Structural Reforms in France, 2013-2017

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Contact: Tomas Brännström

E-mail: GROW-A2@ec.europa.eu

European Commission
B-1049 Brussels

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Executive summary

Chapter 0. French competitiveness under scrutiny

1. The crisis has undeniably been a negative shock to manufacturing employment (Figure 0.3). The dynamic shows that between 2008 and 2013, the French manufacturing sector destroyed almost 500,000 jobs, which represents as much job destruction as in the previous – yet longer – period characterised by substantial growth. In fact, the surprise comes more from business services. While between 2000 and 2008, services created more than one million jobs, largely enough to absorb the jobs destroyed in the industry, job creation in services came to a halt after 2008. This may explain why currently, de-industrialisation has become much more difficult to tolerate than in previous years.

2. In the same vein, the evolution of the industrial production index (Figure 0.4) shows that Southern European countries – France, Italy and Spain – have a productive performance below the Eurozone average, whereas Germany had reached its pre-crisis level of industrial production by 2011. For France and its Latin fellow countries, the crisis has been more than a transitional effect; it appears as a "change in constant" that has permanently affected their general level of industrial production. In this respect, the aftermath of the crisis appears to be a major shift in the position of France, which is increasingly moving towards a service economy.

3. Whether de-industrialisation is an issue is subject to controversy. Some argue that what matters is specialisation in comparative advantages, irrespective of their industrial nature. Others object that manufacturing differs from other sectors of the economy because its health conditions the wealth of most other sectors in the economy. Manufacturing is a major consumer of business services and concentrates the largest share of both exports and business R&D investments (although services and the agro-food sector also contribute significantly to it). Hence, due to its pervasive role, de-industrialisation raises concerns about the vitality of the French economy.

4. Finally, the evolution of the French trade balance does not provide a more optimistic picture (Figure 0.5). The persistence of the French trade deficit suggests a sharp decrease in the competitiveness of French companies in international markets. While the recovery of the Spanish and Italian trade balance is mainly due to weak domestic demand (iAGS 2015, 2016), the growth in the gap between France and Germany casts doubt on the competitiveness of the French economy. In what follows, we examine the sources of this decrease and examine the role played by labour costs, productive investment, market strategies and finally barriers to the entry and growth of companies.

5. This preliminary analysis of the French productive system points to the following conclusions: (i) Labour costs. France has an hourly wage cost close to that of Germany. The problem in France comes from the wage differential in the business service sector because manufacturing industries are important users of business services. Wage moderation policies in Spain were established as a response to the financial crisis; (ii) Productive investment. The volume of investment, whether public or private, is not an issue. It is the nature of the investment that seems to be at stake. Business investment seems particularly geared towards real estate, because of high prices, rather than towards productive investments; (iii) Non-price competition. Private R&D investment by companies is significant but weaker than in the most innovative countries, such as Germany. Returns to the French tax credit

scheme in terms of business R&D seem unreasonably low with respect to costs borne by the taxpayer; (iv) Creative destruction. Overall, the common view a deficit of entrepreneurship exists in France is false. However, industrial turbulence has led to a failure to renew the productive system because, given their productive efficiency, incumbents are more likely to survive than new players This is similar to the findings of Bellone et al. (2008), who analyse market selection in French manufacturing in the nineties. The authors show that the determinants of firm survival depend upon firm age. The selection process is more severe for young firms because industry structures favour the survival of mature firms. Concerning the latter, markets select against persistent bad performers rather than temporary losses of efficiency. These results reveal the presence of barriers to firm growth – not to entry – as an important driver of industry dynamics in French manufacturing.

6. The combination of, on the one hand, the structural weakness of productive and private R&D investments and, on the other hand, increased price competition stemming from neighbouring countries such as Germany and Spain represents a real threat for the competitiveness of the French economy. Fiercer price competition from both the higher-quality end of the market (e.g., Germany) and the lower-quality end (e.g., Spain) casts doubt on the capacity of France to restore its competitiveness. Tax policies recently put in place (CICE, CIR) must translate into real gains in competitiveness, either via significant price reductions on the product market or via productive investments that modernise the French production system.

