of future technologies, such as digital

(7) http://blog.airbnb.com/airbnb-growth-europe/, http://blog.airbnb.com/wp content/uploads/2015/09/Airbnb-Summer-Travel-Report-1.pdf

tax accounts for entrepreneurs that can ensure continued access to information. The broader statistical description of the collaborative economy should help in characterising positive externalities for which authorities may want to design specific tax incentives (DG TAXUD 2016).

Whilst statistical authorities should avoid a policing role, there is likely to be a greater need for reliable statistics on the collaborative economy to at least gauge against levels of recuperated taxation. Primarily, statistics on the size and growth of the collaborative economy are essential as a basis for further analysis. Secondly, feedback from providers via surveys on the ease of paying taxes in the collaborative economy could be used to improve tax administration. Thirdly, it will be valuable to collect accurate and perhaps more frequent statistics on the size of the informal sector (Eurostat 2016) in order to observe if there is any impact from the rise of the collaborative economy, and to assess the broader implications for taxation. Finally, existing tax revenue statistics (EC 2016c) will require fine-tuning and guidance in the collection of data on national taxes raised to provide for a more accurate distinction between revenues from employment versus self-employed.

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E2 The 'grey area' between employment and self-employment: implications for official statistics

Teemu Kautonen and Ewald Kibler(*)

Introduction

Official statistics traditionally classify work in terms of employment or self-employment. This is a useful classification for policy regulating, for example, unemployment, pension and other welfare schemes, where employed and self-employed individuals are often treated differently. However, two current phenomena question the policy relevance of sole reliance on the traditional classifications of employment and self-employment. One concerns individuals who receive a salary and a self-employed income at the same time (Folta et al., 2010; Thorgren et al., 2016). The other is the emergence of new forms of work that fall into the 'grey area' between the traditional classifications of employment and self-employment (Kautonen et al., 2010).

We argue that policy makers would benefit from official statistics that capture the contemporary forms of work in a more fine-grained manner than the employment versus self-employment dichotomy. This information would not only allow the policy makers to understand how the world of work evolves, but through this understanding, they could ensure the relevance of regulations and welfare regimes for all individuals notwithstanding what form of work they engage in. In the following, we explore several extensions to the dichotomy of employment versus self-employment. We also present initial ideas for how these concepts could be operationalised in survey studies.

HYBRID FORMS OF WORK

With the decline of career patterns where workers spend their whole career in one organisation, combining elements of paid employment and self-employment is becoming more typical in contemporary careers. This reflects the concepts of 'protean' and 'boundaryless' careers (Briscoe et al., 2006; Hall, 2004) where the individual, not the organisation, is in charge of the career. Switching employers frequently is as normal as are varying spells of self-employment followed by employment, and vice versa. Portfolio careers, where an individual might have a job and run a business at the same time, are also not untypical.

Maintaining the relevance of the pension and social security systems in the face of evolving patterns of work is a challenge for European policy makers. Often employees enjoy a higher level of protection and a more generous benefits status compared to the self-employed, who have more responsibility over their own pensions and insurances. If careers that combine employment and self-employment become more common, the question arises whether making a distinction between the traditional forms of work in welfare policy is meaningful, efficient and equitable.

Against this backdrop, we propose that official statistics such as the Labour Force Survey should allow for hybrid forms of work and contain variables that capture career dynamics. Instead of inquiring, for example, for the present self-defined employment status, survey studies could ask about the relative importance of paid employment and self-employment for the respondent. The question could concern the relative importance of those forms of work in terms of the individual's total income or the weekly number of hours worked. Furthermore, surveys could capture this information for

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the recent past such that the policy analyst would see how much fluctuation there is in the relative importance of self-employment and employment. Similarly, surveys could inquire about the number of jobs and spells of self-employment that the respondent has had in the past two to three years in cross-sectional studies, and in the period since the previous wave in longitudinal surveys. This would give information on the dynamics of people's careers.

QUASI SELF-EMPLOYMENT

In this section, we explore a 'hidden' form of work that lies in the regulatory grey area between employment and self-employment. We use the term 'quasi self-employment' (Kautonen et al., 2010; Schmidt and Schwerdtner, 1999) to refer to work arrangements where an individual is formally self-employed but in many ways, de facto an employee. This phenomenon has received media attention especially on the initiative of trade unions, which have expressed concerns about employers 'pushing' employees to become self-employed subcontractors in order to avoid the obligations inherent in employment relationships.

Policy concerns related to these work arrangements concern the disadvantages experienced by the individuals from being self-employed compared to being in an employment relationship. These include loss of trade union representation, being outside the protective sphere of laws regulating employment relationships, and a social security status that is inferior compared to employees (Kautonen et al., 2010). Moreover, research suggests that these individuals may experience higher levels of stress due to the low and fluctuating levels of income related to operating in the margins of entrepreneurship (Block and Wagner, 2006; Bögenhold and Fachinger, 2007).

Although the evidence on the prevalence of quasi self-employment is mostly anecdotal with the exception of one relatively small study in Finland (Kautonen et al., 2009), official statistics accounting for this phenomenon would provide policy makers a realistic picture of how widespread quasi self-employment actually is, how it evolves over time, and with inferential analysis, also what implications these work arrangements have for the individuals. For this purpose, we next follow Kautonen et al. (2009) in proposing five empirical criteria that could be used to identify quasi self-employment[(1)]. The more of these criteria that a work arrangement meets, the more likely it is quasi self-employment. At the same time, it should be noted that none of these criteria in and by themselves define quasi self-employment and many of them are perfectly typical in 'genuine' self-employment (see Kautonen et al., 2009 for a detailed discussion).

The first criterion is the individual being classified as self-employed. We propose that instead of self-defined employment status, an objective criterion can be used, such as how the individual's work status is defined for tax purposes. The second criterion is that the self-employed individual does not have any employees. This can be asked as a follow-up question to all individuals identified as self-employed in survey studies. An additional advantage of this question is that it gives us data on the economic externality of job creation by the self-employed.

The third criterion is a strong economic dependence on a single principal, possibly the former employer. This dependence limits the individual's freedom to develop their business as they wish, which is typical of 'genuine' self-employment. Survey questions suitable for capturing this facet of quasi self-employment include the number of clients the self-employed worker has or the share of turnover generated by the most important client. Another question could inquire whether the self-employed individual works within a third organisation that is not their direct client but to whom they pay part of their income as rent (e.g., Uber drivers; self-employed hairdressers renting a chair in a salon). This would capture work arrangements where the employer offers work in a subcontracting relationship, thus shifting the demand risk from the employer to the self-employed worker.

The fourth characteristic relates to the degree of integration of the self-employed worker in the principal's organisation: to what extent the principal can exert managerial authority over the self-employed worker. A survey can operationalise this, for example, by asking to what extent the principal client can determine the time and place of work and whether the self-employed worker operates under the client's brand.

(1) Because the discourse on quasi self-employment often assumes that individuals only take up self-employment for lack of viable employment alternatives, it is sometimes referred to as 'involuntary self-employment' (Kautonen et al., 2010). However, we contend that because involuntariness is subjective, it is mainly relevant for policy analyses where the objective of analysis are phenomena such as job satisfaction, stress, or quality of life. In this note, we constrain the discussion to the regulatory perspective and use the neutral term quasi self-employment.

The fifth possible characteristic of dependent self-employment is that the impulse for the individual's becoming self-employed came from the former employer and/or from the present exclusive client. An example of such an external impulse is the employer's decision to outsource a function formerly performed by an employee and contract the same employee to perform this function as a self-employed worker. One possible way to operationalise this criterion would be to identify respondents who meet the other four criteria and then ask whether the idea for the current self-employment came from the individual her- or himself, or the current principal client or the third party firm under whose banner the self-employed worker operates.

QUASI EMPLOYMENT

The underlying logic of the discussion surrounding quasi self-employment is the potentially incorrect classification for welfare purposes of a de facto employed person as self-employed. Could the opposite case also exist and if so, what are its policy implications?

We argue that project-based work can be close to self-employment. This is more so if the individual is responsible for project acquisition in order for their employment to continue beyond the current project, or if the individual moves between units or organisations, de facto selling their expertise to the projects that need it. Consultancy and research work in externally funded projects are typical examples of this type of work arrangement that we in this note call quasi employment.

The policy implications in this case are (even) less straightforward than in the case of quasi self-employment. In principle, individuals in quasi employment enjoy an employee's legal and social security status, and they can also be members of a trade union. It is however possible that their status differs from those in permanent employment relationships, for example because a full benefits status requires a certain amount of time with the same employer that the individual's project work does not achieve. Even though quasi employed individuals received a monthly salary, the security of income only concerns the fixed period of the project. Hence, the work contains an element of uncertainty over the longer-term level of income, similar to self-employment (Kautonen et al., 2014). Assuming for the sake of argument that the benefits status in quasi employment was below that in permanent employment, and the income secure for a short fixed period of time, the following policy questions emerge: do and/or should regulations incentivise quasi employment and are people in such work arrangements treated equitably in the welfare regime?

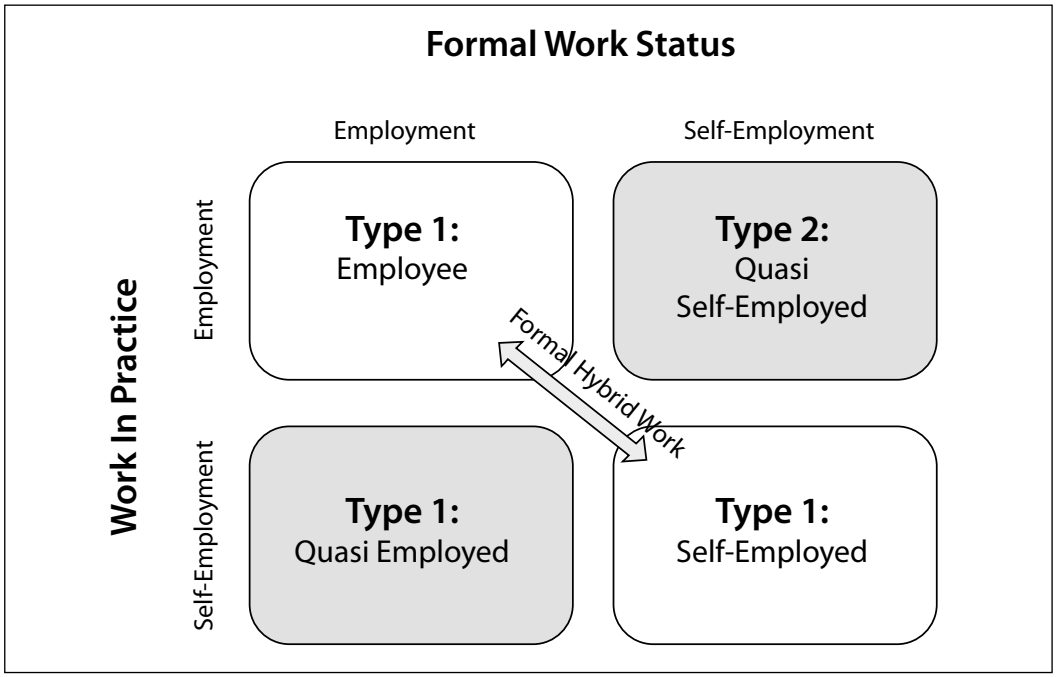
Having information on the magnitude and individual-level consequences of such precarious employment would allow the policy maker to adjust the unemployment, pension and other elements of the welfare regime to ensure their relevance to this possibly growing group of workers. Empirical indicators could include variables such as the number of employment contracts within a reference time period, the number of employers in the same time period, the share of total income that is based on performance, and the degree of responsibility for acquiring the work that earns the income. Similar to quasi self-employment, the more of these criteria an individual's work meets, the more 'entrepreneurial' or akin to self-employment their employment is.

CONCLUDING REMARKS

In this note, we argued that forms of work that are more precarious than traditional permanent employment relationships appear in the legal forms of employment and self-employment. **Figure 1** summarises the above discussion on hybrid forms of work (being employee and self-employed at the same time), quasi self-employment (Type 2) and quasi employment (Type 3) as a fruitful way forward to capture the multifaceted contemporary forms of work more accurately than the traditional dichotomy of employment versus self-employment.

Further, we suggest that even though these precarious forms of work are often associated with disadvantages especially when compared to permanent employment relationships, this is not the whole story. For example, Hytti et al. (2013) demonstrated that work characteristics often associated with self-employment, such as the degree of autonomy and variety in work, were significantly and positively related to job satisfaction. In fact, the study found that these characteristics of work predicted job satisfaction much better than the official employment status (employee versus self-employed). Therefore, individuals whose work meets the criteria for quasi self-employment or quasi employment – which both involve entrepreneurial elements such as an uncertain level of income – might be quite happy with their work. If that was the case, excessive regulation making these types of work difficult might do more harm than good. Official statistics that follow the development of the forms

Figure 1: Online platforms and skills demand



Source: Forms of work

of work in the grey area between employment and self-employment would aid in making these assessments.

In addition to the forms of work addressed in this note, other related extensions that official statistics such as the Labour Force Survey could consider relate to assessing the entrepreneurial potential in society. Official statistics have limited information to offer on entrepreneurship beyond the employment versus self-employment dichotomy. But self-employment comes in many forms. Some of them differ little from employment relationships and contribute little more to society than a person in an employment relationship, whereas more growth-oriented entrepreneurship and new forms of ambitious social enterprises can provide significant benefits to society. The Global Entrepreneurship Monitor (www.gemconsortium.org) and the Panel Study of Entrepreneurial Dynamics (www.psed.isr.umich.edu) offer a number of easy-to-implement measures for assessing the types of entrepreneurship within the employment status category of self-employment, as well as the latent entrepreneurial potential among those who are employed, unemployed and outside the labour force.

