EUROSTAT REVIEW ON NATIONAL ACCOUNTS AND MACROECONOMIC INDICATORS

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Aims and scope

EURONA is an open access, peer-reviewed, scholarly journal dedicated to National Accounts and Macroeconomic Indicators. EURONA aims at providing a platform for researchers, scholars, producers and users of macroeconomic statistics to exchange their research findings, thereby facilitating and promoting the advancement of National Accounts and Macroeconomic Indicators.

EURONA publishes empirical and theoretical articles within the scope of National Accounts and Macroeconomic Indicators, as well as articles on important policy uses of these statistics. They may relate to both users' and producers' interests, present subjects of general relevance or investigate specific topics.

EURONA is non-partisan and applies the highest standards to its content, by emphasising research integrity, high ethical standards, validity of the findings and cutting edge results. EURONA gives room to all viewpoints.

The articles published in EURONA do not necessarily reflect the views or policies of the European Commission.

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Editorial

Consistency and exhaustiveness are two key quality characteristics of national accounts and related macroeconomic statistics. Each of the articles in this second EURONA issue of 2018 consider aspects of these two features.

In the first article of this issue, Paul McCarthy takes the reader through the history of accounting standards — not only the System of National Accounts (SNA), but also related standards for government finance statistics and the balance of payments. The author argues that these three systems have converged considerably over the years, as users consider the consistency of these statistics as important. This raises the question whether they could or should be fully integrated in the future.

When the European System of Accounts (ESA) 2010 was introduced in European countries in 2014, a lot of media attention focused on the inclusion of illegal activities — at the time restricted to drugs trafficking, smuggling and prostitution — as part of GDP. Illegal activities are included in the accounts to make GDP exhaustive in terms of its coverage of economic activities in a country. Ilcho Bechev, in the second article, discusses possibilities to include other illegal activities, such as fencing, bribery and, the topical subject of migrant smuggling. He provides conceptual and practical considerations on the measurement of a range of such activities.

In the third article, Pedro Martins Ferreira presents a new methodology to estimate imports and exports of goods for the EU Member States that are internally consistent, in other words, without so-called trade asymmetries. The method was developed and applied within the Figaro ("full international and global accounts for research in input-output analysis") project, in which inter-country supply, use and input-output tables have been produced for the EU. The method has been labelled "QDR" as it also provides a breakdown of trade into quasi-transit trade (Q), domestic trade (D) and re-exports (R).

Finally, in the last article, Erwin Diewert and Kevin Fox provide an addendum to their article that was published in EURONA 1/2017, which dealt with the issue of consistency of real GDP and inflation measures across space and time. The authors show that this issue is connected to the problem of interpolating purchasing power parities (PPP) between PPP benchmark years, which is a common challenge for international institutions involved in PPP exercises.

The four articles together thus provide stimulating reading material that sheds light on the various aspects of consistency and exhaustiveness of the accounts. I hope you will enjoy reading them. Reactions to the articles are always welcome at ESTAT-EURONA@ec.europa.eu.

Paul Konijn

Editor of EURONA

1 Integrated frameworks for economic accounting standards

PAUL McCARTHY ([1])

Abstract: the origins of national accounting can be traced back to the 17th century. However, modern national accounts have largely developed since the late 1940s, although some initial forays commenced a couple of decades earlier. The three most important standards for the economic accounts are those for the 'family of macro-economic accounting' — national accounts themselves, the balance of payments and government finance. They were initially established separately from each other, although the nature of the subject matter meant that there was a significant degree of overlap in the concepts described. However, harmonising these three standards took some time to achieve and some minor consistency issues still exist.

The origins of national accounting have been described in detail by Bos (2017). Details about the development of international statistical standards for national accounts (*System of National Accounts*, or SNA), balance of payments (*Balance of Payments Manual*, or BPM) and government finance statistics (*Government Finance Statistics Manual*, or GFSM) are provided in this article. It also looks at the extent to which the SNA (particularly the 1993 and 2008 versions) provides the detailed data required to analyse current economic developments using the outcomes of two high-level enquiries as evidence of the suitability of the SNA as an international statistical framework.

The SNA has evolved since its beginnings in the mid-20th century, with successive versions refining the concepts underlying the accounts while simultaneously updating the system to take into account new economic developments (for example, more complex financial derivatives). Items are added to the SNA research agenda as they emerge to ensure the SNA maintains its relevance. For example, in the past decade the importance of globalisation has increased as has its complexity, while rapid advances in technology have also brought 'digitalisation' into the national accounts research agenda.

Finally, the efforts that have been put into harmonising the SNA, BPM and GFSM have been very successful with consistency being achieved in the latest versions apart from some subtle differences in wording that could lead to inconsistent interpretations, particularly with regard to some financial sector issues. Is it now time to integrate these three important international statistical standards into a single over-arching standard for economic accounts?

JEL codes: B00, E01, E60

Keywords: national accounts, balance of payments, government finance, satellite accounts, globalisation, digital economy

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1. Introduction

Over the past century, the range of economic statistics available has been expanded considerably in response to demands from government, economic analysts and academic researchers. Not only has the range of data increased but much more detailed data are now available on many topics. Many datasets, such as national accounts and government finance, can be related to each other because they are produced using harmonised standards. In addition, comparisons between countries are possible because most countries compile their statistics largely in accordance with internationally-accepted statistical standards.

Collecting statistics is not a new undertaking. References can be found to population counts by the ancient Greeks and Romans, with the main reasons being either to assess the numbers of suitably-aged males available to conduct a war or for taxation purposes. Population censuses have continued through the many centuries since. Statistics relating to other topics can also be found quite readily through the Middle Ages, particularly those relating to agricultural products (for example, the production of crops or wool).

Charles and Daudin (2015) refer to some initial attempts at measuring foreign trade in the early 17th century and to England and Ireland systematically recording the balance of trade from 1696 using data from their ports. Some rudimentary government accounts were available in the 15th century, recording revenue collected and government expenditures financed by this revenue (Arslan (2017)). These elements of an economic accounting system developed independently of each other, partly as a function of the information available and partly the inclinations of those involved in improving them over time.

It was also in the 17th century that statistics emerged which attempted to provide an overview of a country's entire economy (what we now refer to as national accounts). Like the population counts made by the ancient Greeks and Romans, the underlying reason for their development was related to conducting wars; in this case to assess the ability of an economy to raise the revenue to sustain the war effort. Although their creators described the concepts they were measuring and the methods they used, at that time no-one developed a set of standards for compiling these accounts.

Such standards are now available for the national accounts and related statistics (in particular, balance of payments and government finance statistics). Several organisations have been involved in drawing up and refining these standards since the middle of the 20th century. They have developed to the point where they are almost completely consistent, even though different organisations have been responsible for producing them.

This paper examines the emergence of the statistical standards for the national accounts and those for its two most closely related datasets (balance of payments and government finance) and looks at possible future directions for these standards.

2. Development of national accounts

National accounts provide the broadest available statistical record of an economy. They draw together economic statistics that are generally collected separately from each other and present them as a detailed, consolidated set of data. The national accounts present details of production, income and expenditures for the major domestic economic sectors (households, government, corporations, non-profit institutions) as well as for the external (rest of the world) sector.

Detailed statistical standards for national accounts have evolved since the middle of the 20th century, along with more comprehensive frameworks for two of the sectors — government and the rest of the world — and guidelines for various other economic statistics (for example, money and banking, input-output, prices). A point often overlooked is that the concepts underlying national accounts provide a conceptual framework for the collection of economic statistics. It is particularly important that the statistical surveys that provide data for the accounts are either based directly on the national accounts concepts or can be readily related to them.

Some elements of national accounting can be traced back to the second half of the 17th century. Petty, King and Davenant devised the first national income estimates for England, while Boisguillebert and Vauban produced similar statistics for France (Bos (2017)).

The development of the modern national accounts started in the late 1920s, along with the idea of establishing international standards for compiling the accounts. The League of Nations convened an international conference in 1928, with the final report highlighting the desirability of countries compiling economic statistics and encouraging the development of uniform presentation methods to enable international comparisons. In 1939, the *World Economic Survey*, published by the League of Nations, included estimates of national income for 26 countries, with a time series of about 10 years (at that time, national income was considered by economists to be the single most important indicator of an economy's performance). Progress on developing international standards then stalled because of World War 2, although some countries continued to produce national accounts for their own purposes, particularly to monitor the impact of the war on their economies.

The modern era for national accounts developed from this initial step by the League of Nations, hastened by the economic stresses associated with World War 2 and the recovery efforts afterwards. In addition, the conceptual foundation provided by Keynes' General Theory highlighted the need for a statistical framework to support analysis of the factors underpinning countries' economic activity. Developing an economic analysis framework became even more critical with the post-war recovery programmes stretching the resources of all the countries involved. The United Nations (UN) was formed in 1945 and, via its newly-established Statistical Commission, became involved in setting standards for statistics. In 1947, the first meeting of the UN Statistical Commission emphasised the need for international statistical standards for compiling a wide range of statistics, including national accounts, for policy purposes.

A further important development in macroeconomic statistics during the 1930s was the input-output tables, which were devised by Professor Wassily Leontief. In 1941, Leontief published the results of almost a decade's work in *The structure of American economy, 1919-1929: An empirical application of equilibrium analysis*. Leontief had analysed the input-output structure of the American economy for 46 industries for two years (1919 and 1929). He updated this analysis in 1951 by extending it to 1939. Professor Leontief was awarded the Nobel Prize in Economic Sciences in 1973 'for the development of the input-output method and for its application to important economic problems. Professor Leontief is the sole and unchallenged creator of the input-output technique' ([2]).

Another significant development in international statistical standards in the mid-20th century that had a beneficial spin-off for the national accounts was in the field of balance of payments. The International Monetary Fund (IMF) was established in 1945 as an outcome of the Bretton Woods Conference in July 1944, attended by 44 countries. They had agreed that it was essential to develop a model for international economic cooperation to avoid any repetition of the currency devaluations that contributed to the Great Depression of the 1930s. The IMF's primary mission is to ensure the stability of the international monetary system — the system of exchange rates and international payments that enables countries and their citizens to transact with each other ([3]). It also facilitates international trade, promotes employment and sustainable economic growth, and helps to reduce global poverty. Given its special interest in international transactions, the IMF has been at the forefront of producing the international standards for balance of payments statistics. Another factor that impinges on a country's ability to support particular levels of foreign trade is its financial system, including government finance. As a result, the IMF has also produced the international standards for government finance statistics and for money and banking statistics.

Until the 1990s, a separate national accounting standard was used by countries in the Soviet Union's sphere of influence. It was known as the *Material Product System* (MPS) which, like the SNA, attempted to measure a country's overall economic activity. The first steps in its development were in the 1920s when it became the statistical standard for the Soviet Union. The MPS was also implemented as the standard for national accounts from the 1950s in the 15 countries that came into the Soviet system after World War 2 ([4]). In practice its production boundary was narrower than that of the SNA because the MPS measured only the production of goods, excluding services from its definition of production.

3. Standards for economic accounts

One of the most important developments in statistics since the mid-20th century has been the comprehensive set of statistical standards produced by international organisations. Several classifications (for example, industry, external trade, functions of government) are defined within these standards. They are now compatible across all the economic statistics frameworks and statistical collections.

([2]) See: https://www.nobelprize.org/prizes/economics/1973/press-release/.
([3]) IMF, see: https://www.imf.org/en/About.
([4]) Albania, Bulgaria, China, Cuba, Czechoslovakia, the German Democratic Republic (or East Germany), Hungary, Cambodia, the Democratic People's Republic of Korea (or North Korea), Laos, Mongolia, Poland, Romania, Vietnam and Yugoslavia.

Currently, the main economic accounting standards directly relevant to the national accounts are:

- *System of National Accounts, 2008 (2008 SNA);*
- *European System of National and Regional Accounts, 2010 (ESA 2010);*
- *Balance of Payments and International Investment Position Manual, Sixth edition (BPM6), 2009;*
- *Government Finance Statistics Manual, 2014 (GFSM);*
- *Monetary and Financial Statistics Manual and Compilation Guide, 2018;*
- various satellite accounts manuals (for example, for the environment or for tourism).

Other statistical standards cover subjects such as price indexes and labour force (employment) data. In addition, a large number of 'how to do it' guides have been produced, covering various aspects of the national accounts (explaining, for example, how to compile quarterly accounts or supply-use tables) as well as other topics such as compiling balance of payments estimates.

There was a large degree of overlap between these standards even though they were largely developed independently of each other. Initially, some differences arose between early editions of the SNA and the BPM. Over the past few decades a considerable amount of effort has been put into ensuring that these standards are aligned. The result is that they are consistent apart from minor subtle differences in detail or wording that could lead to inconsistent interpretations of some parts of these standards.

The question that should be asked now is whether it is possible to integrate the various economic accounting standards into a single overarching standard incorporating the SNA, BPM and GFSM. This article examines the feasibility of such an approach. Its starting point is to look at the history of the development of international standards for economic statistics.

3.1 Early versions of economic accounts frameworks (up to 1964)

In 1950, the Organisation for European Economic Co-operation (OEEC), in conjunction with the National Accounts Research Unit at Cambridge University (headed by Richard Stone ([5])) produced a statistical framework for the national accounts titled *A Simplified System of National Accounts*. Based on some country studies and comments from economic statisticians, this standard was revised significantly and was published in 1952 as *A Standardised System of National Accounts*.

While the UN had similar aims as the OEEC in measuring activities across the whole economy, its emphasis was to ensure that the concepts underlying the national accounts were applicable to all countries, including developing economies in particular. The UN emphasised issues related to the comprehensiveness of the accounts such as including imputations for subsistence production within the production boundary. The first national accounting standard produced by the UN was published by the UN Statistical Office in 1953 as part of their 'Studies in Methods' series and was titled *A System of National Accounts and Supporting Tables*. It was updated in 1960 to take account of the experiences of countries in implementing its guidelines and again in 1964 to improve its consistency with the IMF's *Balance of Payments Manual.*

([5]) Richard Stone and James Meade had produced Britain's first national accounts in 1941 to measure the resources available to Britain's war-time economy.

3.2 Economic accounts frameworks (1968-1993)

These early attempts to produce a statistical framework for the national accounts were not formally coordinated. Some members of the teams overlapped but the different organisations involved had their own priorities at the forefront of their efforts so the emphasis in the various manuals was different (for example, as noted above, the UN considered the application of national accounts to developing economies as a high priority). In 1968, *A System of National Accounts* (SNA) was coordinated and published by the UN and was the first version in which the competing priorities for the national accounts were fully taken into account.

The *Balance of Payments Manual* (BPM) was produced by the IMF (as is still the case). The concepts in the SNA's overseas transactions (rest-of-the-world) account were largely, but not completely, consistent with the BPM. For example, at that time reinvested earnings of direct foreign enterprises were treated differently in these two international standards.

3.3 Economic accounts frameworks (1993-1998)

A revised version of the SNA was released in 1993. It both updated and expanded the 1968 SNA. The impetus for the update of the 1968 SNA came from some significant changes in the structure of economies, the availability of more sophisticated price deflators, the broader range of financial instruments that had become available, and various topics of interest that were related to economic activity but which were outside the boundary of production, particularly unpaid household work and environmental issues.

An Inter-secretariat Working Group on National Accounts (ISWGNA) was established to coordinate the revision/update of the 1968 SNA. The ISWGNA consisted of Eurostat, the IMF, the Organisation for Economic Co-operation and Development (OECD), the UN and the World Bank. An important reason for forming the ISWGNA was to ensure that the concepts for the main economic accounting standards were harmonised with each other by having better coordination amongst the agencies involved in producing those standards.

In 1995, the European Union (EU) produced an updated version of the *European System of National and Regional Accounts*, which is commonly known as the 1995 ESA. It was largely consistent with the statistical concepts described in the 1993 SNA but included some refinements to specific definitions that were designed to cater specifically for requirements of the EU.

3.4 Economic accounts frameworks (1998-2008)

During the 1990s, several economic developments impacted on the applicability of some of the standards in the 1993 SNA. In 1999, the UN Statistical Commission agreed to proposals by the ISWGNA to update the 1993 SNA's recommendations on financial derivatives. However, several other economic developments at the turn of the century (mobile phone licences, payments by stock options, non-performing loans, emissions trading schemes) were not explicitly treated adequately in the 1993 SNA, so in 2003 the ISWGNA recommended to the UN Statistical Commission that a comprehensive update of the SNA was necessary. An advisory expert group was established by the Commission to advise the ISWGNA. The group's first meeting was in February 2004 and it met six times during the 1993 SNA update.

4. What do the national accounts measure?

The OECD defines national accounts as follows:

> 'National accounts are a coherent, consistent and integrated set of macroeconomic accounts, balance sheets and tables based on a set of internationally agreed concepts, definitions, classifications and accounting rules. National accounts provide a comprehensive accounting framework within which economic data can be compiled and presented in a format that is designed for purposes of economic analysis, decision-taking and policy-making.' ([6])

In practice, GDP is the broadest measure of economic activity presented in the national accounts and, consequently, the most widely used measure. GDP is frequently used as a proxy for economic well-being. While there is often a correlation between the level of a country's well-being and its GDP, many factors affect well-being and not all are included in GDP. For example, many environmental issues are considered to be outside the SNA's boundary of production (for example, the intrinsic value of having clean water available, although the costs of purifying water supplies are included in GDP).

The effectiveness of the national accounts as a tool for economic analysis, decision-taking and policymaking depends on a number of factors:

- how well does the SNA framework capture all economic activity?
- how well can the SNA framework be applied in practice?
  - are the data available to produce all the accounts completely?
  - what assumptions have to be made?
  - are the data consistent over time?
- how well are the national accounts understood by economic analysts and commentators?

For over half a century the statistical framework provided by the SNA has proven to be resilient to changing economic circumstances, technological change and the increased inter-connections between economies. In fact, the usefulness of the SNA has driven increased scrutiny of national accounts as well as the balance of payments and government finance. While the national accounts are the broadest set of economic statistics, there is a range of other important standards for economic statistics. Even though these standards have been developed by different agencies, the statistics based on them can be completely reconciled with each other, which is important for economic analysts and commentators.

5. Complementary standards

National accounts are designed to measure the whole economy so they depend on virtually the whole range of economic statistics collected by national statistics offices. Two of the most important datasets that feed into the national accounts are the balance of payments,

([6]) OECD *Glossary of Statistical Terms*.

which record transactions between an economy's residents and the rest of the world, and government income and expenditure (government finance statistics). Both are important in their own right for policy purposes, so the statistical standards for these sets of statistics evolved independently of the national accounts, at least initially. Early versions of these standards were not completely consistent with the SNA, although the latest versions have become consistent because of the coordination through the ISWGNA. In particular, until recent years the major data sources for government financial transactions were cash accounts. As a result, the initial standards for government finance statistics were cash-based rather than accruals-based (as required for the national accounts). The 2008 SNA explains the reason for accruals-based accounting being preferred to cash-based as follows (paragraph 3.166):

> 'Accrual accounting records flows at the time economic value is created, transformed, exchanged, transferred or extinguished. This means that flows that imply a change of ownership are entered when the change occurs, services are recorded when provided, output at the time products are created and intermediate consumption when materials and supplies are being used. The SNA favours accrual accounting because:
>
> a. The timing of accrual accounting is in full agreement with the way economic activities and other flows are defined in the SNA. This agreement allows the profitability of productive activities to be evaluated correctly (that is, without the disturbing influence of leads and lags in cash flows) and a sector's net worth to be calculated correctly at any point in time;
>
> b. Accrual accounting can be applied to non-monetary flows.'