Chapter 1. General Characteristics of French Investment

7. The French gross fixed capital formation (GFCF) has been relatively higher than that of its key partners for the past 20 years. This is due essentially to the importance of investment in intangibles by French firms (R&D and software and databases). Investments in "machines and equipment" are less frequent than in other countries.

8. Firm investment appears to be considerably lumpy. Changes in aggregate investment are driven by the number of firms that simultaneously implement spike investment, that is, invest substantially relative to their own stream of investment. Fewer firms invest in intangibles.

9. Firm investment is highly concentrated in a few firms. Although we cannot formally prove it by comparing French figures with those of other countries, this could distinguish France from other EU countries. Specifically, in France, a high level of concentration of investment is combined with a type of investment (intangibles) that is concentrated in the hands of a few high-technology firms. Meanwhile, the share of investment in machines and equipment is declining.

10. The support of R&D through the generous R&D tax credit (CIR) must have positively impacted the increase in intangible assets. This policy was first implemented in 1984 and is one of the most stable and pervasive, i.e., diffused, policy schemes amongst both fiscal and innovation policies in France. Implementation of the R&D tax credit (Crédit d'Impôt Recherche, CIR) has undergone various changes. The new CIR implemented from 2008 onwards is certainly the most important. The reform has raised tax credit spending to approximately 6 billion euros per year. It is currently one of the three most generous R&D tax credits among OECD countries.

11. However, at the same time, it is possible that this stable tax incentive has been detrimental to tangible investment, notably in machines and equipment, and has favoured the offshoring of physical capital through an increase in outward FDI. This is why the tangible investment did not increase much both at the firm level and at the aggregate level. The R&D tax credit has certainly introduced a bias towards intangible assets; firms may have invested in R&D and software much more than

they would have done without the credit. As will be shown in the following chapters, this has not led to leadership in competitiveness, as we would expect, which is also a sign of overinvestment. In this respect, supporting R&D without an upper boundary must be questioned.

12. The capital tax reform implemented by the government under President Macron is a way to rebalance the taxation of tangibles versus intangibles. However, the production capacity, which needs tangible investments, will not be easily rebuilt, while the skills that are necessary for physical production have also disappeared. Moreover, the lumpiness of investment implies that the consequences of a change in tax incentives can take time. For a better understanding of the distortion of taxation, capital taxation should be envisioned globally by considering both tangible and intangible assets.

13. Investment lumpiness appears to be a hindrance to the successful implementation of public policies aiming to support capacity and replacement investments by firms. Such investment inevitably suffers from inertia and stickiness, and because such decisions are strategic, investment by firms is highly firm specific. This is why we believe that investment is likely to be less sensitive to public support. We cannot expect a rise in tangible investment as an immediate response to Macron's tax reforms. This conclusion should not be specific to France, as investment lumpiness is a pervasive phenomenon across countries.

Chapter 2. The Lag Structure of Investment and Productivity Growth

14. The chapter The Lag Structure of Investment and Productivity Growth calculates lag structures for three types of investment: tangible assets, intangible assets, and information and communication technologies (ICT). In a production function framework, investment with a distributed lag structure is substituted for capital stock. The lag structure is modelled as a Poisson-distributed lag in a two-stage regression. The data stem from the Groningen EU KLEMS project. They are country-level data and offer the possibility of distinguishing different types of investments. The analysis focuses on 12 countries of the European Union: Austria, Belgium, the Czech Republic, Denmark, Finland, France, Germany, Italy, Netherlands, Spain, Sweden, and the United Kingdom.