In summary, we make the following suggestions of how the 'grey area' of employment relationships could be better captured in official statistics such as the Labour Force Survey:

Identify individuals who are employees and self-employed at the same time and measure the relative importance of these forms of work to them.

Include variables to identify quasi self-employment: (1) self-employment status as defined for tax/social security purposes; (2) number of employees; (3) dependence on a single client or a third-party organisation to which the self-employed worker pays rent and under whose brand they operate; (4) the degree of managerial authority that the client or third-party organisation can exert over the self-employed worker; and (5) the origin of the idea to become self-employed (the respondent's own idea versus an external party's idea).

Incorporate new variables to identify quasi employment: (1) employee for tax/social security purposes; (2) the number of employment contracts and employers over a certain period of time, such as the last 12 months; (3) length of current employment contract, (4) the share of performance-based salary from total salary; (5) the degree of responsibility for acquiring new projects/contracts for continuation of employment.

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E3 Addressing gaps in data on investment: A focus on infrastructure and intangible investment[(1)]

Debora Revoltella and Christoph Weiss[(*)]

RECENT DEVELOPMENTS IN INVESTMENT IN THE EU

The large decline in gross fixed capital formation (GFCF) in the EU during the recession of 2008-09 and the weak dynamics in the subsequent years have been of primary concern for policy makers. Real investment in the EU fell sharply between 2008 and 2013 despite a brief recovery episode in 2010-11[(2)]. It has been recovering since early 2013 but the performance is not homogeneous among countries and asset classes. A protracted period of low investment might affect growth in the short term, but also potential growth in the medium to long term, in particular if key areas of the economy are affected. In addition to national accounts, economists need to rely on other sources of macroeconomic data to analyse important aspects of investment, including infrastructure investment and intangible investment, and they increasingly make use of firm level data. The availability and quality of the data on investment are thus critical to support effective policy making.

To better understand whether the development in investment is different in some parts of the economy, GFCF in national accounts is typically disaggregated by assets classes and sectors. For instance, when GFCF is disaggregated by asset classes, the data on new intellectual property products (IPP) items – an important driver for long term competitiveness – are widely available for almost all EU member states. With respect to the breakdown of GFCF by sector or activity, the data are more limited as the series are not available at quarterly frequency or for many years in all EU member states. To better analyse public investment, it would be also useful if the data were available not only by government function, but also by asset types.

Corporate investment fell sharply at the beginning of the crisis but it is now the main contributor to investment growth at the EU level. More specifically, expenditure on machinery and equipment and IPP – investment typically made by private corporates – is leading the recent recovery of investment. At the same time, eight years after the beginning of the crisis, GFCF in construction, both residential and non-residential, remains low relative to pre-crisis levels. The contribution of the government sector to the dynamics of investment was positive in the aftermath of the financial crisis but it has been negative since the sovereign crisis, as fiscal consolidation in many countries has been penalising government GFCF. The household and general government sectors together account for 80% of the difference between the level of investment in 2016 and 2008.

Although IPP investment has been positively contributing to investment growth throughout the crisis, it remains at a relatively low level in terms of GDP in the EU and the dynamics over the last decade are weaker than those of peer global competitors, such as the USA or China. Investment in machinery and equipment has contracted in the aftermath of the financial crisis and has been recovering thereafter. However, a number of years of underinvestment might have left a backlog in terms of adoption of new technologies, with the risk of leaving Europe behind. Europe also appears to be clearly lagging behind in terms of infrastructure. Infrastructure investment has been largely below depreciation in recent years, with the ratio of infrastructure investment almost halving in some countries through the crisis period. By looking at aggregate and disaggregated data, the picture that emerges for the EU is a recovery of investment

(*) European Investment Bank
(1) The information and views expressed in this article are solely those of the authors and do not represent the position of the European Investment Bank.
(2) See, e.g., EIB (2016).

but it also points out to the remaining gaps, calling for stronger and more effective targeted policy actions in some specific areas, and this will be supported by more and better data on investment.

INFRASTRUCTURE INVESTMENT

Data on infrastructure investment, let alone its financing sources, are not available in any ready-to-use form, which makes it difficult to document the evolution in infrastructure investment in Europe. However, to design macroeconomic policies aimed at stimulating sustained and inclusive economic growth, it is critical to have a better understanding of the trends in infrastructure investments made by the public and private sectors. There is a clear need for an official definition of infrastructure and it would be helpful if national statistical would report on infrastructure stocks and infrastructure investment.

Revoltella and Brutscher (2016) build on the approach first suggested by Wagenvoort et al. (2010) and exploit a recent change in national accounts to discuss developments in infrastructure investment in the EU. The idea of Wagenvoort et al. (2010) was to use data from national accounts on GFCF in the infrastructure sectors (i.e. education, health, transport and utilities) to construct estimates of total and government infrastructure investment. Private investment was then derived as the difference between the two. In a next step, they broke down the private infrastructure aggregate with the help of Projectware data. This allowed them to distinguish between corporate (non-project) infrastructure investment and investments made through Special Purpose Vehicles (SPVs, i.e. projects). Data on SPVs could be further divided into Public-Private Partnership (PPP) projects and non-PPP projects, using data described in Kappeler and Nemoz (2010).

Revoltella and Brutscher (2016) find that the introduction of the ESA 2010 national accounting categories gives a much more accurate estimation of infrastructure investment in Europe. With the change in national accounts, it is possible to distinguish between GFCF in the infrastructure sectors by different asset class as the data can be disaggregated between GFCF in total fixed assets in the infrastructure sectors and GFCF in other buildings and structures. This means that many investment activities that are unrelated to infrastructure can be excluded from the analysis – such as investments in trucks or in other machinery and equipment, which are included in total fixed assets. This reduces the risk of overestimating infrastructure investments. In addition, it is now possible to differentiate between GFCF in the transport and ICT sectors, which were previously lumped together, and this gives a more granular view on investment trends across different sectors.

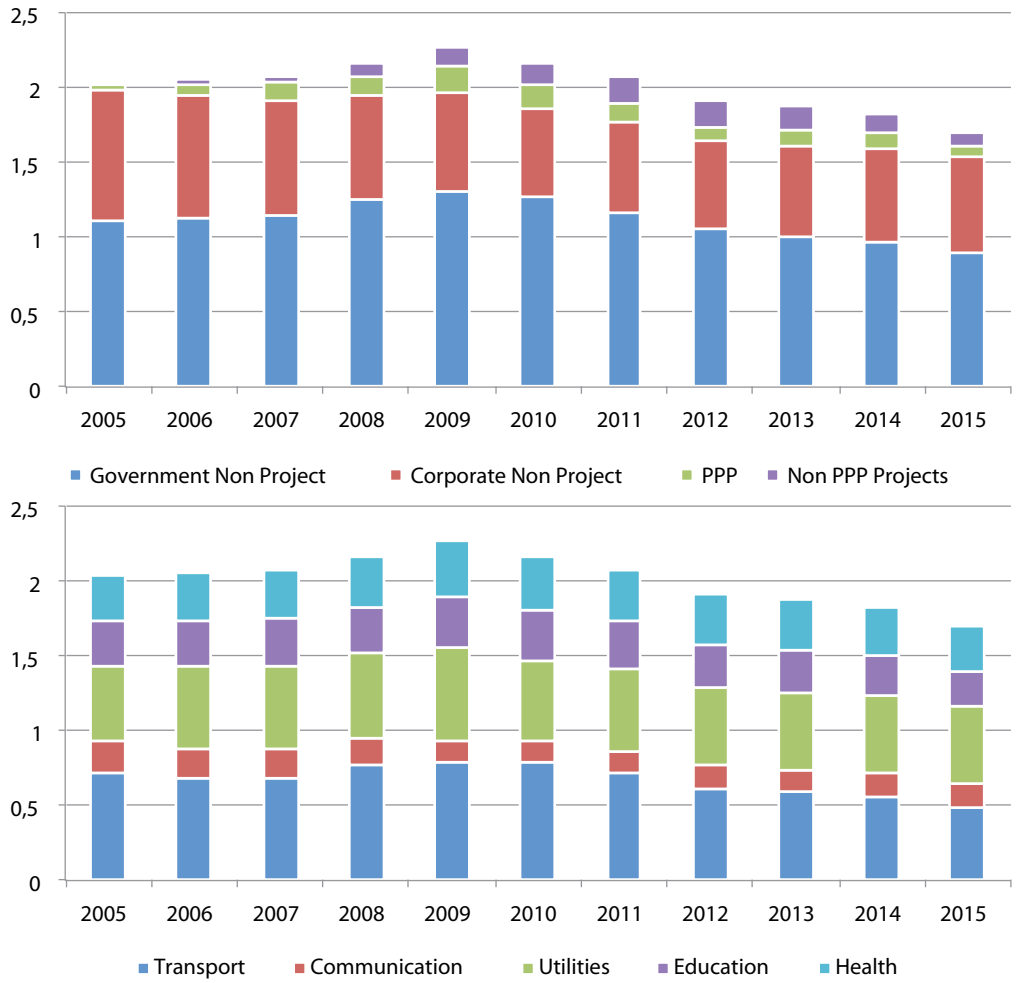
Although the new data better captures infrastructure investment, a few caveats remain. For instance, it not possible to distinguish between GFCF in total fixed assets and GFCF in other buildings and structures for the government sector. To approximate government's investment in other buildings and structures, Revoltella and Brutscher (2016) use the share of other buildings and structure in the government capital stock as a proxy for the share of government GFCF in other buildings and structures (adjusted for differences in depreciation rates). In other words, they assume that the share of government GFCF in other buildings and structures is equal to its historical share[(3)].

The estimates show that infrastructure investment has been falling after 2009 – and that this has been largely driven by a fairly dramatic decline in government infrastructure investment (**Figure 1**). Infrastructure investment by the corporate sector fell at the start of the crisis but public infrastructure investment accounts for most of the difference since 2010. While the ratio of government investment to GDP is close to its long-term average, government investment in infrastructure is substantially below the long-term average, indicating that fiscal consolidation has been the main driver of the decline.

This new measure of infrastructure investment remains a proxy, as there are no official statistics on infrastructure investment. The data used in the analysis are typically available with a large time lag and they are not always available for all countries or years. It would be also useful to have more and better data at the regional level within countries, as sub-national governments account for a large part of infrastructure investment. So

(3) Revoltella and Brutscher (2016) also make additional data adjustments. First, when data on the net capital stock of a country is missing, they replace the missing value with the average net capital stock of the region in which the country is located (i.e. Northern Europe, Southern Europe or Central and Eastern Europe). Second, to deal with outliers, they set negative implied deprecation differentials equal to zero.

Figure 1: Infrastructure investment (% of GDP)



Note: Note: Belgium, Croatia, France, Greece, Lithuania, Poland, Romania are excluded from the analysis due to missing data.

Source: Eurostat, EIB/EPEC, Projectware.

far, it is not possible to apply the methodology used here to develop a proxy of infrastructure at the regional level. Another issue to address is how to better quantify investments in social infrastructure, such as education and health. For these sectors, focusing on gross fixed capital formation in other building and structures often falls short of capturing the full extent of infrastructure investment in these areas. At the same time, any adjustment will have to also take into account the need for comparability with measures of non-social or traditional infrastructure investment. Going forward, and given the importance of infrastructure investment (both in terms of expenditures and potential economic returns), the development of official statistics at the national and regional level is certainly a gap worth closing.

In addition to infrastructure investment, climate change mitigation and adaptation in the EU is another area that would greatly benefit from more data on GFCF. While national statistical agencies currently report data on GHG emissions, installed electricity generation capacity and some statistics on transport in physical units, there are hardly any data on investment in climate change mitigation and adaptation. The data would be critical to formulate long-term policies – including, for instance, data on GFCF in renewable electricity generation, investment in waste and waste-water management, investment in transport systems such as urban transport modal change (including non-motorised transport and urban mass transport), urban development (transport integration and city planning, transport demand management), and inter-urban transport modal change (intermodal terminals, water transport and railways).

INTANGIBLE INVESTMENT

Intangible investment is an important aspect

of investment that is difficult to estimate with data from national accounts. But the changing nature of the global economy has placed more attention on intangible assets as a source of economic growth. In order to understand how intangible assets can be a driver of value creation for individual firms and the economy as a whole, it is important to measure them properly. Although the fixed asset boundary in national accounts has been continuously expanded to better account for the role of intangibles, official estimates treat only a limited range of intangible assets as investment. For instance, the treatment of intangible assets in national accounts has changed with the decision to capitalise software expenditure as capital formation. Software is an important category of intangible assets as it can transform knowledge into computerised information. With the adoption of the European System of National and Regional Accounts 2010 (ESA 2010, which replaces ESA 1995), R&D expenditure is also capitalised as capital formation. However, other intangible assets are notoriously difficult to measure or are simply not measured systematically or consistently across firms or countries and over time.

Corrado et al. (2005) have expanded the core concept of business investment in national accounts by treating as intangible investment much business spending on intangible assets – including design, brand equity, firm-specific training, and organisational efficiency. They define intangible assets as investments that enable knowledge to be commercialised and classify them into three broad categories: computerised information, innovative property and economic competencies (see **Table 1**). Some of the intangible assets are already capitalised in national accounts (SNA 2008/ESA 2010), including R&D, mineral exploration, computer software and databases, and entertainment, literary and artistic originals. But expenditures for design, branding, new financial services, organisational capital and firm-provided training are instead currently treated as intermediate costs in national accounts.

EIB (2016) uses a newly revised and updated release of the INTAN-Invest dataset providing harmonised measures of business intangible investment and capital stock for the market sector of 18 European countries and the US, with data from 2000 to 2013, to analyse the diffusion of intangible investment within Europe and in the US. The measures of intangible investment in EIB (2016) are obtained following the same estimation strategy adopted in the previous releases of INTAN-Invest but resort to new national account data sources[4].