Early versions of national accounts standards dealt with this cash/accruals problem by recommending some adjustments to the cash-based government accounts to bring them more closely into line with an accruals-based set of accounts. For example, assessments of the amount of income tax payable are often based on the earnings in the preceding year so the cash amounts of income tax received do not relate to the same period as that in which the income was earned. Including cash estimates of income tax directly in the national accounts would cause discrepancies in annual percentage changes and potentially between the three alternative measures of GDP (income, expenditure and production). The SNA therefore recommended some adjustments so that government finance statistics, such as income tax, would more closely approximate accruals-based estimates.

The shortcomings of cash-based government accounts led the governments in some countries to move to accruals-based government accounts in the 1990s, at least as an adjunct (supplementary source of information) to their cash-based accounts. It was not until the 2001 issue of the *Government Finance Statistics Manual* (GFSM) that it recommended that government finance statistics should be compiled on an accruals basis.

Historically, the national accounts used information mainly from the current account of the balance of payments but at a more aggregated level of detail than analysts of the balance of payments data required. In principle, exports and imports of goods and services should be recorded in both the national accounts and the balance of payments at the time that the ownership of the goods or services changes hands. However, the most commonly used data source for exports and imports of goods is an administrative system recording trade as the goods physically pass through a country's customs boundary. The time of change of ownership and that of crossing the customs boundary can differ significantly and both

the SNA and BPM suggested making adjustments to more closely align the values obtained from customs data with the time at which ownership actually changed. A simple example of the impact of not reflecting the correct timing in exports of goods would be a large grain shipment that was exported during the first week of a year but which had actually changed ownership the previous week (in other words, in the previous year). In the customs data, the export would be recorded in one year but the business selling the grain would have reported the sale, and a rundown in inventories, during the previous year leading to a discrepancy within the expenditure-based estimates of GDP.

6. The big steps forward for national accounts standards

It is instructive to examine in more detail the evolution of the economic accounts standards. Not only have definitions, concepts and processes been refined but the scope of GDP has also changed over time.

6.1 1968 SNA

In 1968, the United Nations Statistical Office released an updated framework for the accounts -— *A System of National Accounts* (SNA). It was more comprehensive and detailed than the earlier versions and included guidelines for producing input-output tables, flow-of-funds accounts and balance sheets. The accounts were presented in a matrix format, which was designed to show how an economy's transactions fitted neatly into an input-output format. Individual cells of the matrix could be elaborated to provide more detail on various aspects of the accounts. At its broadest level the matrix presentation provided an organised overview of the way in which the full set of accounts related to each other and how the current accounts related to the balance sheets. It was a useful way of presenting the linkages between the various components of the accounts but did not readily lend itself to the more practical issues involved with compiling them.

One chapter within the UN's *System of National Accounts* was devoted to the issues associated with constant price estimates, recognising their importance for economic analysis. The treatment of financial institutions (the imputed service charge) was changed significantly. Reflecting the UN's desire to improve the quality of economic statistics in developing countries, a section (Chapter IX) was devoted to the issues associated with the 'Adaptation of the full system to developing countries'. It covered the problems caused by so-called 'dualism', which is the existence, side-by-side, of traditional and more modern modes of living and economic organisation in an economy. The chapter emphasised the importance of accounting for subsistence production because its share of GDP will decline as an economy develops and becomes more market orientated. Omitting subsistence production will cause GDP growth to be overstated as this change occurs. This chapter also highlighted the importance of some export industries, based on the availability of mineral or agricultural resources, and the potentially large impact of the public sector in influencing growth in these (developing) countries. The chapter included a number of ways in which data on the most

important drivers of a developing country's economy could be presented, via such means as expanding classifications for key industries and presenting supplementary tables showing the market/non-market split of activities. It also set out priorities for compiling the various tables in the accounts.

The 1968 SNA was not completely consistent with the IMF's *Balance of Payments Manual*, although steps had been taken by the UN and the IMF to better align these two standards.

6.2 1993 SNA

The 1993 SNA built on the 1968 version by refining many of the concepts and dealing with practical issues that had arisen when national statistics offices were implementing the 1968 SNA.

The oil crises in the 1970s resulted in major structural changes in many economies and introduced some difficult issues for the national accounts deflators and constant price (in other words, volume) estimates. Most countries compiled their constant price estimates for a base year that was fixed for several years. Typically, rebasing to a more recent base year occurred once every 5 or 10 years. The massive price increases for oil during 1973 and 1974 were reflected in the price deflators for oil products, which resulted in different growth rates in GDP and its major aggregates being recorded depending on which year was chosen as the base year. There were also huge changes in the structure of economies with oil-exporting countries having a large increase in nominal GDP while oil-importing countries generally suffered varying degrees of balance of payments problems and a slowdown in their economic activity which impacted on various components of their national accounts.

Another major change was the introduction of personal computers and their rapid spread through economies in the early 1980s. The 'matched model' method of measuring prices over time was not appropriate for computers because of the rapid changes in technology and so hedonic ([7]) price indexes were developed for computers. In the mid-1980s, the United States Bureau of Economic Analysis started estimating deflators for computers in the US National Income and Product Accounts using hedonic price indexes. However, another problem arose with fixed base estimates because the rapid spread of computers was associated with huge falls in their price. Therefore, the fixed base method tended to overweight the volumes of computers as the time series moved forward from the base year.

The 1993 SNA introduced the concept of 'chain volumes' to ameliorate the problems associated with the shocks from the oil price increases and falls in the price of computers. In essence, the simplest means of estimating chain volumes is by changing the base year every year instead of every 5 or 10 years. In this way, each year's volume changes are estimated using the previous year as the base year instead of having a base year that is several years out of date.

([7]) The OECD glossary of statistical terms defines a hedonic method as 'a regression technique used to estimate the prices of qualities or models that are not available on the market in particular periods, but whose prices in those periods are needed in order to be able to construct price relatives. It is based on the hypothesis that the prices of different models on sale on the market at the same time are functions of certain measurable characteristics such as size, weight, power, speed, etc. and so regression methods can be used to estimate by how much the price varies in relation to each of the characteristics'.

One of the regularly occurring criticisms of the production boundary defined by the 1968 SNA was that it excluded unpaid household work. The issue of including unpaid household work as part of GDP was considered during the deliberations on the changes being introduced in the 1993 SNA, but it was rejected. However, this concern did lead to the concept of 'satellite accounts', which has proved to be an important innovation. They are accounts compiled using the same concepts as the core accounts but which are kept separate from them. Satellite accounts can be used for a wide variety of purposes, with those for the environment, tourism and unpaid household work being amongst the most prominent. The advantage of satellite accounts is that statistics can be produced that are as consistent as possible with the data in the main (or core) accounts but without affecting the consistency or continuity of the core accounts themselves.

Another significant change to national accounts for the 1993 SNA was in relation to the treatment of the output of financial corporations. The way that financial institutions, such as banks, operate is as an intermediary between lenders and borrowers of funds. Part of a bank's receipts for its operations comes from direct charges levied on those either depositing or borrowing funds but a substantial part comes from the difference in the lower interest rates paid to depositors and the higher rates charged to borrowers. This difference in interest rates provides a major source of income for banks and is known in national accounting jargon as 'financial intermediation services indirectly measured' (FISIM). Introducing FISIM to replace the 1968 SNA's imputed service charge for financial institutions was a very contentious issue. Ultimately, the 1993 SNA recommended FISIM as the preferred method for estimating the output of financial corporations but it also allowed the 1968 SNA's approach to be used if a country thought it better suited its situation. One of the important considerations was that estimating FISIM increased GDP because the 1968 SNA's treatment allocated the whole of the service charge as intermediate consumption of a nominal industry so it did not have to be allocated across those industries using the service. When FISIM was allocated, part of it went to final consumption expenditure of households and government, so it increased GDP.

The effect of all the changes introduced in the 1993 SNA was to raise the level of GDP in many countries by about 2-3 %, although the impact on changes in GDP volumes was much smaller. FISIM was a significant component of this increase in GDP.

The EU's standard for national accounts at that time was the 1995 *European System of National and Regional Accounts* (1995 ESA), which was a legal document under EU legislation. The EU uses national accounts data for several important administrative purposes:

- in 1992, the EU specified criteria (commonly known as the 'Maastricht criteria') that EU Member States had to meet to be able to adopt the euro as their currency (two of these were based on national accounts data — the ratio of the government deficit to GDP and the ratio of government debt to GDP);
- the national accounting aggregate gross national income (GNI) is a component of the formula used in determining the contributions of EU Member States to the EU's budget;
- the term regional accounts in the ESA title is significant because regional accounts are used to allocate regional cohesion and support funds.

Using national accounts criteria in these ways depended on the consistency of the relevant data across EU Member States, which the 1995 ESA was designed to ensure.

6.3 2008 SNA

In 1999, the UN Statistical Commission agreed to two ISWGNA proposals for one-off changes to the 1993 SNA. One was an elaboration of the classifications of expenditures according to purpose, which had not been fully articulated when the 1993 SNA was released. The second was a change in the treatment of financial derivatives, which was required because of the extent of the innovations in this type of financial instrument during the 1990s. An important point to note is that the IMF proposed the financial derivatives revision but the ISWGNA was responsible for reviewing the proposals. Identical changes were made to the 1993 SNA and the fifth edition of the IMF's *Balance of Payments Manual* (BPM5) and it was agreed to make the same changes in the forthcoming IMF *Manual on Monetary and Financial Statistics*. The updating process was an example of successful cooperation between the five international organisations with major responsibility for economic accounts frameworks and standards. It ensured consistency on these issues between the 1993 SNA and BPM5.

At its meeting in 2002, the Statistical Commission agreed to establish an advisory expert group to assist the ISWGNA by providing advice on some of the emerging economic issues that required clarification in economic accounts. At that time some difficult issues had arisen whose treatment was not explicitly covered by the 1993 SNA (for example, how to treat mobile phone licences, stock options, non-performing loans, emissions trading schemes). While some interim recommendations had been accepted, the Statistical Commission agreed that further research was required on these, as well as some other issues that had been discussed when the 1993 SNA was being drafted.

By 2003 a sufficient number of changes had been identified for a major revision of the SNA and the 2003 UN Statistical Commission 'endorsed the scope of the updating process with a view to maintaining the fundamentals of the current *System of National Accounts, 1993* (1993 SNA) and its consistency with related publications like the *Balance of Payments Manual*, 5th ed., the *Government Finance Statistics Manual, 2001*, and the *Monetary and Financial Statistics Manual*'. In total, 44 items were identified for consideration by the advisory expert group. Some were important emerging issues, some were required to take account of changes in the ways in which economies operated and some were refinements to make the SNA less prescriptive so that different institutional arrangements in different countries could be better catered for. The UN Statistical Commission emphasised that no fundamental changes would be made to the 1993 SNA during the process. Rather, the update was designed to refine concepts in the 1993 SNA that had proved problematical for some countries in implementing it and to take account of emerging economic circumstances that either did not exist or were relatively unimportant when the 1993 SNA was being formulated.

Two of the changes that the advisory expert group considered during the SNA update were whether to capitalise defence expenditures and to capitalise research and development (R & D) costs. Historically, all defence expenditures were considered to be current expenditures. In the 1993 SNA, a partial change was made, with capital items that were commonly available in the non-defence sectors of the economy (for example, housing) being classified as fixed capital formation. However, expenditures on 'defence-only' products such as weapons, missile carriers and launchers, military aircraft or warships, were still classified as current expenditure. The 2008 SNA made a change by recommending that expenditures on all these types of weapons systems should be classified as fixed capital formation because

they '…. provide an ongoing service of deterrence against aggressors and therefore meet the general criteria for classification as fixed assets'. The advisory expert group also decided to capitalise R & D costs.

The experience of most countries in implementing the 2008 SNA was that the levels of GDP were increased by at least 1.5 % and by as much as 4.0 % but the period-to-period (for example year-on-year) changes were not significantly affected in most cases. The two largest influences on the changes in the level of GDP were capitalising defence weapons systems and capitalising expenditures on R & D. The impacts from other changes were generally less significant but, nevertheless, were important in some countries. In addition, given the status of implementing the 2008 SNA in a country's accounts as being a 'major revision', the opportunity was taken in many countries to put through accumulated revisions (for example, from new or revamped economic surveys), which partly obscured the effects of the changes from implementing the 2008 SNA.

Introducing new concepts into a country's national accounts is a major task because the changes/additions have to be backcast through the entire national accounts time series to maintain consistency in the accounts, particularly for one of the most important uses — estimates of economic growth as measured by changes in the volume of GDP. The need to maintain consistency occurs no matter how large (or small) the change being implemented so backcasting is always required.

The 1995 ESA was updated a couple of years after the 2008 SNA and was released as the *European System of National and Regional Accounts* (ESA 2010).

7. Balance of Payments Manual

Historically, the International Monetary Fund (IMF) has been responsible for the statistical framework and standards relating to international transactions. The IMF released the first edition of the *Balance of Payments Manual* (BPM) in 1948. The latest version was issued in 2008 and is titled *Balance of Payments and International Investment Position Manual, Sixth edition*, commonly known as BPM6.

The early editions of the SNA and the BPM were produced independently, although an updated version of the 1960 SNA was released by the United Nations Statistical Office in 1964 with the aim of improving the consistency of the SNA and the BPM. The fourth edition of the BPM was released in 1977. Some inconsistencies between BPM4 and the 1968 SNA remained, particularly with respect to reinvested earnings.

The 1993 SNA was produced under the auspices of the ISWGNA. The fifth edition of the BPM was also released in 1993 by the IMF. The concepts in the 1993 SNA and the BPM5 were harmonised with each other regarding units, valuations, time of recording, conversion procedures, coverage and financial assets and liabilities (similarly with the 2008 SNA and BPM6, which were updated from their previous versions at the same time as each other). However, some differences in presentation still remain, which are a function of the different aims of the two standards and the requirements of their users.

The SNA is based on the principle of quadruple entry accounting. Transactions are generally between two institutional units and each of the units records the two sides of the transaction, in other words, as a resource and as a use. On the other hand, the BPM6 identifies only the resident party and so each transaction has only two entries at this time.

A major difference in presentation is that the balance of payments is shown from the point of view of resident units while the rest of the world accounts in the SNA present the same accounts, including the same transactions, from the point of view of non-resident units. The classifications are consistent but the ways in which the estimates are presented differ because of the different requirements of their major users. For example, the BPM6 presents financial details classified by functional category (direct investment, portfolio investment, financial derivatives, etc.) whereas the SNA prefers a classification according to the financial instrument (monetary gold, special drawing rights, currency and deposits, etc.). The important point, though, is that the details provided in both the SNA and the BPM allow both sets of data to be completely reconciled with each other.

One final point of difference is that the level of detail presented in the balance of payments tends to be greater than that in the national accounts, reflecting users' requirements for the data (for example, information on counterparty countries in the balance of payments).

The 2008 SNA contains a chapter providing details of the non-resident sector (*Chapter 26: the rest of the world accounts and links to the balance of payments*). It provides sufficient detail for those involved in compiling the national accounts to produce estimates for the rest of the world accounts, given that the balance of payments estimates have already been compiled. However, the much more detailed presentation contained in the BPM6 is necessary for someone to compile the balance of payments and international investment statistics from scratch.

8. Government Finance Statistics Manual

The statistical framework for compiling government finance statistics is the IMF's *Government Finance Statistics Manual* (GFSM). Both the 2001 and 2014 versions of the GFSM recommend that government accounts should be compiled on an accruals basis and should present the full range of financial statements, including balance sheets. Many countries still have cash-based government accounts, which need to be adjusted to more closely reflect the accruals basis on which the national accounts are compiled.

The government finance statistics system provides the data that are used in compiling the national accounts so these two data systems have many concepts in common. The SNA differs from the government finance statistics system in that the SNA's central focus is on economic concepts such as production and consumption of goods and services, whereas the government finance statistics system concentrates mainly on fiscal concepts such as revenue, expenditures, borrowing, etc.

In principle, the government finance statistics system includes all government entities, whether they are part of the general government sector or a publicly-owned enterprise ('public corporation'). Typical examples of public corporations include railways, airlines or utility companies, but the extent of public ownership and control of enterprises differs across countries. In government finance statistics, public corporations are identified separately from general government units because their functions differ from those of such agencies. The public sector consists of general government units plus public corporations.

In the national accounts, the public sector is just one of several sectors that make up the whole economy. Accordingly, the accounts for general government and public corporations are presented separately but with the same structure as the accounts for the other sectors so that aggregates and balancing items are consistent across all sectors. However, a different presentation is provided by the GFSM to analyse the public sector in detail. It includes items such as total revenue, total expense, tax burden and net operating balance, which are all important items for analysing government operations. Some national accounts aggregates (for example, government final consumption expenditure) are not shown in government finance statistics but all the data required to estimate them are collected.

While it is desirable to record government flows on an accrual basis, information on the sources and uses of cash is also important for assessing the liquidity of the general government sector. The statement of government operations is accruals-based. However, as its name suggests, the statement of sources and uses of cash reflects a cash basis of recording. As a result, transactions are recorded when cash is received or when cash payments are made but the cash payment may not take place until a subsequent accounting period. Similarly, revenue can be received in cash before it is earned by the delivery of goods or provision of services to the purchaser.

The result is that alternative presentations are desirable for analysing the public sector, particularly the general government component. The GFSM goes much further than the SNA in providing details of the types of tables required specifically for analysts interested in examining the details of the general government sector.

9. Satellite accounts

The concept of satellite accounts was introduced in the 1993 SNA. The objective of such accounts was to enable issues closely related to the national accounts to be analysed on a consistent basis with the accounts by using the same concepts as the core accounts. Satellite accounts could be linked directly to the core accounts even though they would be compiled separately from them. However, nothing from satellite accounts directly impacts on the core accounts and their major aggregates such as GDP. The types of issues of interest for satellite accounts often have valuation issues associated with them and also tend not to have consistent long-term time series available.

The most prominent satellite accounts are those for unpaid household work (which many argue should be part of GDP), environmental accounts, the 'tourism industry' (which is really a collection of activities undertaken in many industries, as defined in the national accounts), social protection, health, education and agriculture. Standards have been produced for most of these, together with manuals describing appropriate methodology.

Other experimental satellite accounts could be produced by applying different classifications, or extending the SNA's production boundary, or using alternative means of valuing some parts of the core accounts. For example, Eurostat experimented with new methods to estimate FISIM in satellite accounts before deciding how to incorporate estimates of FISIM in the national accounts of EU Member States.

The logic behind satellite accounts can be seen by examining some of the issues involved in producing estimates for unpaid household work and environmental accounts.

9.1 Unpaid household work

Producing estimates of unpaid household work involves a combination of data and valuation problems. One problem is defining what should actually be included as part of unpaid household work. A definition that is well supported is that unpaid household work should include any activities that someone else could have provided as a service to the household. Under this definition, it is clear that some activities are outside the scope of unpaid work. For example, sleeping or travelling to and from work would be excluded because it is not possible to hire someone to undertake these activities. On the other hand, activities such as cooking and shopping would be included as unpaid household work. However, in some cases, these activities may embody an element of leisure rather than work, so it is not clear how much, if any, of these activities should be included. Another contentious example is playing with children. A baby/child-sitter can be paid to look after and play with children. However, is it work or pleasure for the parents to do so? In practice, it is impossible to draw a clear dividing line between unpaid work and leisure, although some conventions can be followed.

Valuing unpaid work also presents some difficult decisions. One method is to record the time taken for the different activities and apply an hourly rate to them. The hourly rate could be the cost of hiring someone to undertake the activity (making the assumption that the quality of output and the productivity of both would be the same). Another method would be to measure the quantities of each service produced (for example, the number of meals rather than the time spent preparing those meals) and then to apply a price to the outputs. In practice, this method would be more difficult to apply because of the problems in obtaining all the data required. There are several variations on these valuation methods but they all have similar conceptual and practical problems associated with the assumptions underlying them.