15. The basic model suggests a general lag structure of approximately 8 to 9 years until the maximum effect is achieved for all tangible investments; for intangible assets, it is approximately 12 years and for ICT, it is approximately 14 years. France, mid-ranked in terms of innovativeness according to the European Innovation Scoreboard (ESB), appears to invest more than Germany per euro of value added but does not succeed in achieving the same return on investment. By the latter, we mean the marginal product of current and past investments, as is assessed in our structural-lag model.

16. Firms in France invest more than twice as much in intangibles as firms in Germany, although intangibles appear to be the least productive type of investment. When assuming that France invests as much as Germany in terms of magnitude and structure, the calculated scenarios show that France, by aligning its investment structure with that of Germany (in terms of tangible, intangible, and ICT investments), could gain up to 3.5% in output. When reducing its investment intensity to the German level, France could even compensate for the loss in output by the gain in a restructured investment portfolio.

17. The relatively low productivity of investments in intangibles, combined with the relatively high public R&D support, indicates that France's investment policy is

questionable. Public support leads firms to invest excessively in intangibles compared to firms in other, more successful countries such as Germany. Generous tax incentives do not appear to pay off, according to our study. Various evaluations of the CIR seem to question the effectiveness of the tax incentives.

Chapter 3. Private Response to Local Public Investment

18. The 2008 crisis revived the discussion about the effectiveness of fiscal policies. This discussion rapidly focused on the magnitude of fiscal multipliers with three main results: (i) such multipliers are larger than was previously thought; (ii) the multipliers are larger when the economy is far from its potential; (iii) the multiplier of public investment is larger than the multiplier of overall government expenditure, and the latter is, in turn, larger than the multiplier of taxation. Therefore, the question of returns on public investments is an important matter that must be quantified. In this chapter, we aim to document how private firms react to public investment in a spatial framework.

19. The chapter uses individual firms' financial statements to build a database on private investment at the department level for France; this is used, together with a newly built database on public investment and capital, to assess the impact of public investment on private investment at the department level. The data highlight the very strong spatial concentration of both private investment and private capital stock, which in turn reflects the spatial concentration of economic activity in France. Total factor productivity follows a similar spatial pattern. Furthermore, over the past decade, the heterogeneity of private investment has increased, albeit less than public investment heterogeneity. By heterogeneity, we mean the standard deviation of investments across departments, thereby focusing on the issue of sigma convergence and/or divergence.

20. The chapter constructs a spatial matrix describing the links between French departments. The matrix captures both economic similarity and physical contiguity. The matrix is used to assess spillovers among departments. Using different spatial models, the chapter shows that public infrastructures (public capital stock) significantly increase private investment but that public investments are not able to do the same. In simple terms, firms are more sensitive to public infrastructures (past public investment) than to current public investments. Similarly, private capital stock drives private investment, pointing to cumulative and self-reinforcing effects.

21. Finally, in terms of spatial dependency, private investment has positive effects on neighbouring departments, but the same cannot be said for public investment or public capital. This positive spatial dependency suggests that without policy intervention, the clustering of private investment activities will be further reinforced. The chapter concludes with the policy implications of the analysis: as public capital stock has a clearer impact than public investment, efforts should be devoted to building a more uniform capital stock across regions.

Chapter 4. The Micro-foundations of Aggregate Productivity

22. The Micro-foundations of Aggregate Productivity develops two measures of firm-year-specific productivity and evaluates the aggregate changes in productivity growth before and after the 2008 financial crisis. Additionally, it accounts for the micro-determinants of these aggregate changes with the help of aggregate productivity decompositions. The index number approach to total factor productivity (TFP) is chosen as the preferred measure of productivity.

23. The report uses dynamic Olley-Pakes decomposition to aggregate productivity changes over the 7 years preceding and following the 2008 crisis. This allows an

assessment of the extent to which productivity changes at the aggregate level come from changes in the efficiency with which firms use technology and from changes in the efficiency with which the market assigns resources among firms and to what extent these changes are driven by firm entries and exits.