In 2000-2013, the average share of intangible

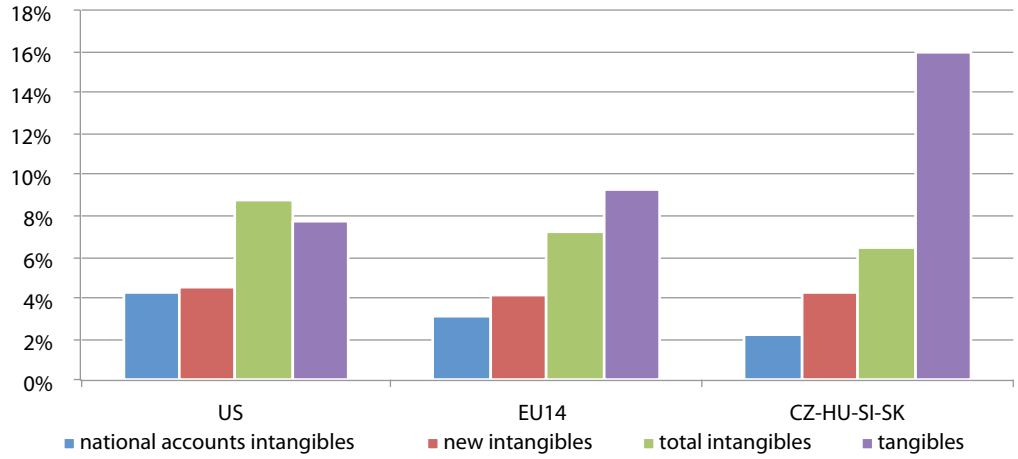
Table 1: Intangible assets and national accounts conventions

Asset	Intang included in Nat Accounts	Capitalisation Factor	Depreciation rate
Computerized Information			
Purchased Software	Yes	1	0.315
Own-Account Software	Yes	1	0.315
Database	See note	1	0.1315
Innovative property			
R&D	Yes	1	0.15
Design	No	0.5	0.2
Mineral Exploration	Yes	1	0.075
Financial Innovation	No	1	0.2
Artistic original	Yes	asset-specific	asset-specific
Economic Competencies			
Advertising	No	0.6	0.55
Marketing Research	No	0.6	0.55
Own-Account Organisational Capital	1	1	0.075
Purchased Organisational Capital	No	0.8	0.4
Training	No	1	0.4

Source: Source: EIB (2016)

(4) INTAN-Invest 2016 data cover total investment in industries from NACE sections A to M (excluding M72) and section S plus the market sector component of NACE M72, P, Q and R (while previous INTAN-Invest estimates did not include industries P and Q but incorporated industry R as a whole). The analysis excludes the real estate industry (NACE section L).

Figure 2: Intangible and tangible investment (% of GDP, average 2000-2013)



Source: EIB (2016)

investment in GDP according to national accounts was higher in the US (4.2%) than in the EU14 (3.1%) as well as in the four new EU member states (NMS) included in the analysis (2.2%) (**Figure 2**). Moreover, the GDP share of tangible investment in the three areas (7.7%, 9.2% and 16.0% respectively) was higher than the intangible share. But when a broader view of intangible assets is included in the analysis, the gap in intangible investment between the European economies and the US becomes even wider. Adding new intangibles to national account assets makes the GDP share of total intangible investment increase to 8.8% in the US, 7.2% in the EU14 and 6.4% in the NMS. The estimates show that in the US the share of intangible investment outpace tangible investment, while in the EU the share of tangible investment remains larger.

The Great Recession has had a differentiated effect on tangible and intangible investment. Tangible investment fell sharply during the crisis, whereas intangible investment was relatively resilient and recovered rapidly in the US but lagged behind in the EU. As overall business intangible investment is large and growing in advanced countries (Corrado et al., 2013), the development of harmonised methods and measures of intangible capital coherent with national accounting practices is essential for a deeper understanding of the sources of economic growth. Policies designed to support research, development and innovation and to make the economic environment more conducive to investment in intangible assets should also adopt a view of innovation that is broader than R&D. This broad view of intangible investment should be better reflected in national accounts.

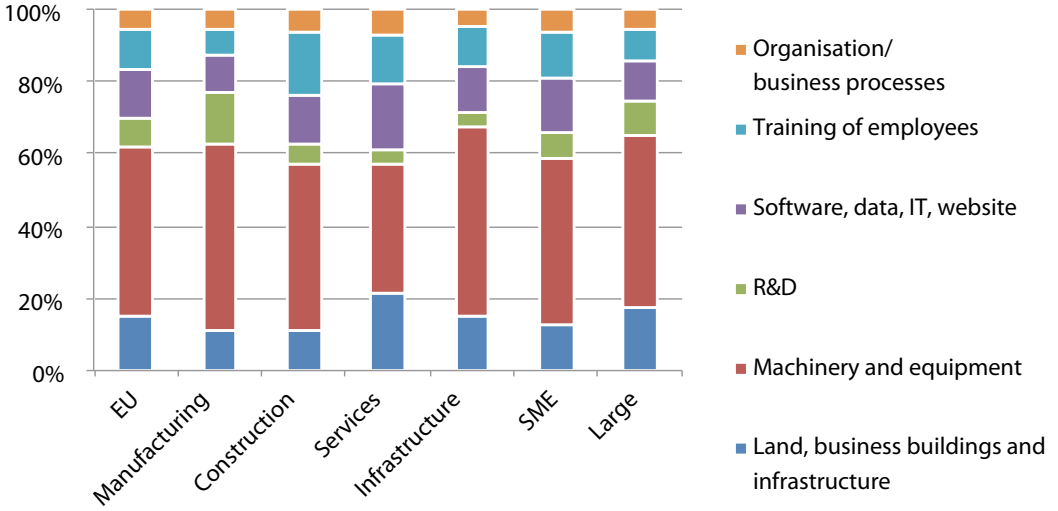
INTANGIBLE INVESTMENT IN THE EIB INVESTMENT SURVEY

The EIB Investment Survey (EIBIS) is a new initiative to better understand recent developments in business investment in the EU. EIBIS is a firm-level survey that gathers qualitative and quantitative information on investment activities by some 12,500 SMEs (with 5 to 249 employees) and larger corporates (with 250+ employees) in all 28 EU member states. EIBIS collects data on firm characteristics and performance, past investment activities and future plans, sources of finance, financing issues and other challenges that businesses face.

Using a stratified sampling methodology, EIBIS is representative across all 28 EU member states, as well as for four firm size classes (micro, small, medium and large) and four sector groups (manufacturing, services, construction and infrastructure) within countries. All firms are weighted by value-added to better reflect the contribution of different firms to economic output. EIBIS adds to existing firm level surveys on investment at the national level by providing full comparability of results across EU member states. EIBIS is also set-up so that the survey data can be linked to firms' reported balance sheet and profit and loss data provided by the Bureau van Dijk ORBIS database, a commercial database of harmonised financial statements. While this is effective, the quality and coverage of data on EU firms could be further improved through the development of a European-wide credit registry (or some similar initiatives).

EIBIS contains information on intangible investment that is self-reported by the firms participating in the survey. Intangibles

Figure 3: Investment areas, by sector and firm size and by country



Note: Question: In the last financial year, how much did your business invest in each of the following with the intention of maintaining or increasing your company's future earnings? Base: All firms who have invested in the last financial year (excluding don't now/ refused responses).

Source: EIB Investment Survey

include R&D (including the acquisition of intellectual property), software, data, IT networks and website activities, training of employees, and organisation and business process improvements. Last year, non-financial corporations in the EU invested almost 40% of their investment in intangibles, while 60% went into fixed assets (**Figure 3**). The share of intangible investment varies across sectors, with firms in the infrastructure sector investing a third of their investment in intangibles, while this share reaches 43% for firms in services and construction. SMEs tend to invest a higher share in intangibles (41%) compared to larger firms (35%). But the share of intangible investment does not vary with firm age, i.e. younger firms do not tend to invest more in intangibles.

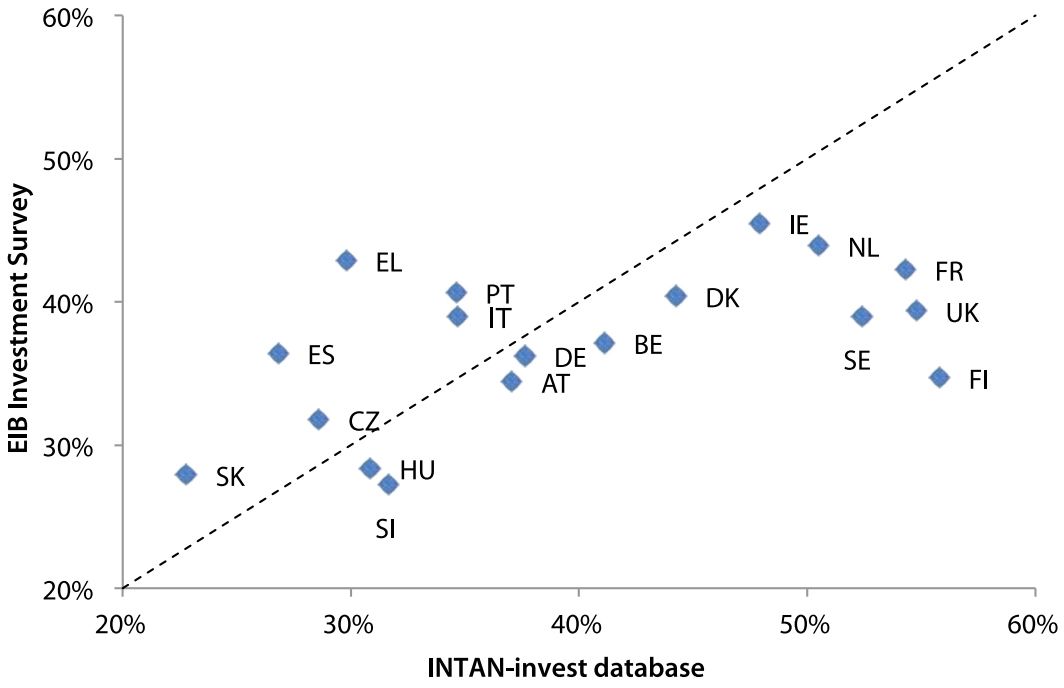
There is substantial variation in the share of intangibles across EU member states, as it ranges from 20% in Estonia and Bulgaria to 45% in the Netherlands and Ireland. And this variation is not only driven by the industry composition in the economy of each member state. This suggests that there is room for public policy to give incentives to firms to invest more in intangibles in many EU economies. The data on intangible investment in EIBIS are in line with macroeconomic data on intangibles – although there are some differences between the two sources of data, especially for countries such as Finland, the UK, or Greece (**Figure 4**), which most probably originate from differences in the sectors included in the aggregate[5].

Given the increasing role of intangible investment as a source of economic growth for the EU, an aspect that is particularly relevant for public policy to relaunch productive investment in the EU is to better understand how firms finance their investment. According to data of EIBIS, firms in the EU rely to a large extent on internal funds (60%) to finance their investment activities, while external finance represents only 36% of investment finance. There is some variation across sectors and infrastructure firms (46%) are more likely to rely on external funds. But firms who invest the majority of their investment in intangibles tend rely less on external finance, with a share of only 27%, compared to those with lower intangible investment intensity (whose share of external finance is 42%). This highlights the need to develop policy measures to increase the sources of external finance for firms that invest more in intangibles.

Bank loans are the most common source of external finance, particularly for the services sector. Leasing is also a common type of external finance, particularly in the infrastructure sector. EU firms that use external finance are on balance satisfied with the amount, cost, maturity,

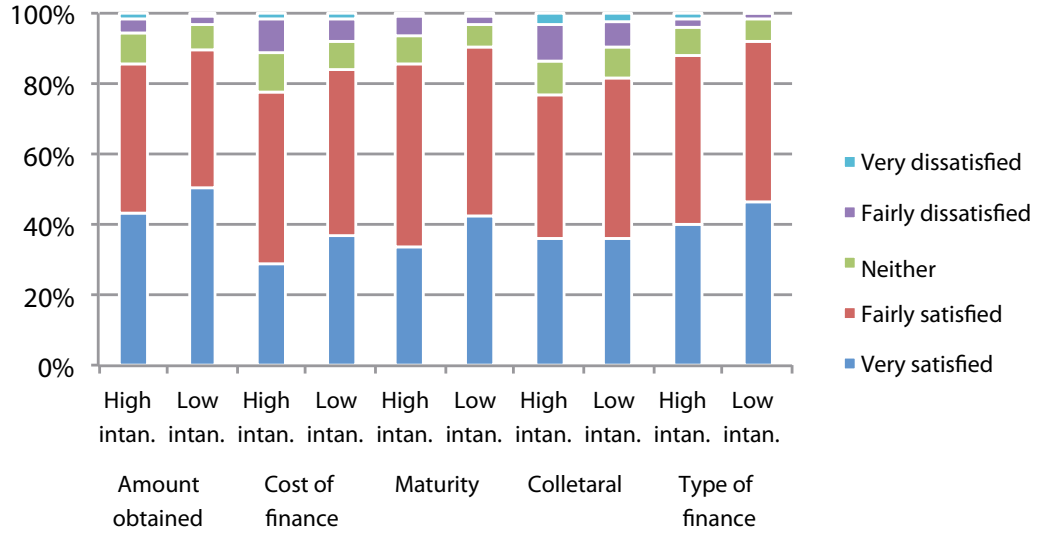
(5) For instance, the share of intangible investment in Germany is 36% in the EIB Investment survey, while it 38% according to the macroeconomic database of INTAN-Invest. If the share of intangible investment was identical using firm-level and macroeconomic data, all countries would be on the 45 degree line in Figure 4. The differences may also be driven by the fact that the INTAN-Invest database covers a broader set of sectors of the economy, e.g. agriculture and the financial sector, while the EIB investment focuses on non-financial companies.