9.2 Environment

Environmental satellite accounts cover a broad range of activities but the main output is an estimate of environmentally-adjusted GDP (often referred to as 'green GDP'). The value of green GDP depends on the values estimated for the main environmental issues — clean air, clean water, national parks, land degradation, etc. Many physical indicators are available (for example, pollution readings, numbers of visitors to parks, tonnes of topsoil lost due to drought or floods). However, unlike most parts of the core accounts, there is no market (value) for most of these types of indicators, so no prices are available to value them. Various indirect methods of estimating prices have been suggested but, depending on the method selected, they can lead to quite different results, which reduces their usefulness.

One of the strengths of the SNA is that most of the transactions included in the production boundary are market-based and so values can be readily observed. Even where input methods must be used, such as for general government services, the value of the labour and materials inputs can be observed. In fact, the most contentious parts of the national accounts over the years have been those for which values have to be imputed (for example, FISIM, subsistence production, rent of owner-occupied housing). Satellite accounts enable alternative estimates to be produced and evaluated without affecting the integrity of the core accounts.

9.3 Changing the SNA's production boundary?

A question that arises from time to time is whether the production boundary should be changed to incorporate unpaid household production or to include environmental issues and estimate the so-called green GDP. On the side of making such changes, proponents argue that they would make the accounts more relevant for many policy decisions. On the other hand, they would potentially affect the continuity of the lengthy time series available in many countries because of the lack of data for these topics for earlier years. In addition, the difficulties involved in assigning a price to physical data affect the usefulness of the estimated values. Producing satellite accounts annually would show how feasible it would be to expand the production boundary to include these topics. It would also require the endorsement of policymakers as to whether such changes would improve the analytical content of the accounts.

10. The SNA and the global financial crisis

The first signs of the 2008 global financial crisis appeared in 2007, when the US housing market began to fall, with house prices at times becoming lower than the mortgage outstanding on many houses. The Dow Jones Industrial Average index peaked in late 2007 and fell steadily through 2008, with the decline becoming more pronounced in late 2008 following the collapse of the Lehmann Brothers investment bank. Questions asked by many commentators at this time included why the global financial crisis had not been predicted by economists and was the SNA a sufficiently robust framework to produce the data required for analysts to accurately assess the economic situation. In fact, in 2006 and 2007 a small number of economists had forecast the crisis, based on the economic data available at that time.

At its February 2008 meeting the UN Statistical Commission proposed that a High Level Forum should be convened to consider the long-term development of the SNA. The timing turned out to be providential with the global financial crisis highlighting the need for detailed economic statistics. The forum held its meeting in November 2008. A key outcome was that the national accounts and related statistics were seen by the forum as '…. the proper policy response by the statistical community to provide adequate information on economic developments of a global interconnected nature' ([8]). The framework provided by the SNA

([8]) Paragraph 19 of the *Report of the High Level Forum on the Long Term Development of the System of National Accounts* to the UN Statistical Commission, 2009, see: https://unstats.un.org/unsd/statcom/40th-session/documents/doc09/BG-SNA2008-3-E.pdf.

would supply the data required to analyse the reasons for the crisis and, indeed, to have enabled the crisis to be forecast. However, few countries had fully implemented the entire SNA, including flow-of-funds accounts and balance sheets, which were critical inputs for economic forecasting.

The forum emphasised that it is essential for countries to produce balance sheets irrespective of their stage of economic development and to ensure that the balance sheets are fully integrated with the accounts of the real economy. However, even now, a decade after the crisis, many countries do not have a sufficiently well-developed statistical system to produce a full set of national accounts. In fact, many developing countries struggle to produce a consistent set of production, income and expenditure accounts each year. The key to analysing major changes in the global economy is for all countries to have strong links between the real accounts and the financial accounts. Such links are provided in the SNA framework so it is incumbent on countries to complete the data sets defined in the SNA.

11. Lessons from the Stiglitz report

In February 2008 (just as the 2008 SNA was being endorsed by the UN Statistical Commission), the French President, Nicolas Sarkozy, established 'The Commission on the Measurement of Economic Performance and Social Progress', chaired by Joseph Stiglitz, a prominent American economist and a professor at Columbia University in the USA. The mandate of the Commission was to identify the limits of GDP as an indicator of economic performance and social progress. In addition to assessing the problems associated with accurately measuring GDP (as defined in the SNA), the Commission was asked to assess what would need to be added to, or changed in, the current definition of GDP to produce better indicators of social progress and how to present the statistics in a way that makes them more understandable for the general population.

One of the main reasons for creating the Commission was the apparent widespread perception in the community that the standard measures of important statistics such as unemployment, economic growth or inflation do not reflect the reality faced by most of the population. One recurring example is for commentators to criticise the usefulness of employment and unemployment statistics because of the International Labour Organisation's standard definition that someone working one hour per week is classified as being employed. Other examples are the published growth in GDP may be much higher than most people believe, given their own circumstances, or the official inflation measures may be perceived by consumers as not reflecting what they 'know to be the case'. There may be legitimate reasons for the growth in GDP volumes being at odds with public perceptions. For example, the GDP volume could be growing strongly but, if a country's terms of trade have deteriorated markedly, then many businesses or individuals could be adversely affected by a loss in their income. In this case the problem is not any error in the statistics. Rather, it is the tendency for commentators to focus on the broadest and most easily recognisable indicator of economic conditions (GDP volumes) rather than another indicator (such as real gross domestic income) that may be more appropriate in the circumstances.

Stiglitz highlighted the role that any increasing inequality, particularly in income distribution, has on public perceptions of the accuracy of aggregate statistics such as GDP or changes in the overall consumer price index (CPI). In addition, while there is a correlation between the level of GDP and well-being, the growth in GDP does not necessarily reflect improvements in well-being. For example, Stiglitz gave the example of traffic jams, which may increase the use of petrol and therefore add to GDP, but they clearly do not improve the quality of life. If GDP is to more accurately reflect well-being, it needs to take account of environmental and social factors that affect the quality of life.

The report of the Stiglitz Commission reinforced the view of the High Level Forum on the Long Term Development of National Accounts that the global financial crisis was not forecast well because '….. many countries lack a timely and complete set of wealth accounts — the balance sheets of the economy — that could give a comprehensive picture of assets, debts and liabilities of the main actors in the economy'. In other words, despite the 1993 SNA framework providing the detail required to analyse the events leading up to and during the crisis, many countries (in fact, it was most countries) did not have the full set of accounts, particularly balance sheets, specified in the 1993 SNA.

Many of Stiglitz's recommendations relate to data that are outside the scope of the national accounts. Some of those that do relate to the national accounts (for example, 'Recommendation 1: when evaluating material well-being, look at income and consumption rather than production') do not require any data not already included in the accounts (net national income, household income and household consumption). Some others involve using the national accounts as a framework and adding data that provide extra information (for example, 'Recommendation 4: give more prominence to the distribution of income, consumption and wealth'). Some of the recommendations involve extensions to GDP, such as by taking environmental indicators into account.

Both the Stiglitz Commission and the 2008 High Level Forum on the Long Term Development of the System of National Accounts showed that many of the statistics that users require are already included in the accounts but they are not well known. There is scope for the data available in the accounts to be highlighted amongst users and particularly commentators such as journalists. Other recommendations in the Stiglitz report show that the 1993 SNA proposals for satellite accounts were far-sighted. The scope for developing satellite accounts is limited by data availability and valuation issues and, in some cases, the length of consistent time series of data. However, satellite accounts provide an ideal vehicle to emphasise the versatility and broad reach of the national accounts themselves.

12. Updating issues

Determining when to update the SNA and the other economic accounts standards is a difficult decision. Rapidly-changing technology, evolution in financial instruments and the effects of expanding globalisation have changed the ways that economies work and interact with each other. It is important that the SNA, the BPM and the GFSM meet the challenge of keeping abreast of the prevailing economic conditions. The issues that arise are whether incremental changes will be sufficient to maintain statistical standards that reflect the economic reality or whether a more extensive update and rewrite of the standards are required. Whichever is the case, one critical concern of economic statisticians is to ensure that all the time series are preserved. The effects of any changes that are introduced need to be backcast through the relevant periods in the time series.

It is not only the time series that need to be considered. In the EU, the levels of some national accounts aggregates are very important. For example, the Maastricht criteria specify particular levels for the ratio of government deficit and debt to GDP. If the level of GDP is raised or lowered by changes in the definition of GDP or its components then it has implications that are broader than those associated with statistical analysis.

One of the lessons from past SNA updates is that the changes tend to be reacting to events (for example, financial derivatives, emissions trading schemes, mobile phone licences). Some retrospectivity is inevitable, but dealing with these types of issues in a major revision is too late, which indicates there needs to be some process for incremental updates in certain circumstances.

There are always pluses and minuses in updating statistical methods and standards. The 2008 SNA provides a handy case study of whether or not the changes were worth the effort. The main pluses were that the 2008 SNA clarified some issues that were obscure or not properly catered for by the 1993 SNA. It reassured users that the national accounts are based on relevant concepts reflecting the current way in which economies operate (both the high level forum in 2008 and the report of the Stiglitz Commission verified that the SNA and related economic statistical standards were relevant and realistically reflected economic conditions). The 2008 SNA built on these perceptions by reassuring users that it was taking account of the latest economic developments and the ongoing national accounts research agenda ensures that it is remaining up-to-date.

The main negative effects associated with the 2008 SNA include the cost to national statistics offices of implementing the new standards. Economic analysts also incurred the costs of coming to grips with the new concepts, assessing their effects on the accounts and updating their models.

In between ('neutral' effects) were that the changes to the levels of GDP were relatively small and they led to very marginal differences in the rate of change in GDP volumes over time. The question then arises as to why the international statistical community should go through the very costly exercise of revising the standards for economic accounts and then for each country to revise its statistics to conform to the new standards if the impact is so small. The answer is that the credibility of economic statistics is at stake if they are based on outdated concepts and do not quickly take account of emerging economic issues. If the 2008 SNA and the BPM6 had not been produced, then it is inevitable that several 'one-off' revisions would have been required to cater for the emerging issues noted above.

13. 2008 SNA research agenda

Annex 4 in the 2008 SNA describes the issues that needed further investigation before they could be resolved. The list of items in the 2008 SNA research agenda is quite extensive. Most had arisen because of the changing nature of economies around the world, the growing importance of multinational corporations and the rapid developments in technology. In the decade since the 2008 SNA was released some of these issues have become more important for the national accounts because their share of GDP has grown (for example, the digital economy) while others have become much more important politically (for example, environmental issues, particularly valuing aspects of the environment).

There were 25 issues listed in the research agenda, grouped under four headings:

- basic accounting rules;
- the concept of income;
- issues concerning financial instruments;
- issues involving non-financial assets.

When the 2008 SNA was released some of these issues were 'on-hold' waiting on new international accounting standards to be developed (for example, for public-private partnerships). Others were relatively new economic phenomena (for example, tradeable emission permits) and further investigations were required to identify the full range of such permits and their characteristics so as to make a decision on their treatment in the national accounts. On the other hand, some issues were long-term problem areas for the SNA so no easy solution was likely, although it was important to consider these issues further (for example, including the value of human capital in the accounts).

14. Current research agenda

Over the past decade, some new issues have been added to the SNA research agenda, with straightforward ones related to general updates that are required periodically (for example, keeping classifications up-to-date), but with more complex issues related to changing economic arrangements (for example, globalisation and global value chains) and financial innovation (for example, financial derivatives) and also with the ongoing problem of keeping up with the effects of rapidly changing technology (the digital economy or digitalisation). Globalisation and digitalisation have increased in importance over the past decade or so, particularly with respect to their potential effect on GDP. Their impact is particularly evident in the practical issues facing the statisticians running economic surveys which then impact on compliers of national accounts.

The word 'globalisation' did not appear in the 1993 SNA or the BPM5, even though the practice of a good or a service being processed in two or more countries within multinational corporations has existed for decades. The improvements in global transport and communications through the 1990s and onwards led to international production becoming more prominent and so 'globalisation' entered the terminology in both the 2008 SNA and the BPM6, although without being explicitly defined.

The IMF describes globalisation as:

> 'Economic "globalization" is a historical process, the result of human innovation and technological progress. It refers to the increasing integration of economies around the world, particularly through the movement of goods, services, and capital across borders. The term sometimes also refers to the movement of people (labor) and knowledge (technology) across international borders.' ([9])

Globalisation and the rapid expansion of the digital economy are problem areas for all economic statistics. From an economic statistics perspective, globalisation has implications for the concepts of residence, production units and remittances. The key issues in measuring globalised production are identifying the role that intangible assets play in production: who owns these assets and how (and how much) income from production is distributed to the owner. A further complication is determining the price component so that volumes can be estimated.

Globalisation also has some significant implications for data collection because of the complex company structures for multinationals. Statistical collections have to obtain data related to resident activities and deal with issues such as the valuation/pricing of products moving across borders but within the same multinational corporation, and with the associated foreign investment flows.

There is no formal definition of the digital economy in any of the economic statistics standards. However, it is possible to identify several different categories of activities in the digital economy:

- businesses selling goods or services via the internet (for example, Amazon);
- intermediary services in which a purchaser is matched with a provider (for example, Uber, eBay);
- products delivered directly to a purchaser via downloads (for example, software, statistical data/tables);
- 'free' services that are supported by advertising (for example, Facebook, Twitter).

Even after the difficult task of defining the relevant concepts has been completed, obtaining data from the providers of these types of services is also challenging. For example, they can be located anywhere in the world, so identifying them and dealing with issues related to their national accounts residence status is problematic. Even if output data can be collected, additional problems arise in constructing the deflators required to estimate volumes of digital products. Hedonic price indexes have been used in many countries to adjust prices for the quality changes in computers and so estimate the volumes of expenditures on computers but identifying the price component of digital services provides an extra complication that needs to be resolved.

([9]) IMF (2008), *Issues Briefs – Globalization: A Brief Overview*, see: https://www.imf.org/external/np/exr/ib/2008/053008.htm.

15. Conclusion

The current standards for economic accounts have evolved since the middle of the 20th century. Initially, they were developed without direct coordination between the responsible organisations which were focussing on their own specific requirements. However, it was not long before the advantages of harmonising the frameworks for national accounts and balance of payments became clear. In 1964, the UN released a special update of the SNA to bolster the consistency between these two standards. Over time, steps have been taken to coordinate changes to the SNA and BPM in particular. More recently, the SNA and GFSM have also been aligned.

The current situation is that the international standards for the national accounts and related economic statistics are robust and statistics based on them meet user needs, provided the complete set of national accounts data is produced. Emerging issues are being resolved as they arise. As has always been the case, the SNA and the BPM may need to be changed periodically on a one-off basis (as for financial derivatives in the late 1990s) and more extensively every couple of decades. It is important that the scope of the national accounts and related statistics is changed only infrequently to maintain the integrity of the major national accounting aggregates and the confidence of users.

One of the lessons from the 2008 global financial crisis was that many countries had not compiled the full range of accounts specified in the SNA, which hindered a full analysis of the emerging problems and the reasons for them. Both the French Government's *Commission on the Measurement of Economic Performance and Social Progress* (the Stiglitz Commission) and the UN Statistical Commission's *High Level Forum on the Long Term Development of National Accounts* endorsed the SNA framework as providing the information necessary to analyse economic developments. However, it is essential that all countries produce all the accounts specified, including balance sheets, to support such analysis.

Whenever a change is made to the economic accounts, whether a one-off change or a more major revision, it is critical that the time series of the data is preserved. Breaks (or steps) in the time series are poor statistical practice and are unacceptable to users.

The rapid changes in the structure of economies caused by globalisation and digitalisation mean that the main economic statistical standards (SNA, BPM and GFSM) will need to be revised to keep them up-to-date and relevant. It is also possible that the range of satellite accounts could be extended. For example, one possibility currently being examined is to develop a digital economy satellite account to test the impacts of different ways of treating the digital economy.

The questions that arise about periodic revisions are whether or not one-off changes should be made to these standards or whether a more major update, such as that from the 1993 SNA to the 2008 SNA, is required. The answer is that it really depends on the extent that any changes can be confined to one part of the national accounts or whether they spread through large parts of the accounts. In addition, the extent to which other standards may be affected needs to be considered. The 1999 update of financial derivatives provided an example of a successful one-off change because it was confined to a relatively self-

contained part of the overall national accounts. In addition, it provided an important lesson in coordination with the balance of payments and the national accounts standards having the same set of amendments flowing through to them simultaneously.

The final issue is the extent to which the SNA, BPM and GFSM could be integrated into a single standard. These three standards are now harmonised with each other, although some subtle differences in detail or wording between the 2008 SNA and the BPM6, mainly relating to the financial sector, could lead to inconsistent interpretations of these standards.

Two possibilities arise to ensure that future versions of the SNA, BPM and GFSM are completely consistent.

The first is for the ISWGNA to agree on the concepts to be included in a slightly larger version of the SNA. It would be a national accounts framework but with some balance of payments and government finance components, specified at a more detailed level than at present, to ensure consistency amongst all the overlapping elements. The BPM and GFSM could provide the very detailed description of supplementary data and alternative views they require (for example, alternative views of the data or cash-based accounts). In effect, all three standards would define the common core, which is backed up by more detailed standards for balance of payments and government finance statistics.

The second possibility could be implemented with the existing standards and has broader implications for economic statistics standards in general. It is to electronically link the SNA, BPM and GFSM. It could also be possible to extend such links to related documents such as implementation guidelines. As an example of the possibilities, useful links have been provided within the 2008 SNA. Clicking on items in the table of contents, the glossary or the index takes the reader directly to the relevant text in the body of that document. Developments in technology have made it possible to fully cross-reference items between documents such as the SNA, BPM and GFSM. In addition, links could be provided from these documents to the 'how to do it' guidelines such as Eurostat's *Handbook on Quarterly National Accounts*. Developing detailed electronic links between the various standards and implementation guidelines would be a very useful advance.

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2 Expanding the coverage of illegal economic activities in national accounts

ILCHO BECHEV [1]

Abstract: This paper discusses a theoretical possibility of expanding the coverage of illegal economic activities (IEAs) in possible areas that go beyond the minimum recommendations adopted in a number of European countries. It also investigates the relevance and sources for statistics on additional IEAs within national accounts. The study further suggests that a broad set of IEAs under the heading of online services could be of interest in terms of their economic significance and that this area may be worthy of further investigation.

JEL codes: E01, E23, E26

Keywords: national accounts, illegal economic activities, methodology, estimation

[1] Eurostat, Unit C.5: Integrated global accounts and balance of payments.

1. Introduction

In 2014 when the European Statistical System (ESS) was preparing for the introduction of the 2010 European System of National and Regional Accounts (ESA 2010) manual, the media began to run stories with headlines such as 'Sex, Drugs and GDP'. Official statisticians were prepared for this sort of interest which was hardly proportional to the projected and later proven impact of illegal economic activities (IEAs) on economic output in Europe.

Recording the illegal economy was not a methodological change introduced by ESA 2010, rather it was a change brought about by much earlier work on international and European statistical manuals and guidelines. However, the implementation of ESA 2010 marked the point when various and often diverging national statistical practices on IEAs were harmonised. Thus, as of September 2014, all of the EU Member States were to include estimates for the three so-called core IEAs — prostitution, the sale of illegal drugs and the smuggling of alcohol and tobacco — in their national accounts.

It is now four years since these changes took place, so it may be worthwhile to take a fresh look at the decision to include these three activities in national accounts. Why were these three specific activities chosen? Those who took part in making the decision said that the debate around IEAs and their inclusion in the compilation 'created hard discussions' between compilers of European national accounts in the early 2000s (Fløttum (2007)). As an outcome, specific steps were taken and it was agreed to include IEAs in national accounts; it was decided that it would 'be sufficient to concentrate on what are likely to be most significant illegal activities; production of and trade in drugs, prostitution and smuggling of alcohol and tobacco' (Fløttum (2007)).