24. We use the French administrative firm-level data: FICUS-FARE provides information on firms' balance sheets collected by the French national statistical agency, the INSEE. These allow coverage of the entire universe of French firms over 2001-2015.

25. We find a productivity growth slowdown after the financial crisis, with TFP growing at 10.7% between 2001 and 2007 and at 6.8% between 2009 and 2015. Aggregate changes were mainly due to between-firm reallocation of market shares among surviving firms. This term tended to become stronger after the crisis, which means that allocative efficiency improved after 2008. Nonetheless, this may also indicate that markets became more concentrated after the financial turmoil. The contribution of the technical efficiency term was relatively small, and it tended to become negative after the crisis. The contribution of new firms in the market had an almost invariably negative effect on aggregate productivity after the crisis. This is possibly explained by the relatively low interest rates that prevailed after the financial crisis, allowing relatively low-productivity firms to enter the market.

26. Possible policy conclusions from this chapter may include improving market selection given the negative contribution of new firms in the market to aggregate productivity. In addition, policies promoting faster adoption of technology should be implemented, given the negative contribution of within-firm efficiency to aggregate changes in productivity. Although such policies are not easy to define, recent efforts by the French government to restore firm margins and favour investment can be perceived as policies that will eventually lead to wider adoption of new technologies;

27. The fact that we find an improved allocative efficiency together with a productivity growth slowdown may open new research questions evaluating the limits of the concept of allocative efficiency, understood as the process by which an increasing amount of resources goes to the most productive firms. If all production goes to the single most productive firm, a perverse effect of allocative efficiency would be to limit the positive effect of increased competition on firm behaviour.

Chapter 5. Firm-Level Productivity Distributions and Labour Market Outcomes

28. This chapter brings detailed information regarding the relevant aspects of the dynamics of the heterogeneity of French firms and its links with the labour market. More particularly, we evaluate job creation, wage differences across firms, the way in which value added is shared among workers and shareholders and the relative importance of skilled jobs for total employment.

29. We evaluate for different periods, before and after the 2008 crisis, i) distributions of firm productivity (cumulative distribution functions); ii) differences in (value added) weighted mean productivity and simple productivity averages; and iii) quartiles of firm productivity levels, and we relate them to the labour market variables mentioned in the previous paragraph. This report measures firm productive efficiency by means of total factor productivity (TFP).

30. We use the French administrative firm-level data: i) FICUS-FARE on firms' balance sheets and ii) DADS matched employer-employee data, providing detailed information on the firms' workforce. These data are collected by the French national statistical agency, the INSEE, and cover the entire universe of French firms over 1997-2015.

31. Firms that are more productive have larger market shares. In other words, the weighted average of TFP – weighted by market shares – is systematically higher than the simple arithmetic mean. This is particularly true after the financial crisis in 2008. The wedge between the weighted and the arithmetic mean was relatively small in 1997, and it became substantially larger over time, with an initial difference of 4.1% and a final gap of 24% in 2015. This divergence is the result of a clear positive trend of the weighted average TFP and a negative trend of the unweighted average TFP, suggesting a negative and permanent shock of the crisis on the average firm.

32. Heterogeneity in firm TFP distributions substantially increased after 2008. This is mainly due to the bottom of the distribution. Firms at the upper end of the TFP distribution appear to create more jobs (on net) than those in the other quartiles, while firms at the bottom appear to destroy jobs (on net). Firms in the top quartile also create more skilled jobs and have relatively higher skilled labour shares. Additionally, they pay higher wages on average and yet have a lower labour share in value added.

33. Two competing forces have been driving changes in aggregate labour shares (and therefore, changes in inequality between workers and shareholders) since 2008. On the one hand, firms increasing their market shares have a lower labour share in value added. On the other hand, over time, firms at the top of the TFP distribution have increased their average labour shares since the crisis. Despite the positive trend for the top productive firms, their average labour share remains largely below that observed for the rest of the firms.