Figure 4: Investment areas, by sector and firm size and by country2



Source: EIB Investment Survey and EIB (2016)

Figure 5: Investment areas, by sector and firm size and by country2



Note: Question: How satisfied or dissatisfied are you with …? Base: All firms who used external finance in the last financial year (excluding don't know/refused responses).

Source: EIB Investment Survey

collateral and type of finance received. But firms who invest more in intangibles are more likely to report that they are dissatisfied with the external finance conditions, and this holds along all the dimensions and particularly for the cost of funding and collateral requirements (**Figure 5**). Policy makers should keep these differences in mind – including the lower share of external finance for firms that invest more in intangibles and the fact that they are more likely to report to be dissatisfied with the conditions for external finance – when they design and develop new schemes, in particular innovative financial instruments, to support intangible investment in the EU.

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E4 Getting skills right: Measuring the demand for skills in the digital economy

Vincenzo Spiezia(*)

Introduction

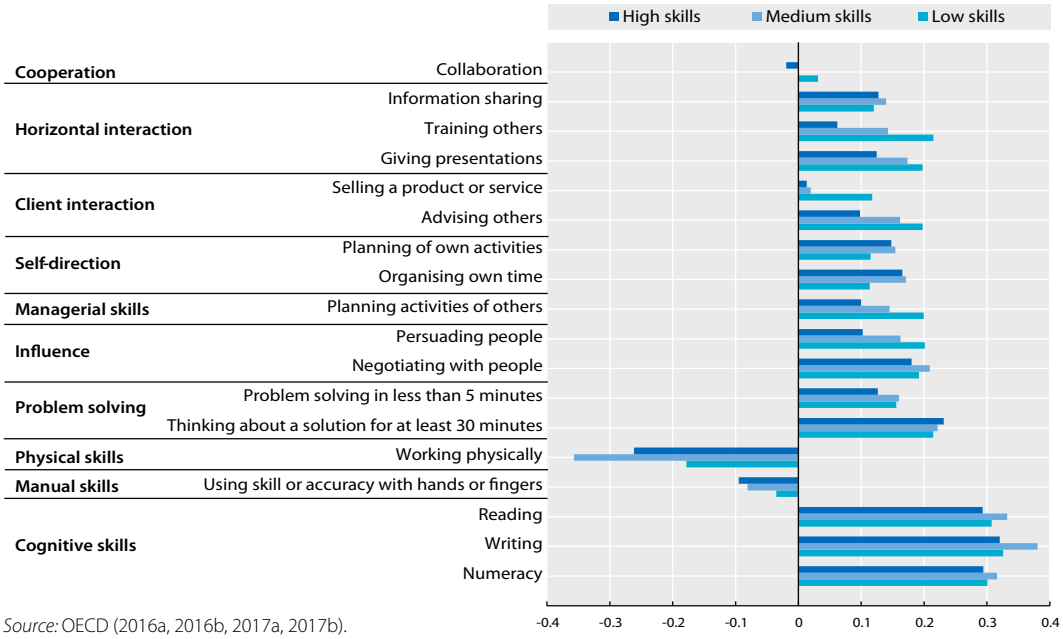
Increasing use of ICTs at work is raising the demand for new skills. Current skills statistics, however, do not seem suitable to address the scope and the pace of such changes. This paper highlights some key trends in skills demand driven by digitalisation and discusses four tools to improve skills measurement in official statistics: job tasks surveys; skills assessments; experts and science-based technology evaluations; and online job vacancies.

RECENT TRENDS FOR SKILLS DEMAND

The demand for skills is developing along three lines. First, the production of ICT products and services – software, web pages, e-commerce, cloud, big data, etc. – requires *ICT specialist skills* to program, develop applications and manage networks. Second, workers across an increasing range of occupations need to acquire *generic ICT skills* to be able to use such technologies in their daily work – access information online, use software, etc. Finally, the use of ICTs is changing the way work is carried out and raising the demand for *ICT complementary skills*, e.g. the capability to communicate on social networks, to brand products on e-commerce platforms, etc.

Figure 1 provides some measures of ICT complementary skills based on the correlation between job tasks and the frequency of ICT use at work. Higher use of ICT at work is associated

Figure 1: Correlations between daily use of ICTs at work and other tasks - by skill level



Source: OECD (2016a, 2016b, 2017a, 2017b).

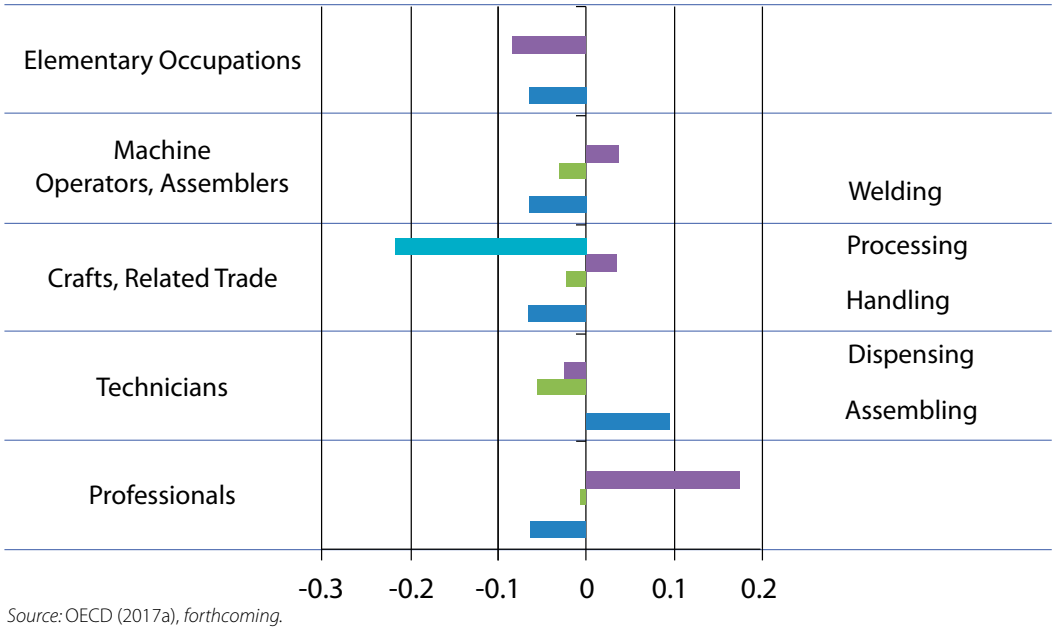
(*) Organisation for Economic Co-operation and Development (OECD)

with tasks that require more interaction with co-workers and clients, more problem solving and less physical work. As ICTs are reshaping business models and firms' organisation, the skills required to perform these tasks become more important. Changes in the tasks set associated to increasing use of ICTs tend to be larger for people in low-skill occupations than for those in middle and high-skill occupations. Therefore, the need for re-skilling is likely to be bigger for those people that educational and training systems have more trouble to reach.

Automation is also changing the distribution of tasks between humans and machine: "Tasks that cannot be substituted by automation are generally complemented by it" (Autor, 2015; see also Arntz, Gregory and Zierahn, 2016). As a result, robots tend to be skill-biased, i.e. they complement skilled workers and substitute for unskilled ones.

Figure 2 provides evidence for the robots' skill bias depending on the functions they carry out. For instance, Processing Robots are positively correlated with Professional Occupations and negatively correlated with Elementary Occupations (although results are mixed for

Figure 2: Estimated correlation between robots (by application) and employment (by occupation)



Source: OECD (2017a), *forthcoming.*

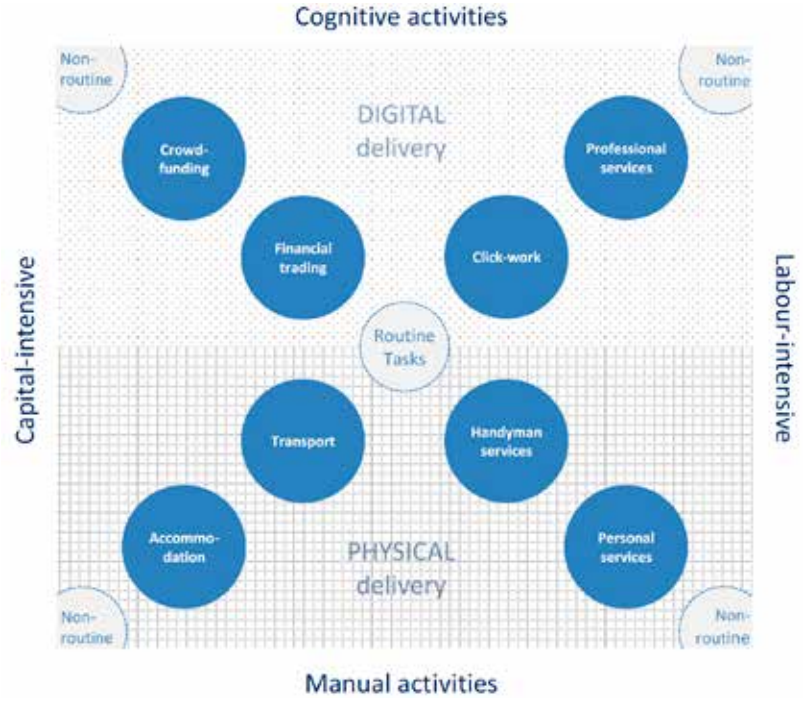
Technicians and other mid-skill occupations).

Some categories of robots appear to have a negative impact even on skilled occupations. For example, this is the case for Assembling Robots on Professionals Occupations. These robots can substitute for production workers performing routine tasks, which would explain the negative correlation with Elementary Occupations. When robots substitute Professionals Occupations, a major group composed of skilled, non-routine occupations (e.g. engineers) they are likely to do so by making redundant their supervisory or co-ordinating role. That happens because using robots can increase the quality of the goods produced and the overall efficiency of the workflows.

The effects of digital technologies go beyond employment and skills to the very organisation of work. In an increasingly integrated global economy, digital technologies are enabling firms to segment work in new ways and to increase the use of temporary labour. With innovative online platforms, new intermediary firms are connecting individual providers with individual customers, turning some full-time, long-term jobs into an uneven flow of "on-demand" tasks. If continued, this trend could deeply change the relevant skill-mix of workers.

Figure 3 associates skills demand to a set of key features of platform services markets, based on whether services: *i)* are delivered digitally (upper half) or delivered physically (lower half); *ii)* are capital-intensive (left) or labour-intensive (right), *iii)* mainly involve cognitive activities (above) or manual activities (below), each of which, in turn can, mainly consist of *iv)* routine and low-skilled tasks (centre) or non-routine and high-skilled tasks (corners). These criteria help to differentiate differences among platform markets and to

Figure 3: Online platforms and skills demand



Source: OECD (2016b).

anticipate their implications on skill demand.

These changes in the demand for skills present two major challenges to skills development systems, including formal education, training and the recognition of skills acquired through non-formal learning. First, while there is awareness that the skills profile of citizens and workers will be very different than in the past, the skills of the future are difficult to identify with certainty due fast technological changes. The second challenge is to ensure that, once changes in skills have been identified, skills development systems adjust sufficiently fast to match new skills demands. The next section will discuss some approaches to address the first challenge, i.e. measurement.

IMPROVING SKILL STATISTICS

Current skills statistics are based on educational attainments acquired in formal education, vocational training with standardised content and occupational classifications with codified and predictable tasks. As boundaries between disciplines fade away, the task content of occupation changes and the skills bundles required by new tasks are transformed, current skills statistics carry little information for the design of skills development systems.

In addition, the use of digital technologies in formal education and vocational training has the potential to improve learning but outcomes needs to be monitored and assessed through suitable statistics. Digital technologies are also creating new opportunities for skills development. Massive Online Open Courses (MOOCs) and Open Educational Resources (OER) modify learning methods and give access to quality resources to a larger population over more flexible hours. Too little of these changes are captured by available statistics.

More detailed and timely statistics are necessary to forecast long trends, identify emerging skill demands and respond with adequate supply of education and training.

Skills statistics could be develop into four directions:

1. Job tasks surveys;
2. Skills assessments;
3. Experts and science-based technology evaluations;
4. Online job vacancies.

The remaining of this paper will provide examples of the use of these four tools and briefly discuss their advantages and limitations.

JOB TASKS SURVEYS

Some countries have developed dedicated surveys to collect information on jobs tasks and skills from employees and employers. In the United Kingdom, for instance, the Employer

Skills Survey (https://www.gov.uk/government/publications/ukces-employer-skills-survey-2015-uk-report) provides a comprehensive picture of skills needs and training investment, including vacancies and skills shortages, employee skill gaps and the recruitment of education leavers and young people.

The survey, which covers over 91,000 establishments with at least two people on the payroll, was first conducted at UK wide level in 2011 and has been conducted biennially since. It explores the skills challenges that employers face both within their existing workforces and when recruiting, their use of the skills of their staff, the levels and nature of investment in training and development, and the relationship between skills challenges, training activity and business strategy.

In Germany, the BIBB/BAuA Labour Force Surveys (https://www.bibb.de/en/2815.php) are telephone surveys of 20,000 gainfully employed people, jointly carried out by the German Federal Institute for Vocational Education and Training (BIBB) and the German Federal Institute for Occupational Safety and Health (BAuA) and funded by the German Federal Ministry of Education and Research (BMBF). The surveys are carried out in intervals of six years. The aim of the survey is to provide differentiated and representative information regarding the working population and jobs in Germany for quantitative employment and qualification research as well as for occupational health and safety reporting.