The practical difficulties of including other IEAs should not prevent researchers and practitioners from exploring more deeply the *theoretical possibility* of recording additional IEAs when compiling macroeconomic statistics. Therefore, the aim of this paper is to go beyond the already adopted minimum recommendations and to investigate the relevance and sources for statistics on additional IEAs within national accounts. The study further suggests that a broad set of IEAs under the heading of online services could be of interest in terms of their economic significance and that this area may be worthy of further investigation.

This paper is divided into six main chapters, each explaining the treatment of a separate IEA. The six activities covered are: illicit firearms trafficking; fencing of stolen goods; migrant smuggling; infringement of intellectual property rights, counterfeit goods and piracy; bribery; and illegal gambling ([2]). Before treating these in more detail, the paper briefly provides some background information relating more generally to IEAs.

([2]) Due to its complicated and cross-cutting nature the provision of money laundering services merits a separate study and is not tackled by the present paper; information on this subject is included in Eurostat (2018).

2. Background

ESA 2010 established a methodology for measuring economic activity which requires EU Member States to include part of the illegal economy (prostitution, drug trafficking and smuggling) in their calculations of gross domestic product (GDP). The definition of production given in the ESA means that only transactions entered into voluntarily should be included within the estimate of GDP, regardless of whether the transaction was legal or illegal; in other words, the transaction between client and consumer must be consensual.

Here it is important to note that according to ESA 2010 (paragraph 1.79), a transaction that has been carried out in a mutual agreement *implies* 'prior knowledge and consent' of the institutional units involved. In other words, information asymmetries are not a prerequisite to exclude a transaction from the production boundary, rather what counts is mutual agreement at the time of the transaction, no matter what level of prior knowledge was possessed by each of the parties. This is an essential assumption when considering the context of IEAs, since by default illegal transactions are prone to bear more information asymmetries than legal ones, as IEA transactions are generally irreversible in the sense that traders are not obliged to repair, replace, reduce the price or give a refund if goods bought turn out to be faulty or do not look or work as advertised.

According to the ESA 2010 recommendations, transactions related to IEAs should be included in national accounts when significant. Thus, there should only be a need to include other types of IEAs if these would have an impact — materiality threshold — of at least 0.1 % on a country's gross national income (GNI). This threshold is to be applied to the potential impact on GNI: and any complex issue should be assessed as part of a total and should not be broken down into smaller parts (Eurostat (2014)).

The institutional units involved in the three core IEAs are classified as households, in other words, there is no employer-employee relationship assumed. The gross value added (GVA) generated on domestic territory is therefore identical to mixed income for these units and all entries to be recorded between residents and non-residents in the national accounts fall within the boundary of GDP and there are no further transactions to be recorded in the transition from GDP to GNI (Eurostat (2018)).

The guidelines to the statistical recording of the three core IEAs are well-described in Eurostat (2018), Sections 3.4-3.6. It provides recommendations on the modelling approaches that might be adopted for these different types of IEA. A supply-side approach is recommended for prostitution since producers have lower incentives to hide their transactions, whereas demand-side approaches are recommended as more reliable starting points for estimating sales of illegal drugs and the smuggling of alcohol and tobacco.

Furthermore, recommendations are made for the statistical classification of these three IEAs within NACE (the statistical classification of economic activities):

- prostitution services are classified in NACE Rev. 2 Class 96.09, where escort services are part of other personal service activities;
- the trade element of illegal drug trafficking is classified to NACE Rev. 2 Class 47.73, dispensing chemist in specialised stores, stalls or markets;
  the production of cannabis plants, coca bushes or opium poppies is classified to NACE Rev. 2 Class 01.28, growing of spices, aromatic, drug and pharmaceutical crops;
  the production of illegal synthetic drugs (LSD, ecstasy, amphetamines, etc.) is classified to NACE Rev. 2 Group 21.2, the manufacture of pharmaceutical preparations;
- the trade element of smuggling is classified to NACE Rev. 2 Class 47.99, other retail sale not in stores, stalls or markets.

Recommended data sources for information on IEAs range from administrative information derived from police, customs or ministries (for example reports or expert opinions) to surveys conducted among consumers of IEAs, and country reports from non-profit organisations, academia or international research institutes. These sources cannot be directly incorporated into the statistical recording of IEAs, since they differ in various respects (for example, their population covered or the period covered) and so they are generally difficult to compare or combine, while some information may be available from one-off studies or sources that are not available on a regular basis. On the other hand, some information on the core IEAs is available for all countries and experts seem to have an overview of the situation.

3. Illicit firearms trafficking

The trafficking of illicit firearms is one of Europol's priority areas ([3]). In 2014, the EU agency for law enforcement cooperation estimated that there were almost half a million lost or stolen firearms in the EU ([4]). According to the European Commission (2013) 'the illegal firearms trade generates between EUR 125 million to EUR 236 million per year globally, which represents between 10 to 20 % of the total trade in legal firearms'. A key feature of illicit firearms trafficking is that it is mainly caused by diversions from the legal firearms trade and conflict-related stockpiles. Illegal firearms trade occurs on both large and small scales, with these firearms traded by a variety of methods (some more sophisticated than others), see Eurostat (2018), paragraph 141.

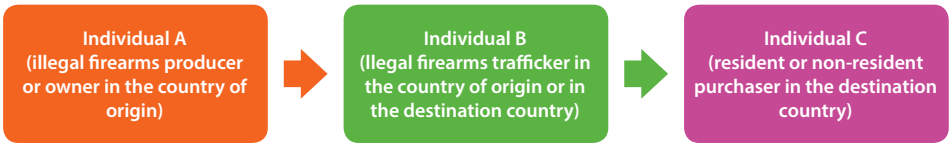
Although there is no explicit definition of illicit firearms and their trafficking in macroeconomic statistical manuals, a definition of this particular IEA could be borrowed from the United Nations (2001), as Article 3 (e) of the Firearms Protocol states:

> '… the import, export, acquisition, sale, delivery, movement or transfer of firearms, their parts and components, and ammunition from or across the territory of one State Party to that of another State Party if any one of the States Parties concerned does not authorize it in accordance with the terms of this Protocol or if the firearms are not marked in accordance with article 8 of this Protocol.'

([3]) See: https://www.europol.europa.eu/crime-areas-and-trends/crime-areas/illicit-firearms-trafficking.
([4]) Ibid.

On this basis, an illegal firearms trafficker could be defined as 'a person who deals or trades in illegal firearms. According to Eurostat (2018), such traffickers are considered to be self-employed (resident units or notional resident units)' (see paragraph 139). Thus, illicit firearms trafficking could be defined as a service provided by a professional trafficker who facilitates the sale of an illicit firearm between two parties (see Figure 1). From the viewpoint of economic activities, traffickers would then be classified to NACE Rev. 2 Class 47.99, other retail sale not in stores, stalls or markets.

Figure 1: Base model for illicit firearms trafficking



Source: Eurostat (2018)

For the purposes of compiling national accounts, several items linked to illegal trafficking would need to be estimated, possibly by using the following sources.

To estimate the contribution made by illegal firearms trafficking to GDP, additional data are needed. These data are: import and export volumes and prices; domestic production volumes; and street (final consumption) prices. Data on storage and transportation costs are also needed to calculate the intermediate consumption of traffickers.

As is the case with other IEAs, data availability for illicit firearms trafficking is generally scarce. Since one of the common datasets used as a proxy for quantities is data on seizures from the police and customs services ([5]), supply-side models would be better suited for modelling this phenomenon. However, data on seizures represent only a fraction of all illicit firearms trafficking, so adjustments for the perceived detection rate are necessary. Another issue with seizures is that data tend to be quite volatile, so models should be based on long-term trend analysis of time series if possible. Other input data for supply-side models could be firearm diversions (thefts/losses); crimes committed with firearms; firearms registries; and the legal production and trade of firearms.

For prices, data might be available in EU Member States within interior ministries, police records, investigative reports and other research projects. In conflict zones, prices tend to increase as security decreases (Florquin (2014)). Another data source for prices of illicit firearms could be crypto markets. It has to be noted, however, that evidence suggests prices quoted on the Darknet tend to be above the average price for illicit firearms in a number of countries (Global Financial Integrity (2017)).

As with other IEAs, data from estimates are usually calculated for a given benchmark year with estimates extrapolated thereafter. Proxies that could be used for this purpose are to be found in crime statistics, for instance firearms-related homicide rates.

Various sources indicate that the illicit firearms trafficking market in Europe is in general rather small, and that 'trafficking is almost exclusively a supplementary rather than a primary source

([5]) According to ESA 2010 (paragraph 6.10) these are classified as uncompensated seizures (K.4).

of income for a small number of organised criminal groups involved' ([6]). A similar conclusion is suggested, for example, by Smekens and Verbruggen (2005) who estimated a maximum annual benchmark value of EUR 12 million for the trafficking of firearms in the Netherlands, which 'is negligible in the context of the [Dutch] national accounts'. For this reason, estimates for this IEA are not included in the European national accounts and balance of payments data.

4. Fencing of stolen goods

In Eurostat (2018), 'fencing' is defined as 'the business of buying, selling or dealing in, stolen goods'. The person who operates this business is a 'fence'; the role of the fence as a professional middle-man is essential. This is because the sale of a stolen good from a thief to a final consumer would otherwise be treated as a second-hand sale within the household sector and as such neither the sale nor the purchase would be recorded in national accounts under household consumption (ESA 2010; paragraph 3.182e). A fence could be defined in a narrower sense by applying Klokars' (1974) three criteria for a professional fence:

- a fence is a buyer and seller with direct contact with thieves (sellers) and customers (buyers);
- a fence buys and sells stolen property regularly and profitably, and has done so for a considerable period of time;
- a fence has acquired a reputation as a successful dealer in stolen property among law breakers, law enforcers and others.

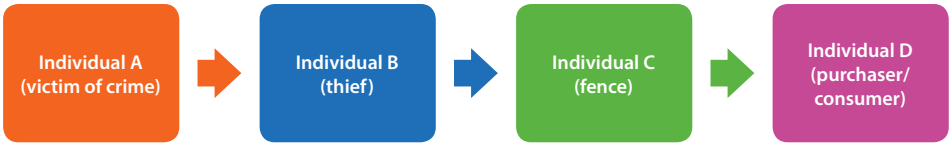
Professional fences often use a legitimate 'front' business to hide their illegal trade. In most cases, the fence should be classified in the same institutional unit and same economic activity as their legitimate business. Fences often specialise in particular products: for example, pawn shops specialise in portable electronics and jewellery, while scrapyards may specialise in stolen car parts. Trainum et al. (1991) noted that together with second-hand and antique shops, pawn shops and scrapyards were identified as the most common fencing marketplaces. A relatively new phenomenon is that of e-fencing, which makes use of established e-commerce platforms as marketplaces. Therefore, depending on how the fencing is carried out, activities will be classified according to NACE Rev. 2 as either Class 47.79 (retail sale of second-hand goods in stores) or Class 47.91 (retail sale via mail order houses or via internet).

There are three essential parts to a fencing transaction (see Figure 2):

- property is stolen from its owner;
- property is bought and concealed by the fence; and
- the fence sells the stolen property to a purchaser.

([6]) See: https://www.europol.europa.eu/crime-areas-and-trends/crime-areas/illicit-firearms-trafficking.

Figure 2: Base model for fencing



Source: Eurostat (2018)

Although this IEA falls within the production boundary of national accounts, the activity as such is not addressed in detail within ESA 2010 ([7]). However, fencing was discussed by the Advisory Expert Group on National Accounts when updating the 1993 System of National Accounts (SNA). When doing so, delegates unanimously agreed that the 'sale of stolen goods (fencing) should be recorded similar to the recording of sales of second-hand goods — that is, recording the value added and trade margins of distribution activities' (United Nations Statistics Division (2006)).

An example of the flows related to fencing is presented in Table 1, in which van der Werf (1997) investigates the flows that occur when a truck is stolen, fenced and exported.

Table 1: Flows related to fencing — example adapted from van der Werf (1997)

	Before	Theft	Revaluation	Fencing	Value added	Sale
Individual A (initial owner)	100 000	−100 000				
Individual B (thief)		100 000	50 000	−50 000		
Individual C (fence)				50 000	20 000	−70 000
Individual D (export)						70 000

In this example, the value of the stolen asset diminishes due to the theft. Therefore, a revaluation needs to be recorded before it is received by the fence. Value added is equal to the trade margin made by the fence after the asset has been handled ([8]). However, when there are recurring thefts from individual A (the initial owner/retailer) 'part of the margin on the goods sold [by the retailer] must cover the cost of the stolen goods' (Eurostat (2017) paragraph 4.29, see also ESA 2010 paragraph 3.56 ([9])).

As with other economic activities, producing a consistent estimate of fencing requires estimates for the volume, price and intermediate consumption (of stolen goods). As can be seen in the example above, stolen goods are likely to be elastic in price and are subject to revaluation. Nevertheless, prices should follow developments witnessed for legal second-hand markets of the respective goods. Therefore, if a solid benchmark point can be established, then a time series of prices could be used to extrapolate future values. A similar benchmarking method could be applied to estimating quantities by using data reported by interior ministries and extrapolating this based on crime statistics. For costs (in other words,

([7]) It is briefly described in ESA 2010 paragraph 1.79: 'purchases, sales or barters of illegal drugs or stolen property are transactions, while theft is not'.
([8]) This model assumes near-zero intermediate costs for the fence (covering for example, storage, transportation, etc.).
([9]) Further considerations on the effects of theft in NA were discussed at the fourth meeting of the Advisory Expert Group on National Accounts in Havinga et al. (2006).

the intermediate consumption of the fence), Kazemier et al. (2012) suggest in their model that a 10 % fixed rate could be applied on trade margins.

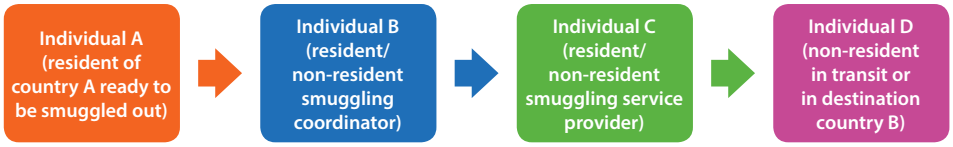
It should be mentioned that fencing bears many similarities to illegal firearms trafficking and second-hand sales, therefore it is important that these activities are clearly separated from each other so that they are not double- or triple-counted.

5. Migrant smuggling

Migrant smuggling is a profitable business for criminal networks with estimated annual turnover reaching billions of euros ([10]). According to Europol, more than 90 % of irregular migrants use these 'facilitation services' and in 2015 alone the estimated annual turnover related to migrant smuggling was EUR 3-6 billion, with some scenarios suggesting this figure could be twice or even three times as high ([11]).

In the EU there is a common definition for migrant smugglers which refers to persons who intentionally assist non-EU nationals to enter, transit through, or reside in an EU Member State, in breach of the law ([12]). It should be noted that migrant smuggling is different from human trafficking: whereas the former is an activity into which the parties involved enter by mutual agreement (in other words, with the consent of the person(s) being smuggled), the latter implies victimisation as there is no mutual agreement. Therefore, 'migrant smuggling is a transaction where [irregular] migrants are not forced to move and it is a resident-non-resident transaction. If the migrant is forced to move it is classified as human trafficking, not as an illegal economic activity' (Eurostat (2018) paragraph 180). Furthermore, although ESA 2010 does not explicitly mention migrant smuggling, there is a brief reference to it in SNA 2008 ([13]).

Figure 3: Base model for migrant smuggling



Source: Eurostat (2018)

([10]) European Commission, Directorate-General for Migration and Home Affairs, see: https://ec.europa.eu/home-affairs/what-we-do/policies/irregular-migration-return-policy/facilitation-irregular-migration_en.
([11]) See: https://www.europol.europa.eu/crime-areas-and-trends/crime-areas/facilitation-of-illegal-immigration.
([12]) Council Directive 2002/90/EC of 28 November 2002 defining the facilitation of unauthorised entry, transit and residence, see: http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32002L0090&from=EN.
([13]) 'Examples of activities that may be illegal but productive in an economic sense include (…) illegal transportation in the form of smuggling of goods and of people, and services such as prostitution.', *System of National Accounts 2008*, paragraph 6.44.

In Eurostat (2018) there are two main types of agreement identified for migrant smuggling:

- a 'pay-as-you-go' agreement, no final destination is predetermined and the speed and direction of travel depends on the migrants' ability to pay at each step. In this case, the role of the smuggling coordinator could be reduced compared with the base model;
- a 'full package' agreement is less common, whereby migrants pay a fee in their country of origin to a smuggler that arranges several services so the migrant is transported to their chosen destination country.

In the base model (see Figure 3) smuggling coordinators (Individual B) are self-employed persons, providing services which should be classified to NACE Rev. 2 Class 79.12, tour operator activities, while service providers (Individual C) should be classified depending on the specific service they provide, for example, guiding, transportation, accommodation, catering.

Given that 'pay-as-you-go' agreements are the dominant mode of migrant smuggling, data compilers in destination and transit countries should be interested in transactions between resident smugglers and foreign migrants, who by definition are non-residents. From an EU perspective, models for migrant smuggling could be reduced to estimating the effects of border-crossing and transiting through the EU. These models could disregard the migrants' consumption of smuggling services before their point of entry into the EU. Frontex data from the European Border and Coast Guard Agency (2017) suggest that EU border crossing is in many cases facilitated by non-resident smugglers, therefore only a limited part of all smuggling transactions are relevant for the balance of payments of EU Member States. Transiting through the EU is more likely to be (fully) operated by resident service providers and in this case transactions between migrants and facilitators should be recorded as transportation and travel services.

Data sources for migrant smugglers' fees could be police reports, interview-based media publications or information from social media. Prices may depend on factors such as the border type (land or sea), the types of services provided by smugglers, and the risks they bear. Prices are further affected by seasonality and by shifts in supply and demand.

For the number of smuggled migrants, EU data compilers could use data on detections by police authorities and Frontex. However, these data should be adjusted using migrant detection rates to reflect true numbers. There are also statistical methods suggested by Morral et al. (2011) in the context of illegal border crossing between the United States and Mexico, such as:

- capture-recapture methods;
- stratified sampling of border crossings;
- surveys and respondent-driven sampling ([14]);
- synthetic and proxy measures ([15]).

([14]) 'Respondent-driven sampling begins with a non-random sample of individuals from the population of interest, interviewing them about their characteristics of interest (...) and then asking them to distribute invitations to participate in the survey to their friends'.
([15]) For example, indicators derived by expert-based judgements, econometric models, mathematical simulations, etc.

The intermediate consumption of smugglers can be related to payments for other IEAs such as bribery or document forgery. On the other hand, smugglers who provide transport or accommodation services to migrants should incur normal costs. In many cases smugglers are running legal transport or accommodation businesses, for example as taxi drivers or owners/operators of hotels and/or hostels, and therefore their intermediate consumption would be already be accounted for.

6. Infringement of intellectual property rights: counterfeit goods and piracy

Counterfeiting and piracy cover a set of IEAs related to the infringement of intellectual property rights (IPR). According to estimates by the OECD/EUIPO (2016), these activities account for 5 % of EU imports of goods. Europol/OHIM (2015) has described counterfeiting and piracy as a 'global phenomenon that has evolved significantly with the advent of better technology in all areas of the supply chain, such as manufacture, distribution, ordering and purchasing'.

In Regulation (EU) No 608/2013 of the European Parliament and of the Council of 12 June 2013 ([16]) concerning customs enforcement of intellectual property rights and repealing Council Regulation (EC) No 1383/2003, counterfeit and pirated goods are legally defined, where the former are:

(a) goods which are the subject of an act infringing a trade mark in the Member State where they are found and bear without authorisation a sign which is identical to the trade mark validly registered in respect of the same type of goods, or which cannot be distinguished in its essential aspects from such a trade mark;

(b) goods which are the subject of an act infringing a geographical indication in the Member State where they are found and, bear or are described by, a name or term protected in respect of that geographical indication;

(c) any packaging, label, sticker, brochure, operating instructions, warranty document or other similar item, even if presented separately, which is the subject of an act infringing a trade mark or a geographical indication, which includes a sign, name or term which is identical to a validly registered trade mark or protected geographical indication, or which cannot be distinguished in its essential aspects from such a trade mark or geographical indication, and which can be used for the same type of goods as that for which the trade mark or geographical indication has been registered.

([16]) See: https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:32013R0608.

Pirated goods are defined as:

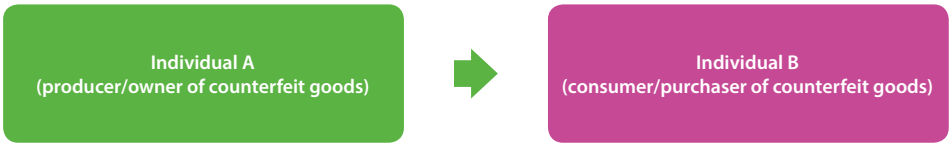
> goods which are the subject of an act infringing a copyright or related right or a design in the Member State where the goods are found and which are, or contain copies, made without the consent of the holder of a copyright or related right or a design, or of a person authorised by that holder in the country of production.

In addition, ESA 2010 (paragraph 3.132) defines intellectual property products as 'the result of research and development, investigation or innovation leading to knowledge, use of which is restricted by law or other means of protection'.

The inclusion of counterfeiting and piracy in national accounts was discussed during the update of the SNA 1993, when the Advisory Expert Group came up with a recommendation to include examples 'such as production and distribution of (. . .) counterfeit products (. . .)' (Havinga et al. (2006)). While there were no specific examples of counterfeiting and piracy subsequently mentioned in the SNA ([17]), the OECD et al. (2002) stated that the recording of IPR infringements 'does not pose special problems' as long as it 'resembles the production process for legal activities'.

In the base model of counterfeiting and piracy (see Figure 4), there is an interaction between a seller (Individual A) and a buyer (Individual B) of a counterfeit or pirated good. The seller could be a producer or an owner of the good and is usually classified as a self-employed person or a non-financial corporation.

Figure 4: Base model for counterfeit goods and piracy

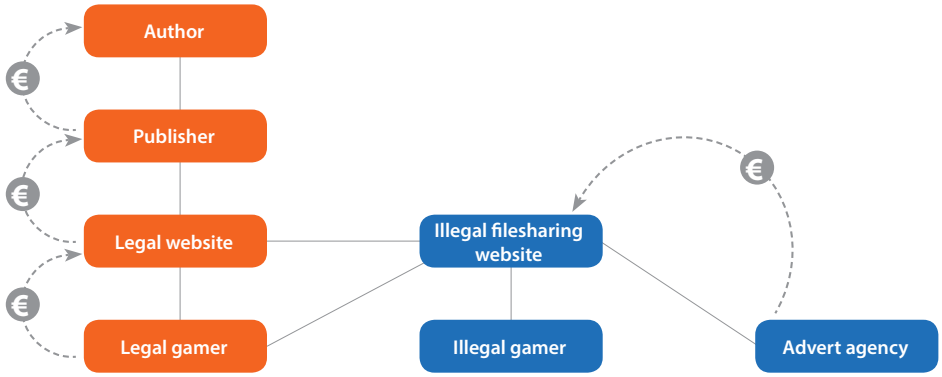


Source: Eurostat (2018)

In practice, this model describes better the interaction between two such individuals when the counterfeit/pirated item is a tangible good. Indeed, the model is not particularly well suited to describing the infringement of digital copyright — a prevalent form of piracy which 'stems from the online dissemination of protected content' (Europol/EUIPO (2017)). Concerning the infringement of digital copyright, business models are usually more sophisticated and providers of illegal materials typically operate more extended supply chains, such that there are usually more than two participants involved. Figure 5 presents a common model in which there is no economic transaction between the IPR offender and the consumer, but there is a transaction with an advertising agency.

([17]) However, there were no specific objections to having more detailed examples during a discussion between members of the Advisory Expert Group.

Figure 5: Example of a digital piracy business model



Source: Europol/EUIPO (2017), p. 27

In the piracy model presented in Figure 5, the economic transactions should (in theory) be registered in the financial reports of the advertising agency, and thus also in the national accounts.

If it could be assumed that this is the predominant *modus operandi* of piracy, then the volumes generated by this service could be disregarded from statistical estimation. Furthermore, the counterfeiting of tangible goods is in many cases carried out by legal enterprises, which leaves only a fraction of all IPR offences not captured in official statistics. Because the counterfeiting of tangible goods is a type of trade in goods, a valuable source of information for EU Member States could be the Anti-Counterfeiting Intelligence Support Tool (ACIST); this is a database maintained by the European Observatory on Infringements of Intellectual Property Rights ([18]). The database provides harmonised monthly data on the numbers and estimated value of goods that are detained by customs authorities in the EU.

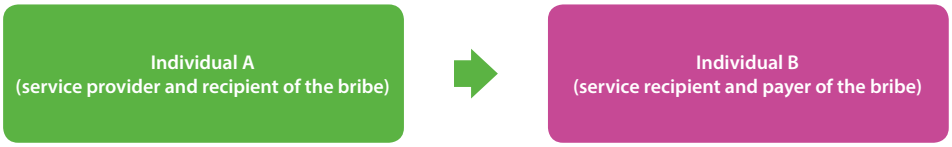
Finally, counterfeiting often involves the illegal production and smuggling of tobacco and alcohol. It is therefore important to separate counterfeiting from the core smuggling activity, and to apply adjustments for double-counting in cases where this counterfeiting and piracy are already included in national accounts.

([18]) Anti-Counterfeiting Intelligence Support Tool (ACIST); an EU database that gathers information on detentions, at borders and in the internal market, of items that are suspected of infringing intellectual property rights, see: https://www.tmdn.org/enforcementintelligence-webapp/.

7. Bribery

Bribery is a corrupt practice that is defined in Eurostat (2018) as 'the act of taking or receiving something with the intention of influencing the recipient in some way that is favourable to the party providing the bribe'. In a base model for bribery (see Figure 6), there is a service provider (Individual A) who produces a specific service for a consumer of this service (Individual B) against the payment of a bribe. As with other IEAs mutual consent between the two parties is essential.

Figure 6: Base model for bribery



Source: Eurostat (2018)

Although bribery is not explicitly mentioned in ESA 2010 or SNA 2008, it was discussed by the Advisory Expert Group on National Accounts in 2006 when the SNA 1993 was being updated. Table 2 presents the outcomes of the e-discussion related to the treatment of bribery within national accounts as recommended in OECD (2002).

Although most members agreed with the propositions in Table 2 during this preliminary e-discussion, the final outcome of the debate was that 'bribery should not be treated as compensation of employees', contrary to the possibilities mentioned in OECD (2002) and that 'bribery should not be discussed in the updated SNA' (United Nations Statistics Division (2006)).

Table 2: Recording of bribery in national accounts — results from e-discussions among the Advisory Expert Group

Question	Agree	Disagree	No opinion
Do you agree that in the provision of market goods and services, bribes taken by employees as an additional margin on the 'official' price should be recorded as an increase in the value of output of market production matched by an identical increase in the compensation of employees?	16 (76 %)	5 (24 %)	0 (0 %)
Do you agree that if the bribery is accepted as a standard practice in provision of non-market services, then the bribe should be recorded as additional compensation of employees and an increase in output of Government	12 (57 %)	7 (33 %)	2 (10 %)
Do you agree that the bribes linked to the provision of non-market services that are not allowed or not publicly accepted should be recorded as current transfers? The same holds for payments to persons in privile ged positions to obtain a contract?	18 (86 %)	2 (19 %)	1 (5 %)

Source: United Nations Statistics Division (2006)

However, Eurostat (2018) adopts the OECD's recommendations. Thus, it suggests that bribery is reflected in increased output and compensations of employees, or mixed income/gross operating surplus when the service provider is a self-employed/unincorporated enterprise. Depending on their sectoral classification, bribes are household final consumption or intermediate consumption for the service consumers. Another practical recommendation from Eurostat (2018) is to treat market and non-market transactions similarly when bribes are not allowed or not publicly accepted.

From a statistical perspective it could be challenging to define subjective terms such as 'publicly accepted' or 'standard' practice, especially when these involve bribery. One possible way of defining bribery as an economic transaction in this context could be by applying a magnitude-based approach. This approach would leave out all high-value transfers, assuming that these are not publicly accepted by default. Therefore, the type of bribery that could potentially affect economic output would be so-called 'petty corruption'.

Although there is no official statistical definition of petty corruption ([19]), references to it can be found in policy papers, the European Commission (2017) described it as corruption that 'occurs in the interaction between lower echelons of the public administration and individual citizens'. The phenomenon is also of interest in academic research, where Argandoña (2017) described it as: 'small payments to an officer or employee, public or private, who is responsible for a non-discretionary service, in order to facilitate, accelerate, or cheapen a procedure, for example, issuing a passport or connecting a house to a power distribution network'.

There are two main reasons for the relative lack of interest in estimating petty corruption for the purposes of national accounts compilation. The first is that it is hard to define what constitutes petty corruption, in other words, what is the objective extent of the public's acceptance. The second is that there is no evidence that this form of bribery has a significant impact on economic output. On the contrary, petty corruption was reported by the European Commission (2014) to be widespread in only a few places and is usually 'perceived to be higher than it is actually experienced by citizens in their everyday life' (Bąkowski and Voronova (2017)).

Eurostat (2018) suggests two evidence-based methods to quantify bribery. The first involves producing estimates using administrative data; the main problem with this method is the low rate of reporting for such offences. However, the statistical community is trying to come up with harmonised indicators for measuring corruption. Following the European Commission (2011) action plan on crime statistics, the European Commission (2016) collected and released a set of preliminary official criminal justice statistics on corruption offences. The second evidence-based method for producing statistics on bribery involves conducting sample surveys on corruption and integrity. Surveys such as these have been recognised within Eurostat (2018) as being 'the

([19]) The adopted standard breakdown of corruption follows the International Classification of Crimes for Statistical Purposes, which disaggregates corruption into:
07031 Bribery;
070311 Active bribery;
070312 Passive bribery;
07032 Embezzlement;
07033 Abuse of functions;
07034 Trading in influence;
07035 Illicit enrichment;
07039 Other acts of corruption.

most solid source of information, as suggested by an increasing number of experiences, both at national and international level'. A notable effort to standardise survey methods in producing evidence-based corruption statistics is being steered by a task force on corruption measurement that is organised by the United Nations Office on Drugs and Crime (UNODC) ([20]), which has recently published a *Manual on Corruption Surveys — Methodological guidelines on the measurement of bribery and other forms of corruption through sample surveys* (United Nations Office on Drugs and Crime (2018)).

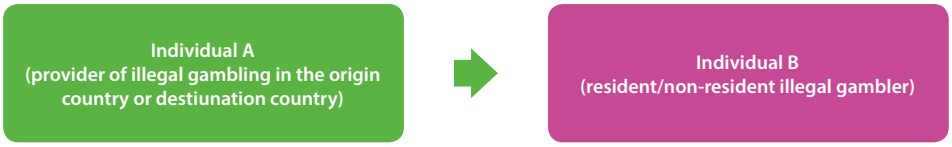
8. Illegal gambling

Turnover from gambling in the EU was estimated at EUR 84.9 billion in 2011, an amount that is thought to be growing by about 3 % per year ([21]). Illegal gambling exists alongside legal gambling, and it resembles its legal counterpart in many ways. Due to its addictive nature, illegal gambling is an IEA that is often compared with the production and sale of illegal drugs, while it is often investigated together with other illegal and criminal activities such as money laundering and usury (lending money at unreasonable, unethical or immoral rates).

Eurostat (2018) borrowed the definition of illegal gambling that is taken from the 2010 EU Presidency Progress Report on the legal framework for gambling and betting in the Member States of the EU (Council of the European Union (2010)). It describes illegal gambling as gambling 'in which operators do not comply with the national law of the country where the services are offered, provided those national laws are in compliance with EU treaty principles'.

Recording illegal gambling transactions is similar to recording legal gambling transactions, where 'the amounts paid for lottery tickets or placed in bets consists of two elements: the payment of a service charge to the unit organising the lottery or gambling and a residual current transfer that is paid out to the winners' (ESA 2010, paragraph 4.135). Thus, in the base model of illegal gambling (see Figure 7) there is an interaction between the provider of illegal gambling (individual A) and a gambler (individual B). The economic activity of individual A falls within NACE Rev. 2 Division 92, gambling and betting activities.

Figure 7: Base model for illegal gambling



Source: Eurostat (2018)

([20]) United Nations Office on Drugs and Crime (UNODC), the task force on corruption includes experts from national and international organisations active in the field of corruption measurement both in developed and developing countries. The work of the task force is in accordance with the framework of the 2030 Sustainable Development Agenda, particularly target 16.5, 'Substantially reduce corruption and bribery in all their forms'.

([21]) European Commission, Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs, see: http://ec.europa.eu/growth/sectors/gambling_en.

Table 3: Illegal gambling estimates

	Size of illegal gambling market	Size of the grey market in April 2016
BE	:	20.0 % (EUR 46.8 million)
BG	:	19,9 % (EUR 27.0 million)
CZ	Verifiable statistics or legal estimations of the illegal gambling market are not available in Czech Republic. Those studies, that are available, rely on very rough estimates.	40.0 % (EUR 92.9 million)
DK	:	12.0 % (EUR 57.7 million)
DE	State authorities estimate the 2015 gross gaming revenues from illegal casino games and online poker to be EUR 885 million (Source: Jahresreport 2014 der Glücksspielaufsichtsbehörden der Länder, 22.12.2015). The size of the total illegal gambling market in Germany is estimated by various studies to be EUR 4-22 billion (Source: Reeckmann, Illegal gambling – Need for research and action, ZfWG, European Journal of Gambling Law, 2015, p. 106).	71.0 % (EUR 865.7 million)
EE	There is no illegal gambling or its effect is very small.	32.0 % (EUR 8.7 million)
IE	:	99.0 % (EUR 755.8 million)
EL	Market actors that participated in the [2010] survey estimate that the annual turnover of illegal online gambling reaches EUR 4.0-4.5 billion, while that of illegal gaming machines is EUR 0.5-1.0 billion. On the basis of [2014] survey, it was estimated that 65 000 gaming machines operating in the illegal gambling market generate a gross gaming revenue of EUR 1.3 billion annually for the persons that operate them illegally.	80.0 % (EUR 226.1 million)
ES	:	30.0 % (EUR 175.9 million)
FR	Estimated to be worth 15 to 20 % of the legal online market (approximately EUR 150 million gross gaming revenue).	28.0 % (EUR 361.3 million)
HR	:	37.8 % (EUR 45.0 million)
IT	The illegal gambling market in Italy is estimated to be worth at least EUR 23 billion.	20.0 % (EUR 210.6 million)
CY	:	76.0 % (EUR 27.5 million)
LV	:	66.0 % (EUR 22.3 million)
LT	:	100.0 % (EUR 12.4 million)
LU	There are no legal online gambling offers in Luxembourg (except a limited offer of the Loterie Nationale with a maximum bet threshold per week of EUR 250). For the 540 000 people in Luxembourg, the value of the illegal market can thus be estimated between EUR 21 million and EUR 28 million.	100.0 % (EUR 17.6 million)
HU	Estimated at EUR 100 million annually.	29.0 % (EUR 19.0 million)

Table 3 (continued): Illegal gambling estimates

	Size of illegal gambling market	Size of the grey market in April 2016
MT	:	:
NL	:	82.0 % (EUR 212.6 million)
AT	A recent 2016 study from Kreutzer Fischer and Partner estimates around 3 000 illegal slot machines in Austria. In relation to illegal online gaming it is estimated that 50 % of the online gambling turnover in Austria is attributable to online gaming offers operating without proper national licenses.	47.0 % (EUR 120.7 million)
PL	Revenues from illegal slot machine operation have been estimated at around EUR 40 million. Source -unofficial estimates. Terrestrial sports betting is legal in Poland, but online casino games are not permitted in Poland. Illegal betting revenues from both sports betting and online casino games is unofficially estimated to amount to approximately EUR 900 million annually, effectively 90 % of the entire online market.	73.0 % (62.0 million)
PT	Illegal offline gambling: EUR 141.5 million in 2001 (according to a report by Gaming Inspection's Operational Program against Illegal Gambling). Illegal online gambling: EUR 40 million in 2012 (according to a report by the Government Commission for Online Gaming); EUR 60 million in 2015 (according to independent consultants).	48.0 % (EUR 57.3 million)
RO	:	55.0 % (EUR 42.8 million)
SI	:	28.0 % (EUR 15.6 million)
SK	Estimated size is EUR 28 million annually. This includes online and land-based gambling.	32.2 % (EUR 40.2 million)
FI	Illegal online casino, betting and poker EUR 140 million. RAY's estimate based on: PAF figures, H2GC, Alexa.com, gambling researches, Veikkaus´s estimate of the market. Illegal offline market: approximately EUR 0.	30.0 % (EUR 194.2 million)
SE	The most recent Swedish Gaming Board report (2014) states that unregulated gambling operators (in other words operators without a national license) in Sweden generate gross gaming revenues of approximately EUR 445 million or approximately 20 % of the total Swedish market.	56.0 % (EUR 478.7 million)
UK	No verifiable data is available.	:

Source: European Casino Association, Country-by-country report; European Gaming and Betting Association citing H2 Gambling Capital, European interactive map

The economic output of institutional units providing illegal gambling is the service charge, in other words, the value of the payments made by individual B minus any winnings collected. The term used in the gambling industry for this difference is gross gambling turnover (GGT). Value added is GGT minus the intermediate costs of individual A such as advertising, rent and other hosting charges incurred.

Illegal gambling can be divided into different types of games. For example, Eurostat (2018) lists games in casinos, live poker, lotto, bingo, e-gaming and sports betting machines. A more general approach would be to separate online and offline illegal gambling. The former has been explored in a few country studies, the main focus of which is illegal gambling machines — for example, Calderoni et al. (2014) and Wärmark et al. (2008). Both of these studies use a supply-side model to provide estimates for the number of illegal gambling machines.

In Europe, legal gambling is predominantly carried out offline (rather than online). However, according to the European Gaming and Betting Association (EGBA) online gambling is growing rapidly, and is expected to account for nearly a quarter of all revenues in the industry by 2020 (European Gaming and Betting Association (2018)). In estimating the size of the illegal gambling market, it could therefore be a good idea to divide estimates into offline illegal gambling (where supply-side models as detailed above are more appropriate), and online illegal gambling (where demand-side models may be more appropriate).

On cross-border gambling, the European sector-specific terminology differentiates between the 'grey' and the 'black' market. In the former, an institutional unit licensed in one EU Member State provides a service in another Member State. According to the European Commission (2016, pages 212-228), there is a large volume of case-law defining illegal activities, which is not within the scope of the current study. Due to the non-harmonised nature of the gambling sector within the EU, there could be an issue of double-counting if the illegal share of gambling is to be statistically estimated. Nevertheless, according to some estimates the illegal gambling market is significant in a number of EU Member States (see Table 3). Therefore, illegal gambling appears seems to be potentially the most significant IEA in terms of its economic impact.

9. Concluding remarks

Macroeconomic statistics should cover all economic phenomena irrespective of whether they are legal or illegal, as long as they can be defined as economic transactions. To get a full and accurate picture of the value of production and consumption in a given period, both declared and undeclared production activities must be taken into account. Including IEAs in statistical recording avoids the distortion of key economic indicators that are derived from macroeconomic accounting.