This is why, on the one hand, the survey focuses on questions regarding the workplace (main fields of responsibility, level of requirements, knowledge requirements, work requirements, need for advanced training, work conditions, work load, etc.); on the other, the survey looks into the relationship between education and employment (school education, vocational and advanced training, professional career, employment that is adequate to the vocational training, career changes, applicability of professional qualifications, etc.). Different occupational classifications allow for a differentiated illustration according to gainful employment and occupations requiring formal training.

The Occupational Information Network (O*NET) conducted by the US Department of Labor since 1998 is probably the best known among this type of surveys (https://www.onetonline.org/). The latest revision of the O*NET database (May 2017) covers about 1100 occupations defined on the basis of the US Standard Occupational Classification (SOC) system. Every occupation requires a different mix of knowledge, skills, and abilities, and is performed using a variety of activities and tasks.

These distinguishing characteristics of an occupation are described by the O*NET Content Model, which defines the key features of an occupation as a standardised, measurable set of variables called "descriptors" (**Figure 4**). These descriptors are organised into six major domains, which enable the user to focus on areas of information that specify the key attributes and characteristics of workers and occupations:

- Worker Characteristics
- Worker Requirements
- Experience Requirements
- Occupation-Specific Information
- Workforce Characteristics
- Occupational Requirements

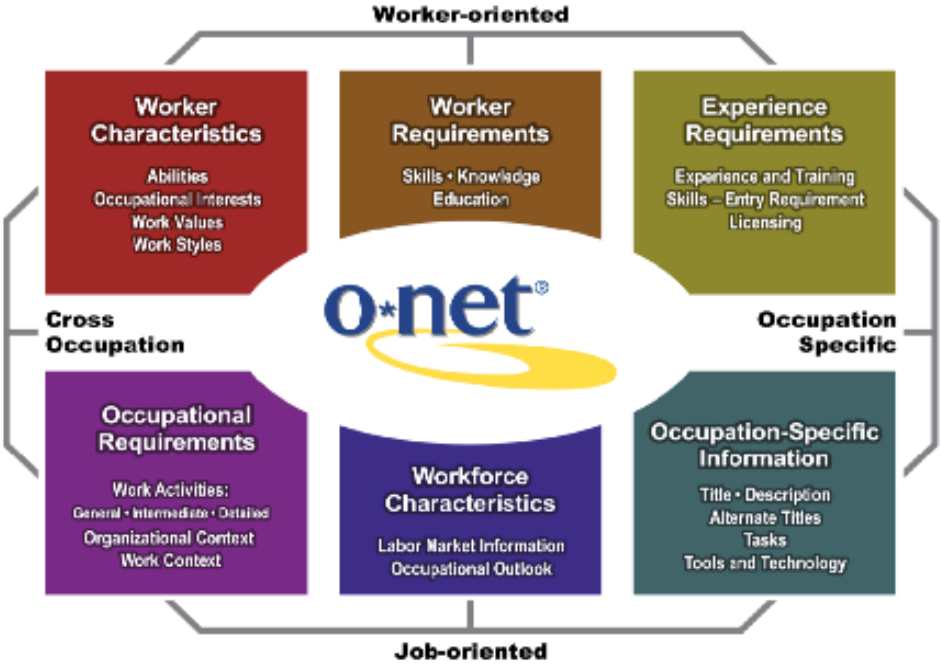
Each descriptor in O*NET is associated with a scale, e.g. Importance, Level, and Extent of the activity.

The O*NET database was initially populated by data collected from occupation analysts; this information is updated by ongoing surveys of each occupation's worker population and occupation experts. This data is incorporated into new versions of the database on an annual schedule, to provide up-to-date information on occupations as they evolve over time. By mid-2016, 940 occupations had been comprehensively updated since the beginning of the survey in 1998. 509 of these occupations had more than one update.

By linking these updates over time, one can examine how the set of work activities involved in each occupation have been changing. In particular, changes in the importance of the ICT use at work can be correlated to changes in the importance of the other 40 work activities.

ICT use is measured by the importance of the work activity "Interacting with Computers". A positive (negative) correlation means that in occupations where ICT has become more (less) important certain activities have also become more (less) important. The sign of the correlation, therefore, can be interpreted as a measure of the degree of complementarity between ICT and other activities at work. In addition, the higher the value of the correlation coefficients, the stronger the complementarity between ICT and these activities.

Figure 4: The O*NET Content Model



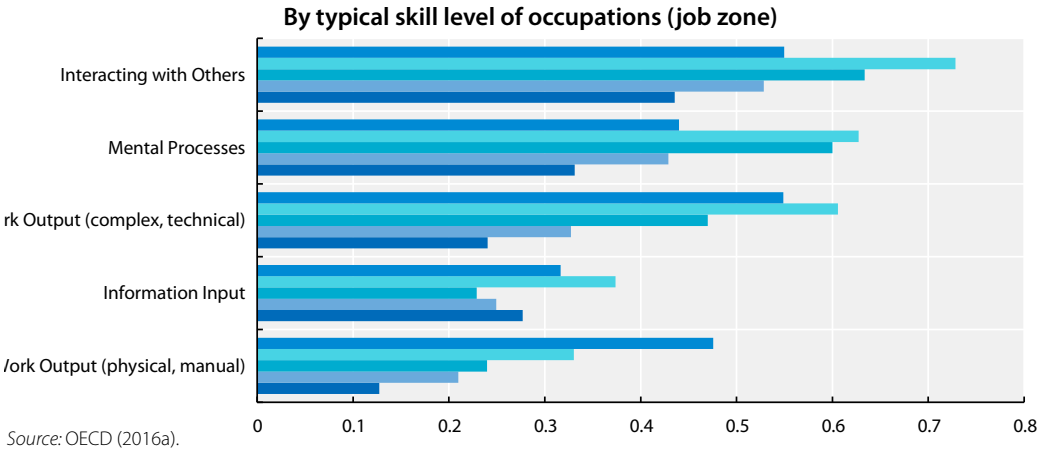
Source: The O'NET Resource Center, https://www.onetcenter.org/content.html.

Figure 5 shows the results of the correlation analysis. To facilitate the interpretation, activities have been grouped in five groups according to the O*NET classification:

- ***Information Input*** - Where and how are the information and data gained that are needed to perform this job?
- ***Mental Processes*** - What processing, planning, problem-solving, decision-making, and innovating activities are performed with job-relevant information?
- ***Interacting with Others*** - What interactions with other persons or supervisory activities occur while performing this job?
- ***Work Output (complex, technical)*** - What skilled activities using coordinated movements are done to perform this job?
- ***Work Output (physical, manual)*** - What activities using the body and hands are done to perform this job?

The correlations are broken down by "job zones" defined by O*NET. The O*NET "job zones" classify occupations into five categories according to the typical level of skills required by the occupation, including work experience, education, and/or vocational training. Zone 1 denotes the lowest level of preparation and Zone 5 the highest level.

Figure 5: Correlations between changes in the importance of ICTs and changes in the importance of the activity groups



Source: OECD (2016a).

The highest correlations are found between ICTs and activity group "Interacting with Others" and the lowest correlations between ICTs and "Work output (physical, material)" as well as with "Information Input". In addition, the correlations show a similar ranking across different job zones, i.e. skill levels. The one exception is job zone 1, i.e. the lowest skill level, where "Work Output (complex, technical)" and "Interacting with Others" are most equally correlated to ICTs. This suggests that, for low-skill occupations, increasing use ICT is associated with an upgrade in the skill content of the manual work.

The strength of the correlations tends to decrease with skill levels. This observation confirms the finding of the previous section that that changes in the tasks set associated with increasing use of ICTs tend to be larger for people in low-skilled occupations than for those in medium and high-skilled ones.

As the above examples show, job tasks surveys are extremely useful to identify how job characteristics change over time and to infer the implications of these changes on the demand for skills. Very few countries, however, have established some survey of this type. One main reason is probably that developing and conducting job tasks surveys is expensive. Most important, the measurement of workers' skills is based on self-reporting and no formal assessment is carried out on their actual skill levels. This is why, the skills assessment surveys to be discussed in the next section, appear as a key complementary tool to improve our understanding of skills needs.

SKILLS ASSESSMENTS

The OECD Programme for the International Assessment of Adult Competencies (PIAAC) is probably the best known – and the only cross-country – skills assessment programme. The survey, conducted in over 40 countries, measures the key cognitive and workplace skills needed for individuals to participate in society and for economies to prosper. The evidence from the survey is meant to help countries better understand how education and training systems can nurture these skills. Educators, policy makers and labour economists can use this information to develop economic, education and social policies that will continue to enhance the skills of adults.

The survey is designed to be valid cross-culturally and cross-nationally for countries to be able to administer the survey in their national languages and still obtain comparable results to provide comparative analysis of skill-formation systems and their outcomes, and international benchmarking regarding adult skills as a survey that will be repeated over time to allow policy makers to monitor the development of key aspects of human capital in their countries.

The survey is implemented by interviewing adults aged 16 to 65 in their homes – 5 000 individuals in each participating country – answering questions via computer, although the survey can also be implemented via pencil-and-paper.

Like the job tasks surveys discussed above, PIAAC collects a range of information on job characteristics, although at the less finer detail that the dedicated surveys. The survey uses an innovative "job-requirements approach" to ask adults who are employed about a number of generic skills they use in the workplace. The survey asks adults how intensively and how frequently they use these skills at work.

Information is also collected about four broad categories of generic work skills: cognitive skills, interaction and social skills, physical skills, and learning skills.

Cognitive skills encompass reading, writing, mathematics and the use of information and communication technologies.

Interaction and social skills cover collaboration and co-operation, planning work and use of time for oneself and others, communication and negotiation, and customer contact (e.g. selling products and services and advising).

Physical skills involve the use of gross and fine motor skills.

Learning skills cover activities such as instructing others, learning (formally or informally), and keeping up-to-date with developments in one's professional field. In addition all respondents are asked about the frequency and intensity of their reading and numeracy related activities as well as their use of ICTs at home and in the community.

Unlike O'NET and other self-assessment surveys, PIAAC tests the participants through formal tests in order to assess their literacy and numeracy skills and their ability to solve problems in technology-rich environments (PSTRE). The objective of the assessment is not to test the use of ICT tools and applications in isolation, but rather to assess the capacity of adults to use these tools to access, process, evaluate and analyse information effectively.

PSTRE tests scores run from below 1 to 3 from low to high. According to OECD (2016a), effective use of 'communication and information search' (CIS), i.e. 'send/receive email' and 'find work-related information on the Internet', requires a PSTRE score of 1 and above; "office productivity software" (OPS), i.e. "use word processors" and 'use spreadsheets', a PSTRE score of 1 and above. Both CIS and OPS require ICT-generic skills but OPS involve a more sophisticated use of ICT and a higher level of ICT skills.

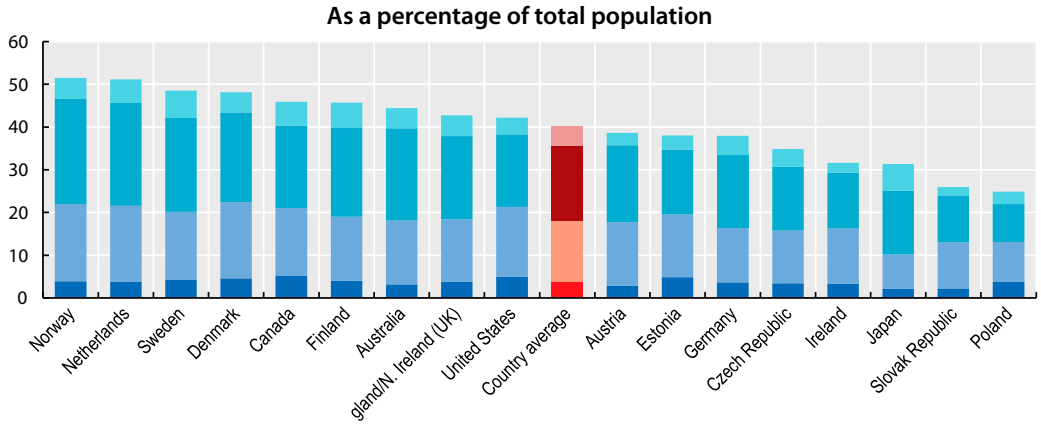
Figures 6a and 6b provide the breakdown of the PRSTE proficiency levels within the population who use CIS and OPS, respectively, every day at work. The results show that between 7 and 15% of the population who report undertaking CIS every day do not actually have the skills required to carry out such tasks (below PRSTE level 1), the country average being at 9.5%.

The gap is even more significant for the OPS tasks as 42% of the individuals do not have the skills required to carry out these tasks (PRSTE level 1 and below) although they report doing so every day. Therefore, a significant number of workers using ICTs every day do not seem to have sufficient ICTs skills to use these technologies effectively.

EXPERTS AND SCIENCE-BASED TECHNOLOGY EVALUATION

A third approach to identify emerging skills needs is to ask experts for their assessment of what tasks, currently performed by humans, can or could, on a short time horizon, be performed by

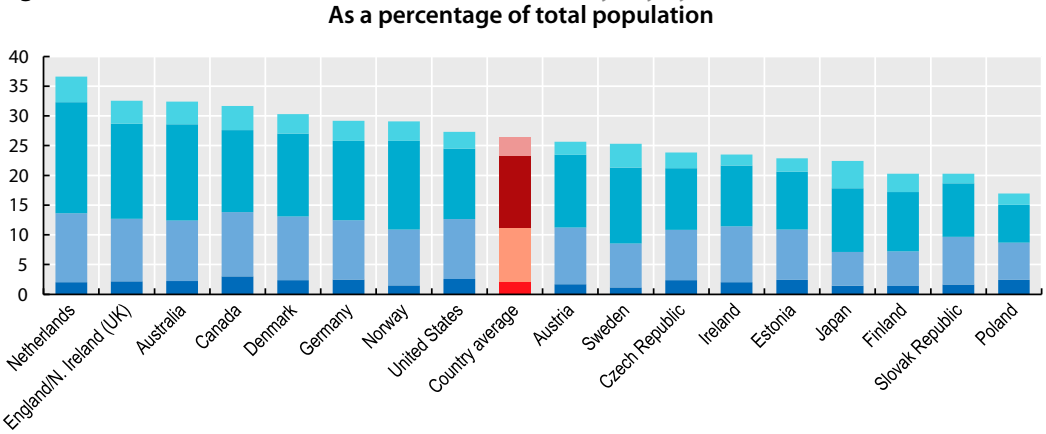
Figur 6A: Breakdown of individuals who use CIS every day by PSTRE levels, 2012



Note: PSTRE assessment data for France, Italy and Spain are not available and not included in the OECD total. Individuals in the following categories of the PSTRE assessment are excluded from the analysis: "No computer experience"; "Opted out of computer based assessment"; "Failed ICT core / Missing".