It took many years of work and many debates among international experts before the recording practices of IEAs within the European Statistical System were harmonised in 2014. The current recommended practice is that a minimum of three core IEAs should be included in macroeconomic statistics. The recommendation to include only these high-value IEAs is practical: statistical compilers should not commit disproportionate resources to calculating insignificant items.

However, it is worth researching how other IEAs could be approached for inclusion in official statistics. This can be done by reviewing existing literature and listing data sources and methods. Eurostat (2018) is a good foundation for this.

One of the interesting conclusions that can be drawn from this study is that IEAs are increasingly related to illegal e-commerce; a non-exhaustive list that could be drawn from this study includes Darknet e-markets, e-fencing, illegal online casinos, illegal online sports betting, or online piracy. The growing importance of illegal online services is not surprising, as IEAs tend to follow trends in the wider economy. Further research could attempt to estimate the value of this broad class of illegal online services and their importance to national economies.

Acknowledgements

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3 QDR methodology: understanding trade flows in the EU

PEDRO MARTINS FERREIRA [1]

Abstract: Trade asymmetry is a well-known fact and there are extensive reports and literature about the causes for those asymmetries. There is also a recognised effort made by trade statisticians to mitigate trade asymmetry over time. Notwithstanding the positive achievements that have been made so far, in order to build inter-country supply, use and input-output tables (IC-SUIOT) we need more than low levels of trade asymmetry: in fact, we need no trade asymmetry at all. The European statistical system (ESS) has a wide-ranging and rich amount of trade data and considerable resources are devoted to measuring trade flows. Nevertheless, the customs union of the EU adds another challenge regarding statistics on trade in goods: EU Member States may declare imports/exports for customs or tax purposes without having acquired ownership of the goods concerned, in other words, the declaration of quasi-transit trade. While relevant for physical trade flows, quasi-transit trade and re-exports distort the geographical distribution of trade among Member States and may be economically relevant. This paper proposes a new methodology called QDR (quasi-transit, domestic and re-export estimation) to address on the one hand trade asymmetries and, on the other, to provide estimates for quasi-transit trade, domestic trade and re-exports. This QDR methodology was used in the Figaro project and was revealed to be useful for identifying trade patterns between countries.

JEL codes: C82, F14, F15

Keywords: supply and use tables; international trade; trade asymmetries

[1] Eurostat, Unit C.5: Integrated global accounts and balance of payments.

1. Introduction

Trade asymmetry is a well-known fact and there is extensive literature and reports about the causes for those asymmetries (Eurostat (2018a)). National statistical institutes and Eurostat have been working for several years to mitigate trade asymmetries, for example, through workshops on trade asymmetries and, the production of quality reports. Notwithstanding the progress that has been made, trade asymmetries still exist which makes it hard for practitioners and researchers to build macroeconomic models or accurately assess economic relationships between countries. Some initiatives to solve trade asymmetries, from a pragmatic point of view, have been developed, as stated in the literature review presented in Miao and Fortanier (2017). These initiatives may be used to provide consolidated estimates of (gross) trade between two countries.

International trade in the EU has an additional complexity compared with the standard issues that may be raised in relation to trade asymmetries, insofar as goods entering or leaving the EU may be simply dispatched or cleared to/from another Member-State. The value of this trade is recorded in the EU's official statistics but the information, while relevant to track the physical movement of goods, may be considered of limited economic interest. As such, there is a need to provide consolidated trade estimates separating what is relevant in terms of physical movements and movements of goods from an economic perspective.

QDR methodology addresses this need to understand the nature of consolidated trade by combining available data for trade in goods and national accounts into a global, consolidated trade data set that is broken down into three categories: quasi-transit trade (Q), domestic trade (D) and re-exports (R). This approach was specifically developed for the Figaro project — full international and global accounts for research in input-output analysis — which aimed to produce experimental EU-inter country supply, use and input-output tables (EU-IC-SUIOT). From the experience and knowledge gained during the Figaro project (which started in October 2015 and finished in December 2017), it was possible to produce a time series of EU-IC-SUIOTs from 2010 to 2015, input output tables (IOTs) for 2010-2015, and supply use tables (SUTs) for 2010 and 2015.

QDR methodology is a crucial part of Figaro since it provides a balanced trade view of exports originating in a reference country which is a fundamental set of information to connect use tables of domestic inputs, the core part of an inter-country input-output table (ICIO).

This paper will highlight the most important aspects of the QDR methodology and specific examples will be shown for better understanding its potential, but also its limitations and assumptions.

2. Methodology overview

The QDR methodology was developed specifically to be used in the Figaro project and it is best described sequentially according to the production steps that are used within Eurostat for estimating consolidated trade flows between two countries. Figure 1 presents a schematic overview of the five steps that compose the full production system. The first two steps do not change or estimate any data whatsoever: these steps simply re-code data and combine different data sets into a unified data structure. They ensure that all trade in goods data received are compliant with the Figaro codelists, for example, variable labels and measurement units. At the end of the first two steps, all of the data sets have been converted/harmonised so they are valued in thousands of euros, have ISO 2-digit country codes for geographical entities and use the harmonised commodity description and coding system (known as the harmonised system, or HS) developed and maintained by the World Customs Organisation.

The third step imputes non-allocated trade whenever this is possible. The fourth step solves trade asymmetry issues through a consolidation process, while the fifth and final step breaks down these consolidated trade flow into quasi-transit trade, domestic trade and re-exports. Steps 3, 4 and 5 are the core of the Figaro system and are explained in more detail in the following sections.

Figure 1: Trade in goods production system steps in Figaro

3. Estimating non-allocated trade

One reason for non-allocated trade and trade asymmetries is confidentiality: for example, when one country reports its trade with a partner as confidential while the trade partner reports a (non-confidential) value for the same transaction. An alternative reason for non-allocated trade may arise when one EU Member State fails to record its trading partner and hence pronounces the partner as 'country and territory not specified' (Eurostat (2017a)). Both of these examples are part of a more general case: whenever one of the two trade partners is unable to fully specify a transaction there will be a trade asymmetry.

Alphanumeric codes are used in intra- and extra-EU statistics to identify confidentiality or adjusted data and trade for which a breakdown of the results at a detailed level of the product classification is not possible (Eurostat (2016)). Some of these alphanumeric codes are susceptible to cause trade asymmetries as described above, in particular, codes for corrections due to reporting erroneous information (use of the wrong code, a selection of goods for which a simplified declaration applies, estimates of missing data broken down by chapter, or confidential data). The country nomenclature used for EU statistics on international trade in goods foresees miscellaneous codes when a country is not specified, for example, codes for stores and provisions, codes for countries and territories that are not specified in general, or codes for countries and territories that are not specified for commercial or military reasons (Eurostat (2017b)).

In order to mitigate trade asymmetries resulting from data only being available for one of the two trade partners, a non-allocated trade estimation procedure was developed. This procedure is applied to data on exports and imports independently prior to evaluating trade asymmetries. We start by defining **fully specified trade** as the trade for which the product code at HS 6-digit level is not alphanumeric and both the reporting country and trade partner are known. The procedure tries to find plausible HS 6-digit level products or a plausible country for the allocation of the non-specified trade.

Methodology

A trade flow from country i to country j (T_{ij}) is the value of goods traded between an exporting country i and an importing country j. There are, in general, two estimates for the same transaction: the exports reported by country i and the imports reported by country j; the latter are often referred to as mirror exports ([2]). Let X_{ij} be an estimate of the $i \rightarrow j$ trade flow based on exports (as reported by country i) and M_{ij} be an estimate of the $i \rightarrow j$ trade flow based on the mirror exports (as reported by country j as imports).

An asymmetry exists whenever $X_{ij} \neq M_{ij}$, in other words, whenever there are two different values for a single flow. The **asymmetry in value** of the $i \rightarrow j$ trade flow is computed by:

(1) $$\Delta_{ij} = M_{ij} - X_{ij}$$

If Δ_{ij} is significantly big and positive, it means that the import partner is declaring a much bigger value of trade than the exporting country, so it is reasonable to use this information to allocate non-specified exports. The non-allocated trade procedure is as follows:

For each HS 6-digit level product:

i. Compute Δ_{ij} for each trade flow;
ii. Define an outlier threshold as

(2) $$\mathrm{h} = max\left(0, q_3 + 1.5\left(q_3 - q_1\right)\right)$$

where q_1 and q_3 are the first and third quartiles of Δ_{ij};

iii. Define significant positive asymmetry $\dot{\Delta}_{ij}$ as:

(3) $$\dot{\Delta}_{ij} = \begin{cases} \Delta_{ij} & , \quad \Delta_{ij} > \mathrm{h} \\ 0 & , \quad otherwise \end{cases}$$

iv. Distribute un-specified trade proportionally to $\dot{\Delta}_{ij}$ with the constraint that the new imputed value does not exceed Δ_{ij}, in other words, it does not exceed the value of the mirror data.

([2]) We assume, for the moment, that both exports and imports are valued free on board (FOB). The methodology to estimate FOB-type imports is described later.

The imputation of non-specified trade is done sequentially, updating after each step the estimates for exports and imports with the imputed values and re-computing Δ_{ij} and $\dot{\Delta}_{ij}$. The imputation sequence is the following:

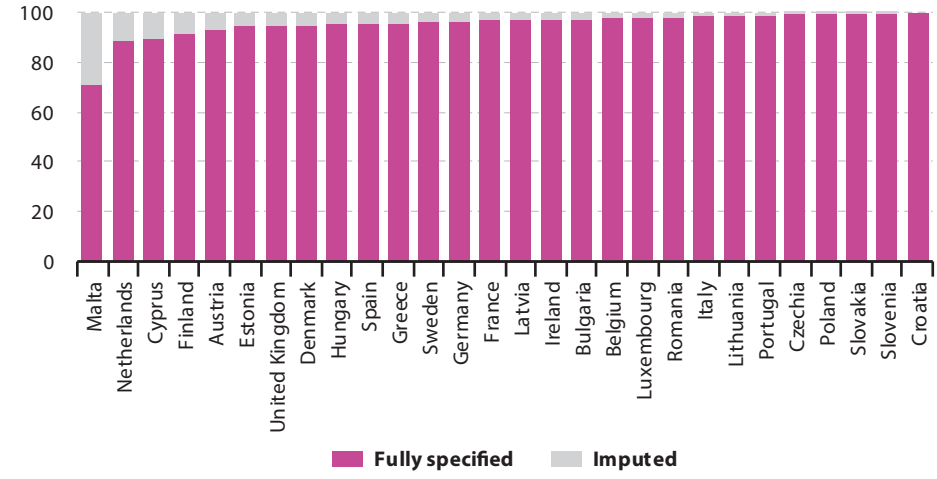
i. non-specified EU partner;
ii. non-specified extra-EU partner;
iii. non-specified product in EU;
iv. non-specified product in extra-EU;
v. non-specified partner where it is not specified if the partner belongs to the EU or is an extra-EU partner.

Results

The output of this imputation procedure for non-allocated trade may be added to the fully specified trade records provided by countries. The imputed records are identified (flagged) as such, which allows them to be traced back and also allows an analysis of the share of total trade that was directly reported by countries and the share that was imputed using this procedure.

This non-allocated trade procedure was able to allocate EUR 163 billion of exports for 2010 which was equivalent to 4.4 % of fully specified exports. The imputation of non-allocated exports ranged from 32 % in Malta, followed by the Netherlands with 13 %, down to 0 % in Poland, Slovenia, Slovakia and Croatia (see Figure 2).

Figure 2: Fully specified trade and imputed trade, by country
(%)



By product, the non-allocated trade procedure led to a re-allocation of exports that ranged from 18 % for electricity, gas, steam and air-conditioning (CPA Division35) and mining and quarrying (CPA Section B) down to 2 % for fish and other fishing products; aquaculture products; support services to fishing (CPA Division 03), textiles, wearing apparel and leather products (CPA Divisions 13 to 15), wood and products of wood and cork, except furniture; articles of straw and plaiting materials (CPA Division 16), electrical equipment (CPA Division 27) and furniture; other manufactured goods (CPA Divisions 31 and 32), see Figure 3.

Figure 3: Fully specified trade and imputed trade, by product
(%)

4. Consolidated trade flows

Fortanier (2016) presented a method developed to balance international merchandise trade statistics that built on work done by previous exercises of this kind; he also presented a literature review on the initiatives to consolidate international trade. This bilateral trade procedure reconciles exports and mirror exports which are supposed to be measuring the same trade flow. The general principle behind the consolidation procedure is that if there are two estimates for the same phenomena, and there is no additional information that allow us to choose one over the other, use both of them but take into account how reliable they each are.

Since exports are free on board type (FOB) type values and mirror exports are cost, insurance and freight (CIF) type values, before consolidating the two estimates there is a need to convert mirror exports to FOB-type values as well.

CIF/FOB

Exports and imports should have the same valuation before they may be used for consolidated trade flows, in other words, they need to be converted so that both are denominated as FOB-type values. To transform mirror exports, which are valued as CIF, to FOB estimates, a method provided by Miao and Fortanier (2017) was adopted. The CIF/FOB data

is presented as the share of costs of insurance and transport relative to import values. OECD estimates are available at HS 4-digit level. CIF/FOB estimates for each HS 4-digit heading were used for all HS 6-digit headings nested within an individual HS 4-digit heading. Whenever a specific CIF/FOB ratio was not available, it was imputed using the most detailed information available, for example, if a particular partner was missing, then the median ratio of similar partners was used, if an HS 4-digit level product was not available, then an HS 2-digit level product was used. Before balancing exports and imports, all imports were converted to FOB-type estimates.

Methodology

The aim of this consolidation methodology is to estimate for each HS 6-digit level product a FOB-type trade flow, from country i to country j. As already mentioned, there are, in general, two estimates for each trade flow $i \rightarrow j$, exports X_{ij} as reported by country i and mirror exports M_{ij} as reported by country j.

The relative asymmetry of the $i \rightarrow j$ trade flow is computed by:

$$A_{ij} = \frac{\left|X_{ij} - M_{ij}\right|}{\left|X_{ij}\right| + \left|M_{ij}\right|} \tag{4}$$

Let $\mathbf{A} = \left[A_{ij}\right]$ be a matrix where each cell is the relative asymmetry of the $i \rightarrow j$ trade flow. The weighted average by row:

$$\theta_i = \frac{\sum_k A_{ik} X_{ik}}{\sum_k X_{ik}} \tag{5}$$

measures how close the exports reported by country i are to the values reported by its trade partners. Similarly, the weighted average by column:

$$\phi_j = \frac{\sum_k A_{kj} M_{kj}}{\sum_k M_{kj}} \tag{6}$$

measures how close the imports reported by country j are to the values reported by its trade partners. In the absence of any reliable information about data quality of either exports and mirror exports, it is reasonable to assume that the consolidated trade flow $i \rightarrow j$ is more likely to be closer to exports if θ_i is smaller than ϕ_j, in other words, if the trade partners of country i present a smaller relative asymmetry than the trade partners of country j.

To guarantee some stability over time [3] of θ_i and ϕ_j, three-year averages are taken instead of annual values. We define **consolidated trade flows** as the weighted average between exports and mirror exports, with weights $\left(1-\bar{\theta}_i\right)$ and $\left(1-\bar{\phi}_j\right)$:

$$T_{ij} = \frac{\left(1-\bar{\theta}_i\right)\cdot X_{ij} + \left(1-\bar{\phi}_j\right) M_{ij}}{\left(1-\bar{\theta}_i\right) + \left(1-\bar{\phi}_j\right)} \tag{7}$$

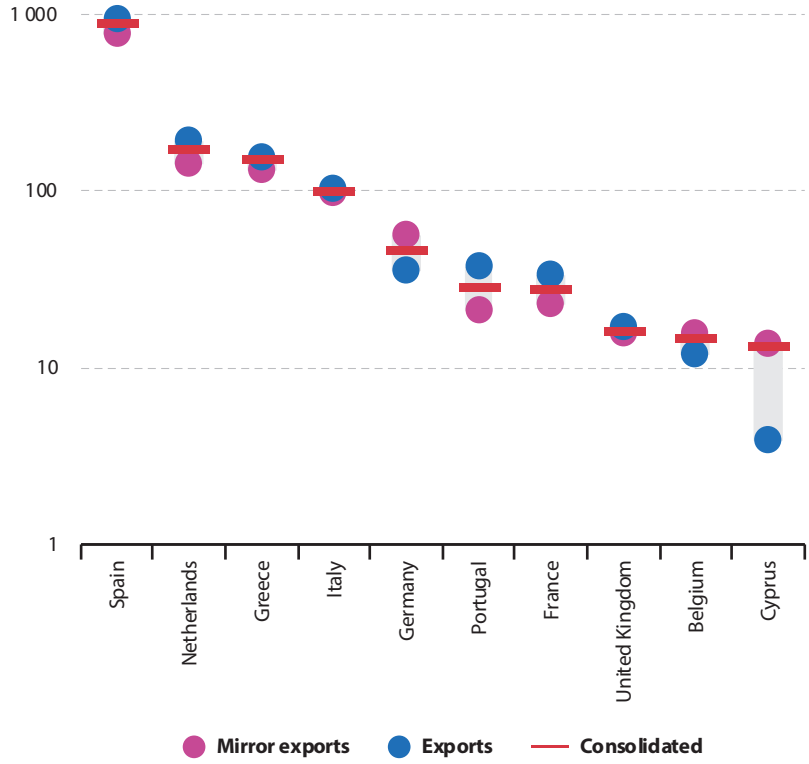
[3] Our analysis shows that, in particular for smaller values of trade, some trade flows θ_i and ϕ_j show volatility over time. To mitigate this, three-year averages are used (based on the reference year and the two previous years).

Formula (5) only applies if exports and mirror exports are both available. When there is just one estimate for a particular flow, for example, only exports are reported, then the consolidated trade flow equals that estimate.

Results

This consolidation procedure is applied both to EU international trade in goods statistics (ITGS) and to United Nations Comtrade data sets for all HS 6-digit level products. Figure 4 illustrates the consolidation of trade for fresh or dried oranges (HS code 080510) for those EU Member States with exports above EUR 10 million (a logarithmic scale was used due to the range of trade volumes across countries).

Figure 4: Exports, mirror exports and consolidated trade of fresh or dried oranges
(EUR million)



Cyprus reported exports of fresh or dried oranges that were valued at EUR 3.8 million, but its trade partners reported mirror exports valued at EUR 13.7 million (FOB). The consolidated flow of EUR 13.3 million is a value that is much closer to the value of mirror exports than it is to the value of exports because the relative asymmetry of exports from Cyprus is significantly greater than the relative asymmetry of its partners' imports. A similar case can be seen for Germany, where consolidated trade was closer to the value of mirror exports than it was to the value of exports. By contrast, in Greece and Italy the consolidated flow was very close to the value of reported exports. The figure also shows that the higher the level of trade asymmetry the higher the risk that consolidated trade deviates significantly from the reported value of exports.

5. QDR

Eurostat (2018b) defines the QDR methodology as making use of the following inputs for the reference year (or the year closest to the reference year):

i. the consolidated view of trade derived from ITGS (which follows the community principle for EU Member States, namely to include quasi-transit trade);
ii. the consolidated view of trade from the UN (which for EU Member States follows the national principle of trade ([4]);
iii. trade margins from the supply table (T1500);
iv. exports in use tables of total inputs domestic inputs (T1611);
v. imported inputs (T1612).

With these inputs, the consolidated view of trade according to the community principle will be broken down into how much gross trade is quasi-transit trade (Q), how much is domestic trade (D) and how much is re-exports (R); the latter may, in turn, be split into the value of the exported good (G) and the margin associated with re-exporting (M).

Quasi-transit trade is an operation when goods are imported into one EU Member State from an economy outside the EU (in other words from a non-member country) and subsequently dispatched to another Member State or when goods exported from one Member State to a non-member country are cleared for export in another Member State.