Source: OECD (2016a).

Figure 6B: Breakdown of individuals who use OPS every day by PSTRE levels, 20122



Note: PSTRE assessment data for France, Italy and Spain are not available and not included in the OECD total. Individuals in the following categories of the PSTRE assessment are excluded from the analysis: "No computer experience"; "Opted out of computer based assessment"; "Failed ICT core / Missing".

Source: OECD (2016a).

digital technologies. A widely-cited study by Frey and Osborne (2013), which estimates that 47% of US employment is at a high risk of automation over the next several decades, is based on this approach. A group of computer scientists classified 70 occupations as either automatable or not, based on a set of job descriptions and their knowledge of current computer capabilities. The occupations chosen were those where the group was most confident in making this judgment. Job tasks like perception and manipulation, creative intelligence, social intelligence were regarded as being less automatable, suggesting that the demand for the skills related to these tasks will be increasing in the forthcoming years.

OECD (2017) asked a group of computer scientists to review the test questions in PIAAC and identify the questions that could be answered by machines today. Experts gave a rating of the ability of current computer techniques to answer each test question after a one-year development period costing no more than USD 1 million, and using the same visual materials that were used by the adults who took the test. The rating options were Yes, No and Maybe, with respect to the capabilities of computers to answer each question. All 11 computer scientists in the group provided these ratings for the literacy and numeracy questions. In addition, six of the experts provided ratings for the test questions on problem solving, and three of them provided ratings for computer capabilities in 2026.

The expert assessments generally placed computer capabilities in the middle of the adult proficiency distribution on PIAAC (**Table 1**). In literacy, for example, performance at Level 2 on the 5-level PIAAC scale means that current computer techniques can generally handle tasks involving several paragraphs of text about a familiar topic and answering questions that require limited inference and enough language understanding to avoid a misleading section of text. However, these techniques cannot reliably answer questions about more difficult passages of text that require more subtle inference and avoiding prominent sections of text that are misleading if not read carefully.

Overall, the preliminary results suggest that the level of computer performance in these three skill areas – literacy, numeracy and problem solving – is comparable to that of many workers. On average, 31% of the workforce in OECD countries uses one or more of the PIAAC skills on a daily basis at work and has a proficiency in these skills at or below the level of current computer capabilities. Another 31% of the workforce uses these skills on a daily basis and has a proficiency that is close to being possible for computers. Only 13% of the workforce in OECD countries uses the three PIAAC skills on a daily basis and has a proficiency that is clearly beyond the capabilities that computers are close to reproducing.

Elliot (2017) analyses possible IT-driven changes in skill demand by reviewing the computer science research literature through the lens of human work skills. The rationale for this approach is that one can identify the development of IT capabilities in the research literature before they are widely applied throughout the economy, thus providing a way of projecting important future shifts in skill demand before they occur. The research literature review of IT capabilities tentatively suggests that IT capabilities that have been demonstrated in research settings could provide the reasoning, vision, and movement skills required in most current jobs; only for language skill does the analysis suggest that a substantial number of current jobs have skill requirements that clearly outstrip the IT capabilities demonstrated in the research literature.

While the approach based on experts assessment and research literature seems very useful, it has

Table 1: Approximate proficiency level of computer capabilities on PIAAC

From 1 to 5 from low to high proficiency

COMPUTER RATING	LITERACY	NUMERACY	PROBLEM SOLVING
Current capabilities, average with Maybe as 50 %	Level 2	Level 2	Level 2
Current capabilities, average 3-expert minimum	Level 3	Level 3	Level 3
Capabilities, in 2026	Level 3	Level 3	Level 3

Source: OECD (2017b).

its shortcomings. First, the expectation that computer scientists in areas related to language understanding and reasoning are able to make judgments about job tasks is a strong one. Often the description of a task is not sufficiently accurate to make such a judgement and there may be large variation within the same task across occupations, industries and countries. Second, for an innovation to deploy its effects on skills demand it takes time and further resources, in a way that the size and the time horizons resources. Therefore, the projections generated by this approach will necessarily be an approximation.

The above consideration suggest that, in order to became useful for skills development policies, experts and science-based assessment should be carried out in a more systematic manner, and a finer level of tasks and occupation and across different countries. This is clearly one avenue that official statistics should consider investing more.

ONLINE JOB VACANCIES

Over the last few years, a number of private firms and a few national statistical offices have started to collect and to analyse online job postings in order to compile statistics on job vacancies. Online job vacancies have a big potential as a source of information on the characteristics of job offers, job seekers and the duration of job postings. They are able to track labour market movements in real time, providing high frequency data. Furthermore, they permit the analysis of shifts in job profiles based on a large range of job requirements on skills, education and experience.

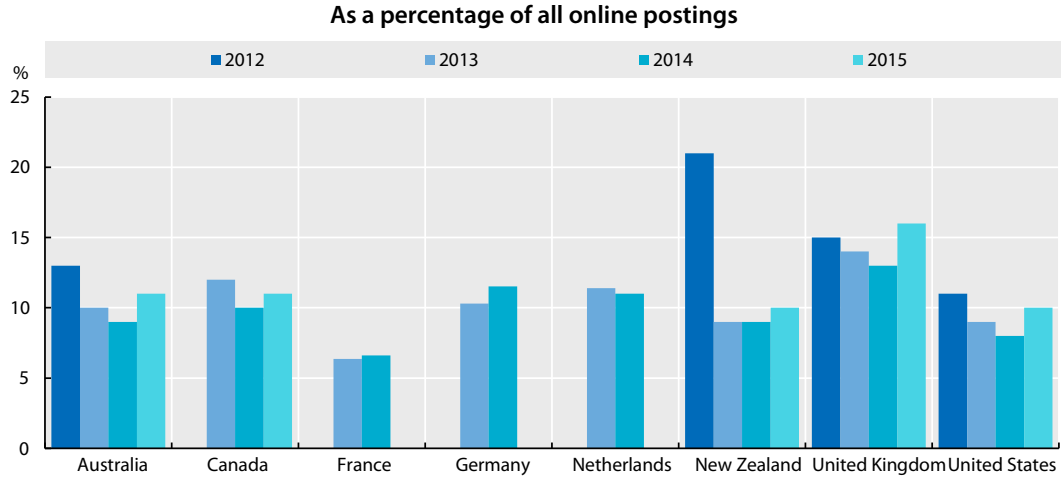
Online job vacancies also have some shortcomings that future developments in data collection and treatment may be able to overcome. First, the total number of online vacancies tends to be significantly lower than the number of vacancies from official sources. Second, only a small share of online vacancies can be classified by industry, preventing a closer comparison with official data. Third, the classification of ICT occupations, which is a complex operation in itself, is not fully consistent across countries. Finally, coverage is limited to a few countries.

Figure 7 shows the job vacancies for ICT occupations as a proportion of all vacancies over 2012-2015. In 2014, ICT job postings accounted for between 13% (United Kingdom) and 7% (France) of all job postings. This share has decreased in Australia (-4 percentage points), New Zealand (-12), the United Kingdom (-2) and the United States (-3) in 2012-2014; it has increased in France (1) and Germany (2) as compared to 2012 while it has remained stable in the Netherlands. The first 5 months of 2015 show a faster increase in ICT job postings, although this may reflect seasonality to some extent.

Figure 8 shows the ICT online vacancy rates in 2013. ICT vacancy rates appear the highest in the United Kingdom (20.1%) while they range between 10.2% in New Zealand and 4.7% in Australia. In the United States, ICT vacancy rates can be computed for a longer period (2010-2014) and show an upward trend from 5.5% in 2010 to 7.3% in 2014.

Vacancy duration, i.e. the time it takes for the vacancy to be filled, provides a further indicator of labour market imbalances. If ICT skills were scarcer

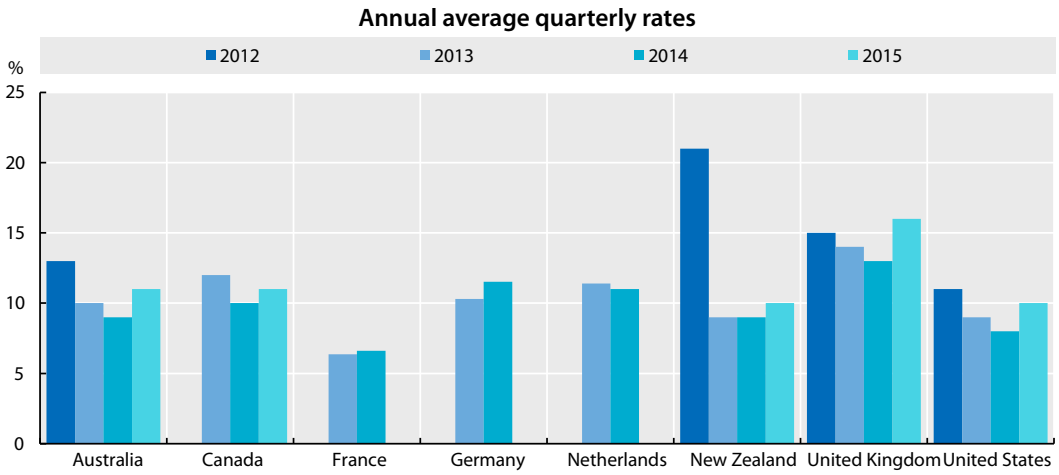
Figure 7: ICT online job postings, 2012-15[a]



([a]) 2015 refers to the period 01.01.2015-26.05.2015.

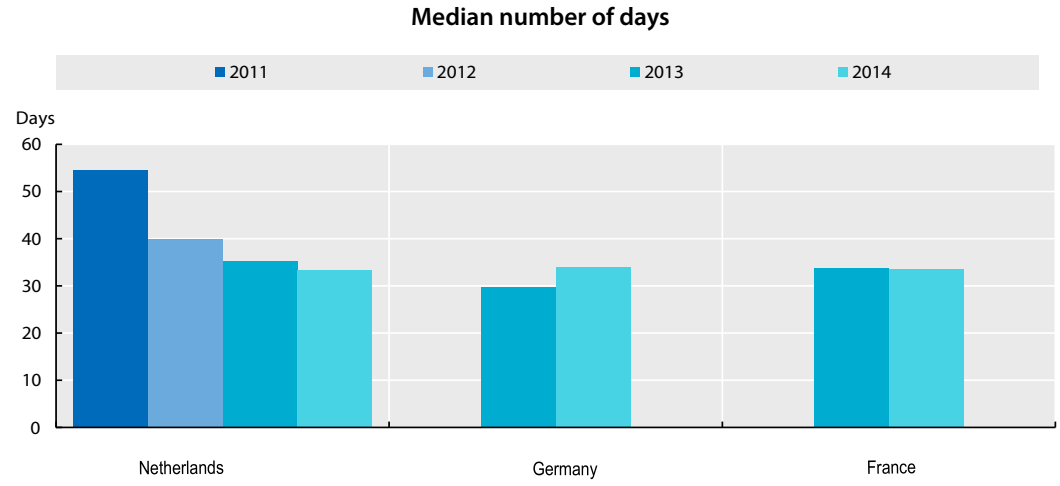
Source: OECD, based on Burning Glass and Jobfeed, May 2015.

Figure 8: Vacancy rates for ICT occupations, 2013



Source: OECD, based on Burning Glass and Jobfeed, May 2015.

Figure 9: ICT vacancy duration, 2011-14



Source: OECD, based on Jobfeed, May 2015.

than other skills, one would expect vacancy duration to be higher for ICT occupations.

Online vacancies permit the measurement of the time that a given vacancy remained posted on the Internet. However, the reasons for withdrawing a vacancy are unknown, i.e. the vacancy may have been filled or the firm cannot find a suitable candidate for that position. Although these two events are of different nature, in both cases longer duration is associated with higher difficulty to fill a position.

Figure 9 shows the mean duration of ICT online vacancies in France, Germany and the Netherlands over the period 2011-2014. In the Netherlands, the mean duration fell from 54.5 days in 2011 to 33.3 days in 2014. Between 2013 and 2014, the mean duration increased from 29.8 to 34 days in Germany while it remained almost unchanged in France.

CONCLUSIONS

Increasing use of ICTs at work is raising the demand for new skills. However, current statistics do not seem suitable to address the scope and the pace of such changes. This paper has discusses four tools to improve skills measurement in official statistics: job tasks surveys; skills assessments; experts and science-based technology evaluation; and online job vacancies. Each of these tools has its own limitations but their combination seems able to provide useful and timely insights in the changes in skills demand driven by digitalisation. As the level of investments to develop these tools is significant and their value depends on their degree of cross-country comparability, international coordination among national NSOs and supranational statistical bodies in this area is crucial.