Re-export is an operation when foreign goods (goods produced in other economies and previously imported) are exported with no substantial transformation from the condition in which they were previously imported. While quasi-transit trade has no economic relevance for the construction of inter-country supply, use and input-output tables, re-exports are relevant, since there is, in general, a trade margin associated with re-exporting. Therefore it is important to distinguish quasi-transit trade from re-exports and in the case of a re-export to estimate the value of the good exported as well as the value of the associated trade margin.

Methodology

ITGS cover goods in quasi-transit, in other words, goods that are brought into or taken out of an EU Member State to be declared there as imports/exports for customs or tax purposes without that Member State having acquired the ownership of the goods (Eurostat (2016)). However, some Member States exclude quasi-transit trade when publishing their own results, to enhance the economic relevance of their national figures). In addition, some Member States exclude quasi-transit trade when sending their figures to the United Nations (UN) Comtrade database. While ITGS follows the **community principle** (to include quasi-transit trade), the UN Comtrade database follows the **national principle** (excludes quasi-transit trade).

([4]) Although the UN Comtrade guidelines specifically request use of the national principle, some EU Member States are unable to provide data according to the requested principle for some products, in particular, those Member States that are unable to provide trade data for the country of consignment and the country of origin; in such cases the data reported follow the community principle.

For a particular EU Member State and HS 6-digit product, let

- X_c be (gross) exports according to the **community principle**, in other words, from ITGS;
- X_N be (gross) exports according to the **national principle**, in other words, from UN Comtrade;
- X_D be the **domestic component of gross exports**, in other words, the country of origin of that good is the exporter country;
- X_R be the **re-exports component of gross exports**;
- X_Q be the **quasi-transit trade component of gross exports**.

Let as well M represent mirror exports of each indicator mentioned above, in other words, M_c, M_N, M_D, M_R and M_Q.

What differentiates the community principle from the national principle is the fact that the latter contains quasi-transit trade. Therefore, the estimator of X_Q is given by:

(8) $$\hat{X}_Q = X_C - X_N$$

The only information about the domestic component of trade is given by the partner country when it declares that the country of origin is the same as the country of consignment, in other words, a country reports that it has imported a good from a country which happens to be the origin for that good. The domestic component of mirror exports (M_D) is estimated by the total imports for which the country of consignment and the country of origin are the same. Then, the estimator for the domestic component of trade is given by:

(9) $$\hat{X}_D = \frac{M_D}{M_C} X_C$$

The estimator of re-exports is taken as the difference between exports according to the national principle and the domestic component of exports, in other words:

(10) $$\hat{X}_R = X_N - \hat{X}_D = X_N - \frac{M_D}{M_C} X_C$$

CONSISTENCY BETWEEN DATA SOURCES

Since there are two different data sources used to provide information for the indicators described above, there might be cases whereby both data sources provide inconsistent figures which may lead to negative estimates of trade, this may be particularly true for X_N which is taken from the UN Comtrade database (while all other indicators are sourced from ITGS). As such, the first thing to do is to identify and correct any data inconsistencies.

Inconsistent data can produce negative estimates for $\hat{X}_Q$ and $\hat{X}_R$ ($\hat{X}_D$ is always positive). Solving:

(11) $$\begin{cases} \hat{X}_Q > 0 \\ \hat{X}_R > 0 \end{cases}$$

we get the following constraint:

$$\frac{M_D}{M_C} X_C \leq X_N \leq X_C \quad (12)$$

This means that as long as exports according to the national principle are greater than or equal to the domestic component of gross exports and less than or equal to gross exports according to the community principle, then the above estimates will be consistent. In fact, exports according to the national principle will be equal to domestic component when re-exports are 0 and they will be equal to exports according to the community principle when quasi-transit trade is 0.

Whenever an inconsistency was identified, X_N was changed to its lower or upper limit defined by equation (12).

CORRECTION OF BIAS IN DOMESTIC ESTIMATES

Estimates of domestic trade are based on information relating to the country of consignment/country of origin, as provided by partner countries. Unfortunately, not all countries provide this information. Taking into account that in the absence of information on the country of origin, the most reasonable and practical estimate is to assume that the country of origin is the same as the country of consignment, then the estimate of the domestic trade component given by equation (10) is biased (upwards). To correct for this upward bias, national accounts data are used to adjust the initial estimates of the domestic trade component. Eurostat table T1611 — **Use table for domestic production** — provides information on exports that were produced in a country while Eurostat table T1610 — **Use tables at basic prices** — provides information for total exports (see Eurostat (2018b). The ratio of domestically produced exports to total exports (T1611/T1610) is an estimate for the share of domestic exports in total exports.

Products in tables T1610 and T1611 are classified according to the CPA classification and at a more aggregated level than HS 6-digit level. Let d_i be estimates of domestic trade obtained from equation (10) for every i HS 6-digit level product within a CPA heading and let d be the domestic exports ratio taken from national accounts. Then, d_i were adjusted using the RAS method of data reconciliation, where the initial matrix has two columns (domestic/re-exports) and as many rows as the number of HS 6-digit level products within each CPA heading. Preliminary estimates are then changed by the RAS method so that the totals by column are consistent with d (taken from supply, use and input-output tables (SUIOT statistics)) and the totals by row are equal to the estimated exports from ITGS.

QUASI-TRANSIT TRADE AND RE-EXPORT PARTNERS

Partners are taken from the distribution of original imports for which the country of origin is different to the country of consignment. Quasi-transit trade, by definition, applies only when the destination and consignment countries are in the EU and the country of origin is outside the EU. Re-exports apply more generally. When the country of origin is the same as the country of destination there is a re-import. Cases of re-imports were not taken into account due to the very small value of this particular type of trade.

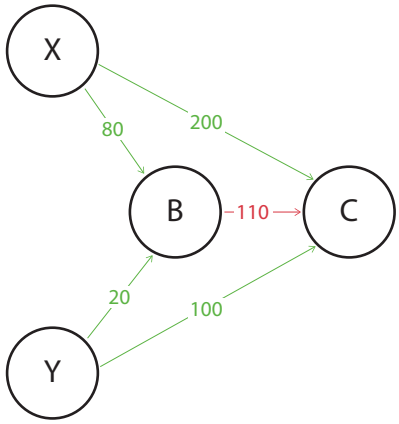
TRIANGULAR TRADE AND RE-EXPORT MARGINS

The final step of the QDR methodology is to take into account the gross trade flows (X_C) that are split into quasi-transit trade (X_Q), domestic trade (X_D) and re-exports (X_R), as well as the estimated country of origin in the case of quasi-transit trade and re-exports, and to identify and correct triangular trade, in other words, when a country of origin ships a good to a country of consignment which is then shipped to a country of destination.

The best way to explain how such triangular trade was corrected is by using a small theoretical example.

Let's assume that country X and country Y export one type of good, directly, to country C, with the value of EUR 200 and EUR 100, respectively. Let's also assume that country B buys EUR 80 of the same type of good from country X and EUR 20 from country Y, adds a re-export margin of 10 % and then re-exports those goods to country C at a value of EUR 88 + EUR 22 = EUR 110.

Figure 5: Hypothetical scenario of triangular trade



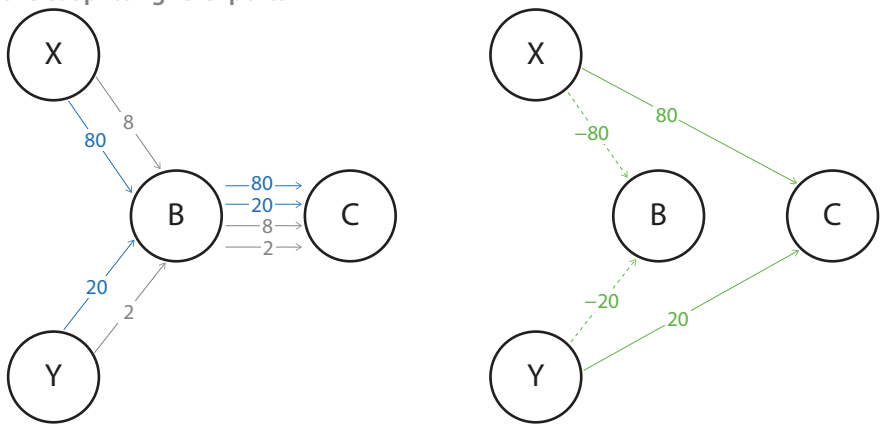
TRADE_TYPE	ORIGIN	CONSIGN	DESTIN	OBS_VALUE
?	X	X	C	200
?	Y	Y	C	100
?	X	X	B	80
?	Y	Y	B	20
?	X	B	C	88
?	Y	B	C	22
				510

The table presented in Figure 5 presents the information that is usually available. Re-exports are marked in red and are usually reported by the country of destination (country C) which declared importing goods from country B, whereas the goods initially came from different countries of origin (countries X and Y).

The first assumption one needs to make is that the value paid by country C to country B encapsulates the value of the good and the value of the re-export margin. Another assumption that needs to be made — due to a lack of more detailed data — is that trade margins for re-exports are similar (independent of the country of origin), in other words, in this case the same margin of 10 % applies to the re-exports from both country X and country Y.

Under these assumptions, it is possible to split the value of re-exports (EUR 110) between the two initial countries of origin and by the re-export margin: the EUR 88 from country X, becomes EUR 80 goods + EUR 8 margin and the EUR 22 from country Y, becomes EUR 20 goods + EUR 2 margin. In addition, the value of goods that country B imports from countries X and Y for the sole purpose of re-exporting can now be connected directly between the initial country of origin and their final destination. This is done by simply imputing the (additional) EUR 80 and EUR 20 values between the country of origin and destination, while removing those same values between the country of origin and the country of consignment (represented as negative flows), as shown in Figure 6:

Figure 6: Splitting re-exports



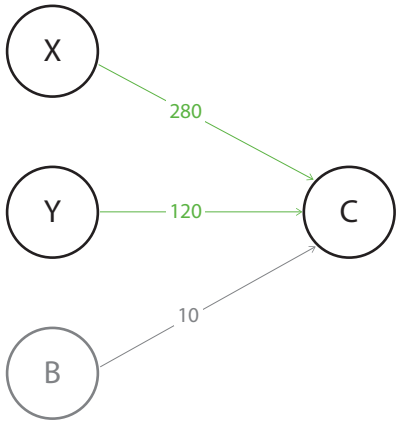
The sum of all transactions presented in Figure 6 totals the exact value of the re-exports and so the re-export records presented in red in the table of Figure 5 can now be replaced by the transactions of Figure 6 without altering the total value of trade (see Table 1):

Table 1: Complete set of transactions represented in tabular form

TRADE_TYPE	ORIGIN	CONSIGN	DESTIN	OBS_VALUE
D	X	X	C	200
D	Y	Y	C	100
D	X	X	B	80
D	Y	Y	B	20
M	X	B	C	8
M	Y	B	C	2
R	X	B	C	80
R	Y	B	C	20
D	X	X	C	80
D	Y	Y	C	20
D	X	X	B	-80
D	Y	Y	B	-20
				510

By aggregating all records in Table 1 we end up with the relevant information that we were looking to deduce, as presented in Figure 7: country X exports EUR 280 of goods that end up in country C, country Y exports EUR 120 of goods that end up in country C, and together these form the full value of goods involved. However, since country B was involved in some transactions as a re-exporting country, it is also possible to identify EUR 10 that country B has charged for the transactions it was involved in (EUR 8 with respect to re-exports from country X and EUR 2 with respect to re-exports from country Y). In addition, the triangular trade transactions and respective countries involved are kept within the table (as shown in blue), so it is also possible to reconstruct the original reported transactions. A final remark: the value of triangular trade flows plus the trade that has been of interest (as described in this paper) equals the initial value of total trade. As such, this method can also be seen as a way to remove the value of trade that was double counted due to triangular trade from the total (raw) value of trade.

Figure 7: Trade transactions of interest



TRADE_TYPE	ORIGIN	CONSIGN	DESTIN	OBS_VALUE
D	X	X	C	280
D	Y	Y	C	120
M	X	B	C	8
M	Y	B	C	2
				410

TRADE_TYPE	ORIGIN	CONSIGN	DESTIN	OBS_VALUE
R	X	B	C	80
R	Y	B	C	20
				100

Results

After running QDR methodology for all HS 6-digit level products, a reference data set for trade statistics was built which contains a consolidated view broken down into quasi-transit trade, domestic trade and re-exports. Table 1 shows the first five records (out of 11.8 million) for 2010. This extensive data set contains information on trade for 176 countries and the rest of the world for about 10 thousand products.

Table 2: Reference trade data for FIGARO at HS 6-digit level

PROD_ STAGE	TIME_ PERIOD	TRADE_ TYPE	HS6	ORIGIN	CONSIGN	DESTIN	OBS_ VALUE	UNIT_ MEASURE	UNIT_ MULT	DECIMALS	OBS_ STATUS	CONF_ STATUS
R	2010	D	010110	ES	ES	AD	0.7	EUR	3	1	E	N
R	2010	D	010110	AR	AR	AE	30.2	EUR	3	1	E	N
R	2010	D	010110	AT	AT	AE	5.1	EUR	3	1	E	N
R	2010	D	010110	AU	AU	AE	1 657.9	EUR	3	1	E	N
R	2010	D	010110	CA	CA	AE	626.1	EUR	3	1	E	N
…	…	…	…	…	…	…	…	…	…	…	…	…

The QDR methodology is able to provide information for several indicators but probably the most important is that of domestic exports, in other words, exports between a country of origin and a country of destination that originated in the economy of the exporting country. This means that QDR is able to provide a breakdown by partner of the exports vector in the use table of domestic inputs (T1611) ([5]).

As an example, the world trade of motor vehicles, trailers and semi-trailers (CPA Division29) in 2010 was estimated to be:

Table 3: Global trade of motor vehicles, trailers and semi-trailers
(EUR billion)

	EU-28	United States	Rest of the world
EU-28	240.3	26.7	108.7
United States	6.1	0.0	66.6
Rest of the world	43.7	124.1	175.9

The two biggest exporters of motor vehicles, trailers and semi-trailers in the EU-28 are Germany and France. Table 4 presents their domestic exports of motor vehicles, trailers and semi-trailers by major trade partner:

Table 4: Domestic exports of motor vehicles, trailers and semi-trailers for Germany and France
(EUR billion)

	Belgium	Bulgaria	Czechia	Denmark	Germany	Estonia	Ireland	Greece	Spain	France	Croatia	Italy	Cyprus	Latvia	Lithuania
Germany	5.1	0.1	2.4	1.2	-	0.1	0.4	0.6	6.1	10.5	0.2	8.8	0.1	0.1	0.1
France	3.7	0.0	0.5	0.3	6.0	0.0	0.1	0.1	5.5	-	0.1	3.5	0.0	0.0	0.0

	Luxembourg	Hungary	Malta	Netherlands	Austria	Poland	Portugal	Romania	Slovenia	Slovakia	Finland	Sweden	United Kingdom	United States	Rest of the world
Germany	0.6	1.7	0.0	3.2	3.0	3.4	2.1	0.5	0.2	1.4	0.7	3.7	14.7	17.5	55.1
France	0.1	0.2	0.0	0.8	0.6	0.7	0.6	0.4	0.4	0.5	0.1	0.6	3.5	0.6	9.0

As a concluding remark, QDR provides a reasonable and efficient way to break down domestic exports by partner, which is crucial for building an inter-country input-output table. In addition, there are other sorts of indicators that can be derived from this new data set of consolidated trade broken down by quasi-transit trade, domestic trade and re-exports that are useful for other types of analysis, for example, analysing re-export margins by country, physical movements of trade, or estimates of quasi-transit trade.

([5]) Accounting for the fact that T1611 is valued at basic prices while trade statistics are valued at purchaser's prices.

6. Future work

It is very hard, if indeed possible, to find a benchmark data set to evaluate the methodology presented in this paper, so it becomes difficult to make a proper sensitivity analysis for the results of alternative methodological choices. Nevertheless, the follow up of project Figaro started in 2018 and is expected to continue until at least 2020. During this period, longer time series for international trade in goods will become available, and it is foreseen to test the robustness of the methodological choices described above across time. Furthermore, there are plans to analyse and develop a methodology to detect/correct product misclassification at HS 6-digit level. Notwithstanding the work that is still ahead, the methodology thus far is an important breakthrough in providing consolidated trade estimates.

Acknowledgements

The author is grateful to Eurostat colleagues in Unit G.5: Goods — production and international trade, for their support and insights on the subject and is also grateful for the cooperation provided by and frequent dialogue with the OECD. The QDR methodology is a product of fruitful discussions during the Figaro project.

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4 Addendum to 'Output growth and inflation across space and time'

W. ERWIN DIEWERT ([1]) AND KEVIN J. FOX ([2])

Abstract: This paper is an addendum to a previous paper by Diewert and Fox (2017) which addressed two problems: (i) how to measure aggregate real output and inflation for a group of countries and (ii) how to construct measures of real GDP for a group of countries where the country measures of real GDP are comparable across time and space. In order to address both problems, it is necessary that the group of countries construct purchasing power parities (PPPs). The present paper looks at the specific problem of interpolating PPPs between benchmark years when PPPs have been constructed. The paper shows that the method of interpolation that was suggested by Diewert and Fox is equivalent to a variant of the method used by the Penn World Tables to interpolate PPPs between benchmarks.

JEL codes: C43, C82, E01

Keywords: purchasing power parities, International Comparison Program, OECD country statistics, inflation, price and volume indexes

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1. Introduction

For many purposes, researchers want estimates of real GDP by country that are comparable across different countries within a group. For each member of any given group of countries under consideration, national statistical agencies provide national price and quantity (or volume) indexes for its GDP. However, these indexes are not comparable across countries ([3]). International organisations like the OECD and the World Bank provide either *annual comparisons* of real GDP across their member countries (this is the case for the OECD) or *occasional benchmark comparisons* of GDP for different countries across the world (this is the case for the World Bank). Given this background, a number of questions arise:

- how should 'world' indexes for real GDP and inflation be calculated?
- how should cross sectional comparisons of real GDP be combined with the time series comparisons of real GDP to construct 'harmonised' indexes of real GDP that can be compared over time and space?
- given that cross sectional comparisons of GDP for a group of countries are made only on an occasional basis, how can these cross sectional comparisons be interpolated between benchmarks in order to obtain a complete time series of cross sectional comparisons?

The OECD and the Penn World Tables have addressed the first two problems; see OECD (2001), OECD (2014), Eurostat (2012) and Feenstra, Inklaar and Timmer (2015) for various approaches to addressing these problems. The interpolation problem has been addressed by Feenstra, Inklaar and Timmer (2015) and Diewert and Fox (2017) who offer competing methods for solving this particular problem. In this paper, we will review Diewert and Fox's suggested methods for addressing the three problems outlined above. The main new result of this paper is to show that the method of interpolation suggested by Diewert and Fox is equivalent to the *blended method of interpolation* which is very close to the interpolation method suggested by Feenstra, Inklaar and Timmer.

([3]) The volume measure of GDP for one country has a unit of measurement that is different from the volume measure of GDP for another country and thus these volume measures cannot be compared with each other.

2. Basic definitions and pseudo Laspeyres, Paasche and Fisher volume indexes

We assume that there are K countries in a comparison of international prices and quantities for some group of commodities over T time periods ([4]). The *value aggregate* for country k in time period t is denoted by V_k^t for $k = 1,\ldots,K$ and $t = 1,\ldots,T$. These value aggregates are measured in units of domestic currencies. We further assume that *country price indexes* P_k^t (or the corresponding *quantity or volume indexes* Q_k^t) are available for the K countries over the T time periods under consideration. These three sets of variables satisfy the following consistency restrictions:

(1) $\quad V_k^t = P_k^t Q_k^t; k = 1,\ldots,K \text{ and } t = 1,\ldots,T.$

In addition to the above three sets of variables, we initially assume that a time series of *purchasing power parities* (PPPs) is available for each country and each time period; in other words, we assume the availability of the series PPP_k^t for $k = 1,\ldots,K$ and $t = 1,\ldots,T$ ([5]). PPP_k^t is denominated in units of the currency of country k and it represents the price in domestic currency of a comparable bundle of products in the aggregate under consideration ([6]). Thus V_k^t, P_k^t, Q_k^t and PPP_k^t are the *four fundamental series* that will be used in the subsequent definitions.

Real relative volumes (or quantities) for each country can be obtained for each year by dividing the national currency aggregate values V_k^t by the corresponding PPP_k^t for that year. We may then denote the resulting *relative volumes* by r_k^t. Thus, we have:

(2) $\quad r_k^t \equiv V_k^t / PPP_k^t; k = 1,\ldots,K \text{ and } t = 1,\ldots,T.$

The *relative volume* of r_k^t can be normalised into *period t country shares* σ_k^t of a world aggregate by using the following definitions:

(3) $\quad r^t \equiv \Sigma_{k=1}^{K} r_k^t; t = 1,\ldots,T;$

(4) $\quad \sigma_k^t \equiv r_k^t / r^t; \;\; k = 1,\ldots,K \text{ and } t = 1,\ldots,T.$

([4]) Typically, the length of the time period will be a year and so we will sometimes refer to annual estimates. But the length of the period may be a quarter or a month or any other suitable measure of time.

([5]) In subsequent sections, we will assume that the PPPs are only available for periods 1 and T; in other words, only PPP_k^1 and PPP_k^T are available for $k = 1,\ldots,K$.

([6]) If there were only one commodity in the aggregate, then PPP_k^t would simply be the price of one unit of the product or service in domestic currency, measured in units of measurement that are comparable across countries. For more information on the construction of PPPs, see OECD (2001) and Eurostat (2012).

Estimates of real expenditures for the world based on the aggregate in question can be defined by the following fixed base *pseudo Laspeyres, Paasche and Fisher world volume indexes*:

(5) $Q_L^t \equiv \Sigma_{k=1}^K \sigma_k^1 (Q_k^t/Q_k^1); t = 1,\ldots,T;$

(6) $Q_P^t \equiv [\Sigma_{k=1}^N \sigma_k^t (Q_k^t/Q_k^1)^{-1}]^{-1}; t = 1,\ldots,T;$

(7) $Q_F^t \equiv [Q_L^t Q_P^t]^{1/2}; t = 1,\ldots,T.$

Note that the OECD uses the Laspeyres definition (5) to define real GDP for the OECD. However, since the Paasche counterpart (6) to the Laspeyres definition (5) is simply the Laspeyres definition run backwards, it seems more appropriate to take an average of these two estimates for world volumes given by (5) and (6).

The second thing to note is that it is not necessary to use the pseudo Fisher index (7) in order to construct estimates of world volumes: rather, it is possible to convert the country aggregate values into a common currency and then use these values V_k^t/e_k^t (where e_k^t is the exchange rate for country k in period t relative to a numeraire country) along with country volumes Q_k^t and normal index number theory to calculate a true Fisher index for the world. We did this in Diewert and Fox (2017) and compared the resulting world growth rates with their pseudo Fisher counterparts and found some small differences ([7]). Growth rates calculated from the Fisher index compiled from the exchange rate method were less smooth than those calculated from pseudo Fisher estimates which do not use exchange rates (but do use PPPs).

The *relative volumes* r_k^t defined by (2) enable us to compare real volumes across the different members of a group of countries at a single time period but they do not allow comparisons across time periods to be made. It is possible to link the cross sectional comparisons of real output or consumption to growth rates over time by multiplying the cross sectional comparisons at time period t, r_k^t for $k = 1,\ldots,K$, by the national volume growth rate of a numeraire country, say country n, in order to obtain the volumes $r_k^t(Q_n^t/Q_n^1)$ for $k = 1,\ldots,K$ and $t = 1,\ldots,T$. These volume estimates would respect the relative volumes defined by r_k^t for each time period t and would also respect the intertemporal relative volumes for country n. The problem is that different choices for the numeraire country would lead to different choices for the resulting intertemporal comparisons. Thus, some averaging of these numeraire based intertemporal volumes is necessary in order to obtain numeraire independent estimates of volume that are consistent over time and space. The OECD uses the weighted average of the country growth weights defined by (5) above to achieve numeraire independent estimates of relative country volumes while Diewert and Fox (2017) used the weighted average growth of the country growth weights defined by (7) above. In the following section, we will define (in more detail) the Diewert and Fox method for obtaining estimates of real output that can be compared across time and space.

([7]) The Diewert and Fox comparisons are extended using more recent OECD data in Diewert (2018).

3. Diewert and Fox consistent-over-time-and-space volume and price indexes

We use the above definitions to construct the Diewert and Fox volume indexes for each country that are consistent with the cross sectional indexes defined by r_k^t and are consistent with the intertemporal aggregate pseudo Fisher indexes Q_F^t defined by (7) above. We define the *Diewert and Fox volume index for country n in period t*, q_k^t, as ([8]):

(8) $q_k^t \equiv \sigma_k^t r^t Q_F^t; k = 1,\ldots,K; t = 1,\ldots,T;$

$= (V_k^t/PPP_k^t)(r^t/r^t)Q_F^t$ using definitions (2)-(4);

$= (P_k^t Q_k^t)(1/PPP_k^t)(r^t/r^t)Q_F^t$ using the identity (1).

Note that $q_k^1 = V_k^t/PPP_k^t$ (since $Q_F^1 = 1$) and $q_k^T = (V_k^T/PPP_k^T)(r^t/r^T)Q_F^T$ for $k = 1,\ldots,K$. Real country volumes for periods 1 and T can be calculated using national accounts information alone for periods 1 and T along with data on PPP_k^t for periods $t = 1$ and $t = T$. The sum of q_k^t over k for $t = 1$ and for a general t can be calculated as follows using definition (8):

(9) $\sum_{k=1}^K q_k^1 \equiv \sum_{k=1}^K \sigma_k^1 r^1 Q_F^1;$

$= \sum_{k=1}^K (r_k^1/r^1) r^1$ using definitions (4)-(7) for $t = 1$;

$= \sum_{k=1}^K r_k^1;$

(10) $\sum_{k=1}^K q_k^t \equiv \sum_{k=1}^K \sigma_k^t r^t Q_F^t; t = 2, 3,\ldots,T;$

$= \sum_{k=1}^K (r_k^t/r^t) r^t Q_F^t$ using (4);

$= r^t Q_F^t$ using (3);

$= \sum_{k=1}^K q_k^1 Q_F^t$ using (3) and (9).

Equations (9) and (10) imply that the following relationships hold:

(11) $(\sum_{k=1}^K q_k^t)/(\sum_{k=1}^K q_k^1) = Q_F^t; t = 1,\ldots,T.$

Thus, the sum of volumes over countries in period t divided by the base period sum of the volumes is equal to the period t pseudo Fisher volume index defined by (7) above.

We interpret q_k^t as volumes ([9]) — that are consistent over time and space — for the value aggregates, V_k^t, or true volumes/quantities. The corresponding *consistent over time and space price indexes* for the value aggregates ρ_k^t are defined by deflating the values, V_k^t, by the true volume/quantity indexes, q_k^t; in other words, we define the *true price index* for country k in time period t as:

(12) $\rho_k^t \equiv V_k^t/q_k^t; k = 1,\ldots,K; t = 1,\ldots,T.$

([8]) Diewert and Fox (2017) omitted the normalising factor r^t in their definition of relative volumes that were consistent over time and space.

([9]) The consistency of q_k^t with each cross sectional comparison of volumes generated by using PPPs is clear. The volumes, q_k^t, are not fully consistent with the time sequence of the individual country national volumes Q_k^t; q_k^t have only the aggregate time consistency property defined by equation (10).

4. Diewert and Fox interpolated price and volume indexes

In this section, we consider using the fixed base country rates of volume growth, Q_k^t/Q_k^1, to extrapolate forward the base period real volumes, q_k^1, for $k = 1,\ldots,K$; in other words, we define the *forward extrapolated real country volume for country k in period t*, q_{fk}^t, as:

$$(13) \quad q_{fk}^t \equiv q_k^1(Q_k^t/Q_k^1); k = 1,\ldots,K; t = 1,\ldots,T;$$
$$= (P_k^1Q_k^1)/(1/PPP_k^1)(Q_k^t/Q_k^1) \text{ using definition (8);}$$
$$= (P_k^1/PPP_k^1)Q_k^t.$$

The corresponding *forward extrapolated price index for country k in period t*, p_{fk}^t, is defined as the observed V_k^t divided by the forward extrapolated real country volume q_{fk}^t ([10]):

$$(14) \quad p_{fk}^t \equiv V_k^t/q_{fk}^t; k = 1,\ldots,K; t = 1,\ldots,T;$$
$$= P_k^tQ_k^t/[(P_k^1/PPP_k^1)Q_k^t] \text{ using (1) and (13);}$$
$$= PPP_k^1(P_k^t/P_k^1).$$

Note the symmetry of the last equation in (14) with the first equation in (13). Note also that we do not require a knowledge of the true PPPs for the periods between *1* and *T* in order to calculate q_{fk}^t and p_{fk}^t for all $t = 1,\ldots,T$.

We now use the (fixed base) country rates of volume growth, Q_k^t/Q_k^T, to extrapolate backwards the final period real volumes, q_k^T, for $k = 1,\ldots,K$; in other words, we define the *backward extrapolated real country volume for country k in period t*, q_{bk}^t, as:

$$(15) \quad q_{bk}^t \equiv q_k^T(Q_k^t/Q_k^T); k = 1,\ldots,K; t = 1,\ldots,T;$$
$$= (V_k^T/PPP_k^T)(r^t/r^T)Q_F^T(Q_k^t/Q_k^T) \text{ using definition (8);}$$
$$= (P_k^TQ_k^T/PPP_k^T)(r^t/r^T)Q_F^T(Q_k^t/Q_k^T) \text{ using (1);}$$
$$= (r^t/r^T)Q_F^T(1/PPP_k^T)Q_k^t.$$

The corresponding *backward extrapolated price index for country k in period t*, p_{bk}^t, is defined as the observed V_k^t divided by the backward extrapolated real country volume, q_{bk}^t:

$$(16) \quad p_{bk}^t \equiv V_k^t/q_{bk}^t; k = 1,\ldots,K; t = 1,\ldots,T;$$
$$= (r^T/r^t)(1/Q_F^T)PPP_k^T(P_k^t/P_k^T) \text{ using (15).}$$

We consider two methods for harmonising the long-run consistent over time and space indexes of aggregate volume growth, q_k^T/q_k^1, with the national indexes of aggregate volume growth, Q_k^T/Q_k^1, for $k = 1,\ldots,K$. The first method (Diewert and Fox (2017)) works by adjusting

([10]) The prices, p_{fk}^t, defined by (14) are not normalised to equal unity for a base country for each period *t*; in other words, p_{fk}^t are predictors for the true inter-temporally consistent price indexes, ρ_k^t, defined by (12). The prices, ρ_k^t, have only one normalisation; in other words, one of the ρ_k^t is set equal to unity for a single country, say $k = 1$ or $k = K$, and for a single time period, say $t = 1$.

the forward extrapolated volumes, $q_{fk}^{\ t} \equiv q_k^{\ 1}(Q_k^{\ t}/Q_k^{\ 1})$, defined in (13) by growth factors that will ensure that the adjusted volumes for period T equal the true consistent volumes for period T, $q_n^{\ T}$, defined in (13) for $t = T$.

We define for each country k the national growth rates of the real aggregate under consideration by G_k and the corresponding harmonised (consistent over time and space) growth rates over the sample period by g_k as:

(17) $G_k \equiv Q_k^{\ T}/Q_k^{\ 1}; k = 1,\ldots,K;$

(18) $g_k \equiv q_k^{\ T}/q_k^{\ 1}; k = 1,\ldots,K.$

It would be ideal if $G_n = g_n$ for each n but this will not happen in real life. Thus, we define the *error factors*, a_k, for each country k as:

(19) $a_k \equiv [g_k/G_k]^{1/(T-1)} = [g_k/G_k]^{1/1(T-1)}; k = 1,\ldots,K.$

Next, we define the Diewert and Fox adjusted *forward extrapolated volume for country k in period t*, $q_{DFk}^{\ t}$, as:

(20) $q_{DFk}^{\ t} \equiv q_k^{\ 1}(Q_k^{\ t}/Q_k^{\ 1})(a_k)^{t-1}; k = 1,\ldots,K; t = 1,\ldots,T.$

The above definitions imply the following equalities when based on (20) for $t = T$:

(21) $q_{DFk}^{\ T} = q_k^{\ 1}(Q_k^{\ T}/Q_k^{\ 1})(a_k)^{T-1}; k = 1,\ldots,K;$

$= q_k^{\ 1}(Q_k^{\ T}/Q_k^{\ 1})([q_k^{\ T}/q_k^{\ 1}]/[Q_k^{\ T}/Q_k^{\ 1}])^{(T-1)/(T-1)}$ using definitions (17)-(19);

$= q_k^{\ T}.$

Thus, Diewert and Fox use national growth rates, $Q_k^{\ t}/Q_k^{\ t-1}$, adjusted by error factors, a_k, to form estimates for the true volumes, $q_k^{\ t}$, defined by (8). These estimates, $q_{DFk}^{\ t}$, will only be approximations for $t = 2, 3,\ldots, T-1$ but they will equal the true $q_k^{\ t}$ for $t = 1$ and $t = T$.

5. The blended method for volume interpolations

The second interpolation method is easier to understand. Recall that the period t forward and backward extrapolated estimates for the true q_k^t were defined by (13) and (15) as $q_{fk}^t \equiv q_k^1(Q_k^t/Q_k^1)$ and $q_{bk}^t \equiv q_k^T(Q_k^t/Q_k^T)$. The *blended method of volume interpolation* forms estimates for q_k^t by taking geometric averages of q_{fk}^t and q_{bk}^t with weights that vary as t varies. Thus, the blended estimates, q_{Bk}^t, are defined as:

$$(22) \qquad q_{Bk}^t \equiv [q_{fk}^t]^{(T-t)/(T-1)}[q_{bk}^t]^{(t-1)/(T-1)}; k = 1,\ldots,K; t = 1,\ldots,T.$$

Therefore, the weight on the forward estimate starts at 1 in period 1 and declines linearly with time until the weight becomes 0 in period T. The weights on the backward estimates move in the opposite direction. The above method for blending two alternative series for the same underlying variable is a variant of the geometric mean splicing method discussed by Hill and Fox (1997) ([11]).

Fortunately, we do not have to make a choice between the Diewert and Fox method and the blended method for interpolation as *both methods generate the same interpolated series*. To show this, we start with the definition of the period t blended volume series, q_{Bk}^t, given by (22):

$$(23) \qquad q_{Bk}^t \equiv [q_{fk}^t]^{(T-t)/(T-1)}[q_{bk}^t]^{(t-1)/(T-1)}; k = 1,\ldots,K; t = 1,\ldots,T;$$

$$= [q_k^1(Q_k^t/Q_k^1)]^{(T-t)/(T-1)}[q_k^T(Q_k^t/Q_k^T)]^{(t-1)/(T-1)} \text{ using (13) and (15);}$$

$$= [q_k^1(Q_k^t/Q_k^1)]^{(T-t)/(T-1)}[q_k^1(Q_k^T/Q_k^1)(a_k)^{T-1}(Q_k^t/Q_k^T)]^{(t-1)/(T-1)} \text{ using (21) for } q_k^T;$$

$$= q_k^1(Q_k^t/Q_k^1)(a_k)^{t-1};$$

$$= q_{DFk}^t \text{ using (20).}$$

Thus, the blended interpolated volume series, q_{Bk}^t, coincides with the Diewert and Fox interpolated volume series, q_{DFk}^t.

([11]) Hill and Fox (1997) blended together two series which provided independent estimates for the same economic variable by taking a geometric mean of the two series with equal weights for the two series. Here we take geometric means with linearly declining and increasing weights for the two series.

6. Interpolating the Diewert and Fox consistent-over-time-and-space price indexes

The blended method of interpolation used definitions (13) and (15) for $q_{fn}^{\ t}$ and $q_{bn}^{\ t}$. Instead of applying the blended method to these volumes, we can apply the blended method to interpolate price indexes using definitions (14) and (16) for the forward and backward extrapolated price indexes, $p_{fk}^{\ t} \equiv PPP_k^{\ 1}(P_k^{\ t}/P_k^{\ 1})$ and $p_{bk}^{\ t} \equiv (r^T/r^1)(1/Q_F^{\ T})PPP_k^{\ T}(P_k^{\ t}/P_k^{\ T})$. However, these price indexes are estimates for the underlying true price indexes, $\rho_k^{\ t}$, which are *proportional* to PPPs when t is held constant. It is usual for PPPs to be normalised, where say the Kth PPP is set equal to unity. Thus, we may use definitions (14) and (16) in order to define the following *normalised forward and backward extrapolated PPPs*:

(24) $PPP_{fk}^{\ t} \equiv p_{fk}^{\ t}/p_{fK}^{\ t}; k = 1,\ldots,K; t = 1,\ldots,T;$

$= PPP_k^{\ 1}(P_k^{\ t}/P_k^{\ 1})/[PPP_K^{\ 1}(P_K^{\ t}/P_K^{\ 1})]$ using (14).

(25) $PPP_{bk}^{\ t} \equiv p_{bk}^{\ t}/p_{bK}^{\ t}; k = 1,\ldots,K; t = 1,\ldots,T;$

$= (r^T/r^1)(1/Q_F^{\ T})PPP_k^{\ T}(P_k^{\ t}/P_k^{\ T})/[(r^T/r^1)(1/Q_F^{\ T})PPP_K^{\ T}(P_K^{\ t}/P_K^{\ T})]$ using (16);

$= PPP_k^{\ T}(P_k^{\ t}/P_k^{\ T})/PPP_K^{\ T}(P_K^{\ t}/P_K^{\ T})].$

Note that the forward and backward normalised PPPs defined by (24) and (25) can be defined using just the PPPs for periods 1 and T and the national price indexes $P_k^{\ t}$. Quantity or volume information is not required in order to calculate extrapolated PPPs.

Now we apply the blended method of interpolation to the normalised PPP series defined by (24) and (25). Thereafter, the *blended PPP estimates* for period t, $PPP_{Bk}^{\ t}$, are formed as:

(26) $PPP_{Bk}^{\ t} \equiv [PPP_{fk}^{\ t}]^{(T-t)/(T-1)}[PPP_{bk}^{\ t}]^{(t-1)/(T-1)}; k = 1,\ldots,K; t = 1,\ldots,T.$

This blended method for interpolating PPPs between benchmarks is equivalent to the Diewert and Fox method for forming interpolated PPPs, which is an attractive attribute given the intuitive logic of the Diewert and Fox method. Instead of the geometric mean as in (26), the method used in the Penn World Tables to interpolate between benchmark years is based on the use of arithmetic averaging of the extrapolated PPPs ([12]). Taking the geometric mean ensures that the results are invariant to the choice of base country, whereas this is not the case for the arithmetic mean.

Diewert (2018) illustrated how close the blended PPPs come to the annual series of country PPPs that are published by the OECD for the years 2001-2017. He also calculated the Diewert and Fox comparable-across-countries-and-time price and volume indexes for 36 OECD countries for the same years.

([12]) See Feenstra, Inklaar and Timmer (2015).

7. Conclusion

The Diewert and Fox method for forming real GDP for the world may be applied at any level of geographical aggregation provided that national price and volume indexes exist for the aggregate in question and provided that either annual or occasional benchmark PPPs are available for the aggregate. In the case of occasional benchmark PPPs, the Diewert and Fox blended method should provide reasonable estimates for PPPs for missing years.

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