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E5 New digital services: Getting the price right

John Verrinder and Paul Konijn[*]

Introduction

The internet has transformed economies around the world in many different ways: old products are delivered in new ways, new products and services are being invented and brought to consumers outside traditional outlets and the roles of producers and consumers are changing. In addition, the changes appear to be continuous and fast.

Traditional statistical methods are challenged by these new phenomena. For example, the sharing economy enables households to act as producers; however, business surveys designed to measure production will not capture their output. Price statisticians struggle to capture the large and fast changes in the quality of the products produced and consumed, and with the fact that many products are becoming more and more customised (see e.g. Ahmad and Schreyer (2016), Bean (2016), Ravets (2016) and The Economist (2016)).

This note focuses on the impact of different forms of digitalisation of services on the measurement of prices and volumes in national accounts, i.e. the measurement of the volume growth of GDP and important components thereof, such as household consumption.

Traditional methods for price and volume measurement

National accountants rely for price and volume measurement on price statisticians to compile Consumer Price Indices (CPIs), Producer Price Indices (PPIs) and others.

In European countries, CPIs [1] are generally constructed by following – each month – the prices of a representative basket of goods and services. The prices are observed, for the most part, by visiting outlets that sell those products. Nowadays, a fair share of the prices can be collected directly from the internet (manually or automatically) and from "big data" sources such as scanner data (see below). Great care is taken that the collected prices are for *the same* products as in the previous month, in order to compute pure price changes, i.e. not affected by any changes in the quality of the products followed. The indices are computed with a formula that also takes into account the importance of each product as indicated by its share in total consumption[2]. These shares are updated each year.

When a product in the sample disappears from the market, it will be replaced with an equivalent product, if that can be found. Fully new products are introduced in the sample once a year. Generally, the introduction of new products is carried out so that it has no impact on the price index.

OUTLET SUBSTITUTION

CPI compilers also take care to properly reflect the shares of the different types of outlets (supermarkets, specialised shops, open markets, internet, …) at which consumers buy. A product can have quite different prices in different types of outlets. If certain outlets get higher market shares, more prices from those outlets will be collected or receive a higher weight. When new outlets appear and become important, they enter the sample at the same time that new

(*) Eurostat (European Commission)
(1) PPIs generally follow very similar procedures, except that the prices are collected directly from the producers.
(2) In practice, the shares are available only for groups of products.

products are introduced (once a year).

The fundamental question is how to treat the price differences between different types of outlets. For lack of better information, statisticians assume that price differences between outlets, for the same product, are fully attributable to differences in quality of the services delivered by these outlets. Thus, the difference in price between a screwdriver bought in a DIY store and exactly the same screwdriver bought in a specialised shop is equal to the value of the difference in service quality between the DIY store and the specialised shop. In this classic example, most consumers would agree that the specialised shop provides the better service, as its staff is often more knowledgeable and can provide better advice on which screwdriver to buy, justifying the higher price. However, the DIY store can benefit from advantages of scale to be able to sell the screwdriver at a lesser price, which raises doubts about the assumption that the price difference is fully due to quality.

Thus, currently, all substitution between outlets is regarded as volume change. Also, the introduction of new outlets does not lead to a change in price. This methodology, which is rather standard, has often been criticised (see e.g. National Research Council (2002)). One reason for criticism is that new outlets are often cheaper than the old ones, which is automatically interpreted as meaning that they provide a lower quality service. The decline in expenditure caused by shifting to cheaper outlets is entirely treated as a decline in the quality of the services and thus leads to a reduction of the volume of GDP. The resulting bias ("outlet substitution bias") could be resolved if actual estimates could be made of the quality differences between outlets, but no satisfactory methods for this have been found so far.

IMPACT OF THE DIGITALISATION OF SERVICES

The internet has shifted (or is shifting) a large share of transactions from traditional to on-line stores. Shopping on-line is a different experience from shopping in brick-and-mortar outlets. There are advantages and disadvantages to consumers. Currently, the above described methodology and the fact that products bought on the internet are often cheaper than products bought in traditional shops imply that the shift to on-line shopping results, *ceteris paribus*, in a decrease in the volume of GDP.

In some areas, traditional outlets are at risk of disappearing altogether, in favour of on-line purchases. An example may be airline tickets, for which one used to go to a travel agent, but nowadays are only a few clicks away. If one could agree that this represents a quality improvement for consumers, then the official statistics are underestimating the volume of consumption. On-line banking (and other electronic financial services) has virtually replaced visits to the bank for routine transactions. None of this improvement, if we agree that it is an improvement, is picked up in the volume of GDP.

The internet, in combination with other technological innovations, such as the smartphone, broadband, GPS location services, etc., has also produced a host of new types of services. These fall in two categories:

- *fully new services*, like social media, Google search, Wikipedia, price comparison websites. Such services are often provided totally free (and thereby also excluded from CPIs). Consumers pay indirectly by either providing personal information and/or by accepting advertisements. Discussions are on-going in the national accounts community whether (and if so, how) a value should be imputed for such free services, and, if so, how to measure their price and volume changes;
- *competitors for existing services*. A good example of this is Airbnb, which provides consumers with the possibility to rent out spare rooms or other living space to other consumers. Airbnb competes directly with traditional hotels, although they provide quite a different service. It is clear that an Airbnb service cannot be directly compared to a service provided by a hotel. In price statistics, the two will be seen as different products. The market share of Airbnb, at the moment, is still limited, reducing the need to introduce it into the CPI samples. (Including Airbnb would probably necessitate the use of automated price collection from the internet to get it right.) So far, the ascent of Airbnb has an impact on the CPI only through the presumably downward effect its very existence has on hotel prices. The inclusion of Airbnb in the CPI would have no direct price impact, in line with the above described methodology, i.e. the presumably lower prices of Airbnb would be seen as a lower quality services than the traditional hotels, which is a contentious assumption.
- There is one consistent issue in the above examples: through the internet and other

technological advances new or alternative goods and services can be produced in a more efficient way than their traditional counterparts, i.e. at lower prices. These new products are often seen by consumers as improvements to the existing products on offer, at least in some of their characteristics.

However, national accounts and price statistics generally assume that price differences can be taken to equal quality differences, i.e. a higher price must imply a higher quality. This fundamental assumption seems less and less appropriate in the modern digital economy.

Example: Uber vs traditional taxis

Uber provides individuals the possibility to use their private cars to provide taxi services. The rides are arranged through a smartphone app. Uber has become, where available, a significant competitor to traditional taxis. The question for statisticians is how to reflect the rise of Uber in GDP and price statistics? Apart from the practical question of getting complete data on Uber transactions, there is the conceptual question of what additional, if any, quality Uber brings to consumers. To determine this, one would theoretically:

- find out what are the characteristics of a taxi ride that people (on average) value most. Options are price, speed, comfort, safety, ease of use, payment options, etc...,
- find a way to measure or evaluate these characteristics, and
- assign a value to them in order to be able to quality-adjust the prices.

It is obvious that this would not be an easy task. Statisticians will have to find more approximate ways to make the comparison.

USE OF BIG DATA

Another impact of new technology on shopping (both on-line and off-line) is that prices can be changed at any time of the day depending, for example, on the demand that is registered at that moment, or on the profile of the browsing consumer. Traditional price collection techniques have difficulty dealing with this as the samples become too small to obtain reliable averages. One solution for this could be the use of "big data" sources such as the transaction data produced by the cash desks of supermarkets (and other outlets) that link prices and quantities to the bar codes of the products ("scanner data"), or prices that are obtained by automatic "crawling" of the internet (the standard in automated price collection from the internet has been set by the Billion Prices Project, see Cavallo and Rigobon (2016)). Hence, whereas the internet brings new challenges, it also brings new opportunities.

Such big data sources hold a lot of promise and several countries in Europe are using them, or plan to start using them, for certain areas of consumption (most importantly food). Nevertheless, they also do not provide an easy panacea: there are ongoing lively discussions among statisticians on the conceptual, methodological and practical challenges to the use of these data in a "live" CPI compilation context, e.g. on the impact it may have on the actual index formulas used (see de Haan et al (2016).

CONCLUSIONS

This note intends to demonstrate that several aspects of the digital economy, viewed by many as having a positive contribution to living standards, do not actually show up that way in the official GDP statistics. There is a need for further debate and research, in particular on how to deal with new services of higher perceived quality but sold at lower prices than more traditional services.

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E6 Certification of data producers

Albrecht Wirthmann[*]

Introduction

Our societies and economies are facing an ever increasing degree of digitalisation. This development can be expressed by the term 'Datafication', which means 'taking all aspects of life and turning them into data' (Cukier & Mayer-Schoenberger, 2013)[1]. Smart devices, electronic networks and constant production of data on all aspects of life and the environment will become an integrative component of how our societies and economies will function. Most if not all data in a decade from now will be 'organic', i.e. by-products from activities of people, systems and things (including billions of low-end and affordable smart devices connected to the internet, i.e. the Internet of Things).

Businesses are becoming aware that data and, more importantly, information, as a result of organising, structuring and presenting data in a given context so as to make them useful[2] is becoming an integrative component of future business models, regardless of the economic sector in which the enterprise operates. E.g. cars will record data on the status of its various components, engine, wheels, power transmission, etc. that will allow to detect faults before they will seriously damage other components of the car (predictive maintenance). Analysis of behaviour of car drivers can help to optimise transport and traffic systems. Information on the use of devices can help to improve the design of new devices. Following behaviour of internet users can improve the design of websites and electronic services to make them more successful.

Most of these new data will be collected by private enterprises and an increasing number of enterprises specialise in data analysis to provide clients with useful information that allows them to improve their business. In addition, enterprises holding big amounts of data build new analytics capabilities to diversify their activities. They also may produce statistical information to monitor trends in society and economy, such as the Billion prices project that collects online prices from websites to construct inflation indexes[3].

In this new order, statistical data, as we knew them, are no longer the (almost) exclusive prerogative of the "official" system. Until recently, NSIs were the key providers of most statistical information needed for the functioning of an economy and society. Their statistics covered a wide area, yet not everything, and generally, they have been credible and have enjoyed a good reputation. Mathematically and inevitably – and probably rapidly – NSI data are becoming a diminishing fraction of all available data.

Like everything of a transformative nature, this is associated with both advantages and drawbacks. A key drawback would be the possible inability to navigate through a vastly expanded array of data and differentiate legitimate from illegitimate data for the same object of investigation. What happens in this case, when we are clearly outside the realm of official statistics? Are we entering a vacuum with a free-for-all? In some ways, this is reminiscent of what transpired a bit earlier with the Internet as a whole. While all the knowledge has come to be within everyone's reach, questions linger as to what is accurate and solid and what is not. The early days of Wikipedia serve as an example. Short of assuming a perfect user,

(*) Eurostat (European Commission)
(1) Datafication was coined by Cukier and Mayer-Schönberger in their book "The Rise of Big Data".
(2) see: http://ecomputernotes.com/fundamental/information-technology/what-do-you-mean-by-data-and-information
(3) http://www.mit.edu/%7Eafc/papers/BPP_JEP.pdf

who can ascertain at a glance which offering is good, what else can be done?

At the same time, demand for statistical information from users of official statistics is increasing. Politicians, researchers or media are asking for timelier data with a higher level of detail (such as geographic location, type of economic activity or societal group). As an example, employment rates or inflation indexes may differ considerably depending on geographic location, age, education or personal income. Increasingly, private data holders and analysts are trying to satisfy this demand, which is currently not met by official statistics.

With no claim of being exhaustive, a few thoughts on this issue are offered here. Our reflection starts with whether or not it is desirable that some quality standards are established to allow users to sift through the world of statistics with a certain degree of confidence, and this in a way that separates the good from the not-so-good. If yes, who will do that, and how?

CERTIFICATION OF DATA PRODUCERS

Most data producers today, deliberate or accidental do not have to abide by known quality standards. Worse, standards as such do not exist except for those specific to NSIs. At this point, there is no widespread agreement, established approach or mechanism to take this matter on in a way comparable to ISO certification. While the official statistical system has neither a monopoly on data nor the potential to become the police of the data world, it does have a moral authority and a protagonist role to play by virtue of its track record regarding quality.

The statistical institute perspective also has to be taken into account. Ascertaining the quality of data and their sources, and eventually arriving at some certification, presupposes that someone is asking for it. Until now, the doors of the official statistics systems are not flooded by applications to do so. On the contrary, the ongoing discussions concentrate on the NSIs going after new data sources. Through that lens, the balance of powers in negotiating is not one of strength. External sources may be willing to accommodate such needs only up to a certain point. Even if that was not an issue and all sources eagerly cooperated, what is the limit of today's official system in absorbing all that is useful before becoming inundated and paralysed? Can it really continue to ever expand its information scope? The main implication from this analysis is that alternative courses of action may be worth exploring.

Potential certification would certainly be one of those, and could be used to expand what is "official". Several possible scenarios can be contemplated, depending on the type of source. Some may well see statistics as part of their business, whether as a primary or secondary activity. These should be encouraged and supported. Others would be negative to the whole idea and become "accidental" data providers with no interest to enter that space. Yet others may pose additional challenges, as not only they see statistics as part of their business but approach it strictly from a commercial, profit-making point of view. Different solutions must be tailored to address the particular circumstances encountered.

The impact on our overall approach starts to be visible with the example of an organisation with substantial data holdings, sufficiently advanced in terms of capabilities, and a positive predisposition. Rather than trying to establish the organisation's willingness to cooperate and share their data, the NSI would start with exploring whether the organisation wants to be certified as a data producer in a particular area. The issues and questions asked would for instance be if an organisation would be willing to adopt the existing quality frameworks, issuing quality statements, adopting and abiding by provisions of confidentiality including penalties for their breach, and generally adhering to most principles that guide the work of the statistical system.

Alternatively, it may be that the organisation neither wants to be certified as a statistical producer nor to share data with an NSI but to work instead towards the idea of federated data, i.e. providing data to third parties to be re-used in another context. A modified set of standards might be applicable in this case.

With the development of the internet and especially social media, almost everybody can publish and disseminate information. Recent examples show that these new ways of information dissemination might have high impact depending on the penetration and reach of the information. This may also be true for false information, which is spread through electronic and social media. Official statistics cannot comment on all information flooding the world wide web, and neither will the statistical system be able to satisfy all demands for statistical information by its users. Therefore the statistical community should consider developing

approaches that allow relevant users to either evaluate the quality of information coming from third parties or allow third parties to produce trusted information (suitable for e.g. policy making).

One approach could be for the NSI to externalise its work in ethical principles and quality frameworks to enable third parties to adopt them in part or entirely to produce trusted information. This process of externalisation would entail the development of standards that would be recognised and followed by other actors. Usually, the adherence to certain principles and standards is certified by specialised authorities. One example of such kind of assessment is the peer reviews within the European Statistical System, which follow a voluntary self-regulatory approach. Certifying other bodies than statistical offices may create an additional burden on official statistics, which is already under high pressure for increasing efficiency. However, it is conceivable that other parties would act as certifying bodies and that a certification process could become one condition for data being used in certain contexts, e.g. for policy making.

CONCLUSIONS

To conclude, with increasing datafication, official statistics will increasingly lose its monopoly on statistical information. Other producers of data will try to expand into the realm of official statistics. At the same time demand for trusted information will increase among the users of official statistics. Official statistics will not be able to meet this increasing demand. One possible solution could be developing a system of standards for quality of statistics that could be adopted by third parties to become trusted producers of statistics. The role of statistical offices would partially change from producing trusted statistics to produce standards enabling others to produce statistics at certified quality levels.

E7 Paying for data

Albrecht Wirthmann[(*)] and Angelo Meuleman[(**)]

Introduction

The development in information and communication technologies led to an increased digitalisation of all kinds of economic and societal activities. Business processes were amongst the first activities being digitalised. Transactions are increasingly done electronically and data is collected as evidence of the performed process and to trigger actions. The sharp decrease of costs for storage capacities enabled storing the resulting data electronically, thus replacing paper files with electronic files, and services could be offered electronically.

With the introduction and expansion of the internet it was possible to extend this process of digitalisation outside of the enterprise. Information flows and transactions between enterprises became digital. Finally, this process expanded to include interactions with individuals. E.g. enterprises are offering services to individuals or individuals are communicating directly with each other over the internet. The introduction of mobile personal devices together with the miniaturisation of sensors and devices and of wireless networks enabled ubiquitous computing. This development can be expressed by the term 'Datafication', which means 'taking all aspects of life and turning them into data' (Cukier & Mayer-Schoenberger, 2013)[(1)]. Applications are offered via the internet and are able to 'datafy' almost all aspects of private and professional life. Cloud services enable storage and processing of huge amounts of data efficiently and in a cost saving way. Advances in artificial intelligence (AI) allow extracting machine usable information from unstructured textual data and finally, from images, videos or sound, further increasing the amount of data and knowledge on data subjects. The internet can also enable linking of data from different sources on data subjects to complete the digital image of the data subjects and their interactions with the real and digital world, e.g. internet service providers combine information on user behaviour from different apps used by the same person for further analysis. Analysing contextual information and interactions in dynamic systems, AI algorithms are increasingly able to predict individual behaviours and future interactions and states of those systems. Taking predictions as behavioural advice by users of electronic services, these predictions are able to influence behaviour and thus change future states of the analysed system. Cyber world influence or even determine "real world" phenomena. Thus, real and cyber world have become two sides of the same coin, e.g. Users of navigation services feed the system with information on their location, direction and speed. The systems use this information to analyse current traffic conditions and to predict traffic conditions in the future. Optimal routes and travel time are calculated taking into account these predictions. If users follow the recommended routes, these systems influence traffic conditions according to their models.

DATA COLLECTION

Data has always been a key asset for statistical offices. They need data to fulfil their mission to provide citizens, societal groups, enterprises and politicians with information of the state and the development of the society, the economy and the environment. This is done by producing statistics, i.e. synthesising the data to extract trends, averages and other statistical figures to describe state and development of statistical populations. As the collection of data has been

(*) Eurostat (European Commission)
(**) Taxistop
(1) Mayer-Schönberger, V., & Cukier, K. (2013). Big Data: A revolution that will transform how we live, work, and think. Houghton Mifflin Harcourt.

an expensive exercise, methods increasing the efficiency of this process have been developed. Introducing sampling did substantially reduce the costs for data collections but also limited the scope of use of these data because sampling means achieving an optimum between sample sizes and pre-defined results at a defined minimum level of quality.

Usually, statistical offices act on the basis of statistical legislation which entitles statistical offices to ask citizens or enterprises and obliges respondents to provide information on the respective topic, i.e. respondents are not reimbursed for responding to questionnaires of statistical offices. Statistical offices are acting on behalf of the government for the public interest. At the same time, statistical offices are committed to reduce the resulting response burden to the minimum necessary, and to look for other sources than asking persons or businesses.

One way for reducing the response burden is to use administrative information, which is already collected due to other obligations of the respondents, e.g. providing information on financial status for reasons of determining taxes. Usually, this information is collected and managed by other public authorities. Increasingly, these data sources are used for producing statistics and statistical offices are authorised by law to use these data for their purposes. Public authorities holding these data are not compensated for providing the data or granting access to the data for statistical purposes. Quite often, it is the case that access is granted on the basis of mutual agreements, which clarify what data is provided, the mode of access to the data and the related security measures. Necessary investments for data access would be covered by the general government budget. These investments would be paid off by savings at the side of the statistical offices.

Statistical offices publish statistical data free of charge. Except for specific conditions, data are published as aggregates, i.e. it is not possible to identify individual units, be it persons, households or enterprises. Exceptions are access to anonymised or pseudo-anonymised data for researchers. Researchers may use these data for analysis but have to ensure privacy and confidentiality when publishing the results. Statistical offices may charge fees for services producing results following specific analysis of the microdata. Normally, statistical data published by statistical offices is disseminated as open data and can be re-used by private businesses or by citizens. Therefore, private businesses usually are not able to earn money by publishing the same data as statistical offices but can offer additional services on top of these data, e.g. more targeted and specific analysis, inclusion into software packages for easier access, creating applications based on the data, etc. It would also be possible that private businesses would publish more granular data or detailed aggregates derived from more granular data. To conclude, once a statistical office decides to publish data on a specific topic, it is not possible to sell the same data by private businesses. However, private businesses may be able to develop business models providing additional services on the basis of these data. It could even be the case, that demand would be stimulated through publishing basic open data to develop a more mature data market including public and private actors (This has been the purpose of the Directive on the re-use of public sector Information[(2)].

DATA COLLECTED BY PRIVATE COMPANIES

Most of the new data are collected by private businesses, e.g. telecommunication data, social network data, collaborative consumption platforms, cashier data or Automatic Vessel Identification (AIS) data. Most of the collected data are side or exhaust products of providing services to customers and users over electronic networks. However, some may argue that these exhaust data are the main purpose of some online platforms. Usually, the data are collected for other purposes than providing data services, e.g. for invoicing/bookkeeping purposes in the case of telecommunication or cashier data, or for improving the service provision, e.g. for probing data in telecommunication sector. In other cases, the collection of data is a central part of the business model. This is the case for services that are offered free of charge to users, such as social networking, internet searches, or messenger services. The services provided to the primary users are then paid by third parties (indirect users) via advertising or other targeted and personalised services fed by analysis of primary user data.

Platforms are often financed as part of service

(2) Directive 2003/98/EC of the European Parliament and of the Council of 17 November 2003 on the re-use of public sector information, http://eur-lex.europa.eu/legal-content/en/ALL/?uri=CELEX%3A32003L0098

provision between two parties, e.g. AirBnB and booking.com for accommodation services or UBER for personal transport services. Platforms often use additional data analysis for supporting their clients with the aim of increasing the attractiveness of the platform, which leads to higher turnover.

In some cases, businesses actively collect data to sell them or to provide services based on the data. Examples would be AIS data or flight trackers[3], which offer data and services for vessel or flight tracking.

As a conclusion, data are at the core of the business models of the above mentioned enterprises, especially those who are offering services on the internet. Related data sources would not exist without this data driven business model. For other businesses, data enabled services could be an additional source of revenue, i.e. when data are collected as part of original service provision and would be re-used for data enabled services.

Businesses also try to stimulate the market by providing free data up to a certain threshold, e.g. tweets or in a specific structure, e.g. Google trends. Motivation for this behaviour can be to develop and showcase data driven applications that fosters demand for more data.

Especially internet platforms profit from network effects, i.e. they need a certain threshold of users or clients to make their services attractive. In many cases, this leads to a quasi-monopolistic or an oligopolistic situation, in which one or very few platforms are serving the vast majority of users in one or more countries or markets. This development can be observed with social media (Facebook, Google+, Twitter, LinkedIn), accommodation services (Booking.com, AirBnB), transport services (BlaBla cars, Uber), search engines (Google, Bing), fitness trackers (Fitbit, Garmin, Withings), etc. Together with the offered services, this is leading to a specific situation as regards to collection of data on the clients of these platforms. Usually, as condition for using the offered services clients agree that their personal information is processed by the service provider for various purposes. The agreement is condition to using the data by the platforms on the one hand and for being able to use the service by the clients on the other hand. In theory, each user can freely decide to consume the offered services. However, the situation is often asymmetric because of the above described network effects. Most of the times, users cannot choose between different models of service consumption, e.g. using the services in exchange of personal data, or paying for consumed services and excluding use of personal data by the respective platform. This situation is also creating social responsibility towards society exceeding mere monetisation of services and data.

In some instances, the new data becoming available are linked to the increased digitalisation of existing economic actors, whereas in other instances, altogether new economic operators, providing genuinely new services. These emerging economical/business models are of course of particular interest to study. Data is necessary for a rich debate on the impact of these emerging phenomena, and to support policy makers to take the right decisions. To take but one example: in the market of shared mobility, there is a lot of confusion. Even experts do not always agree on the benefits or negative impacts caused by ride-sourcing services or different types of car-sharing operators. Local governments often have no insights in short term or long-term impacts of these services. They don't know who to support or not. To remedy this, the Flemish government is in the process of creating a car-sharing framework: each operator could be officially recognised as car-sharing operator. In return, they need to provide data to the government. Local governments can then choose to give special incentives, like parking lots, only to recognised operators. The Belgian government has also created a framework for the sharing economy, which incorporates tax incentives.

Traditionally, data subjects and data providers have coincided i.e. enterprises have provided data to statistical offices about their own activities. As this is no longer the case, the question if statistical offices should pay for accessing and using data that are collected by third parties, mostly private enterprises, and are used in a commercial context by those enterprises. This question is far from trivial. As described above the circumstances of data collection and the economic conditions, under which these data are used by private actors, are very different. In some cases, data would not exist without an economic incentive. In other cases, data are collected as side product. Statistical

(3) e.g. https://www.marinetraffic.com, https://www.vesseltracker.com, https://flightaware.com, http://www.flightstats.com, https://www.flightradar24.com/

offices should therefore analyse the situation on a case-by-case basis. Quite often, use and dissemination of official statistics based on these data sources and economic use of these data will have to co-exist.

CONCLUSIONS

Societal and economic actors have a certain responsibility to enable the functioning of public services including statistical services. This is one of the reasons for justifying provision of information by citizens and businesses to statistical offices without direct compensation or benefit. On the other hand, statistical offices should leave space for commercial activities based on the data economy. Otherwise, statistics would bite the hand that is feeding the data market. Therefore, it will be necessary to establish some common rules and to apply them on a case-by-case basis, taking into account specific conditions.

In addition, monopolist or oligopolistic situations are problematic in an economic and societal context, having the tendency of leading to sub-optimal solutions or bearing the risk of combining too much power in one hand. This increases social responsibility of those who are holding these data to use them for public good. In some sectors, a level playing field might be achieved by reducing monopolistic tendencies. The public sector or other trusted third parties might facilitate the pooling of data from many smaller operators to allow them to benefit from the network effect – either in an open setting, or in a setting where (aggregated) data are shared only amongst operators who are 'paying back into the system' by sharing data themselves. If such structures were to be set up, statistical offices might benefit from them, by aggregating (or receiving aggregates of) operator data.

Accessing and using already existing data sources may lead to savings on the side of the statistical offices, reducing data collections, e.g. as it already done in the context of price statistics. On the other hand, these new data sources often have a reduced signal to noise ratio, which requires more data preparation (pre-processing) or cleansing as well as use of different data sources to produce statistics that is conforming to the high quality aspirations of official statistics. Processing data for access by statistical offices may require additional investments by private data holders that would have to be covered by them. Obligations of data provision may also create unfair competitive situations if only selected businesses would be obliged to provide access to data. These aspects would speak in favour for compensating businesses for these efforts or for creating situations that would burden all players in a similar way.

On the other hand, businesses might also profit from collaboration with statistical offices, creating a minimum market with public, open data. In addition, quality of data services may increase when combining a private data source with data from statistical offices. Standards on data and metadata might contribute to this advantage. In some situations, other authorities might set up models where

To conclude, data provision or access by statistical offices should in general be free of additional costs. In some cases (e.g. the Flemish car-sharing case) data provision might be worked into a framework where data provision is incentivised. In justified cases, marginal costs for services for accessing the data could be covered by statistical offices. The decision should be taken case by case, i.e. by data type and should consider the above mentioned conditions.

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Power from Statistics: data, information and knowledge

OUTLOOK REPORT

The 'Power from Statistics' initiative, jointly organised by Eurostat and the European Political Strategy Centre, aims to determine which topics will be relevant to decision makers and citizens in the future and how official statistics could best deliver information about them.

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