34. Wage gaps between the top and bottom firms progressively increase. Thus, wage inequality between workers has been influenced by increasing differences between firms. All these trends echo several recent findings in the literature that relate market concentration to the aggregate productivity slowdown and inequality – both between workers and between factors of production (labour versus capital).

35. A clear policy implication arising from our findings and the recent literature is the need to tackle market concentration to increase competition among firms. In this respect, France seems to perform poorly in terms of competition on the product market.

Chapter 6. Firm Survival and Growth under Foreign Competition

36. This chapter aims to empirically investigate the way in which foreign competition affects firm survival and growth in terms of number of employees. It also explores how this relation may be altered by the availability of skilled labour in house. Multinomial logit models consider four types of outcome: (1) exit, (2) survive and contract, (3) survive at a constant size, and (4) survive and expand. A host of explanatory variables, including skilled labour and import penetration from OECD countries, low-wage countries and China, explains these outcomes.

37. In addition to firm-level data, we mobilise DADS-matched employer-employee data, providing detailed information on the firms' workforce, and customs data, providing detailed information on firms' international trade (imports and exports). These data are collected by the French national statistical agency, the INSEE, and cover the entire universe of French firms over 1997-2015.

38. Skilled labour is positively related to firm survival and growth and decreases the probability of contraction and of exiting. Importantly, there is an optimal level of share of skilled labour beyond which additional increases are related to higher probabilities of exiting and of contraction compared to survival with no expansion. The share of skilled workers is always related to a higher likelihood of expanding.

Therefore, increasing the share of skilled labour goes hand in hand with growth. Increased shares of skilled labour with growth eventually threaten firm survival.

39. We find competing effects of import penetration on firm exit and survival likelihoods. These stem from stronger competition pressure (pushing firms out of the market to downsize employment or preventing them from expanding) as well as from the "supply channel" (decreasing exiting and contraction probabilities and increasing expansion probabilities).

40. We find a clear pattern between the conditional effect of import penetration and shares of skilled labour, where human capital increases the firm's ability to cope with foreign competition (decreasing the probabilities of firm exit and contraction and increasing that of expansion). This is particularly true for import competition from OECD countries and from China. Although the effect is not significant, higher shares of skilled labour may translate into higher exit and contraction probabilities for some firms in facing competition from low-wage countries.

41. A policy conclusion is to support human capital creation, as it allows firms to better cope with international competition and integrate into global value chains, which seems to be an auto-reinforcing force. What counts is to climb the quality ladder across all sectors, whether manufacturing or not, and not necessarily to focus on high-tech industries. High-technology competition cannot be reduced to a choice in sectors but is pervasive across all sectors, although some sectors are coined as low-tech sectors. In our opinion, such a policy cannot economise on human capital and skilled labour. Nonetheless, attention is required for firms under exit threat, given other firm specificities, where increases in the firm wage bill burden or excessive management of non-skilled workers may push the firm out of the market.

Chapter 7. Workforce Composition, Trade Costs and Margins of Trade

42. This chapter investigates the relationship between workforce composition, cultural distance and the intensive and extensive trade margins of French firms. By trade margins, we refer to the increase in overall exports stemming either from new firms becoming exporters (the extensive margins of trade) or from an increase in the volume of exports by established exporters (the intensive margin of trade). To explore this relationship empirically, we conduct a firm-destination-level analysis using data on French firms' exports to 72 trading partners during the 2000-2015 period and rely on two different measures of cultural distance.

43. We rely on a theory-consistent estimation of the gravity model of trade (Chaney, 2008) in which the dependent variables are the value of exports (in logs) at the destination level, the number of products (in HS4) exported by a firm at the destination level, and a dummy variable for positive trade flows into a certain destination market. We estimate the gravity model of trade using ordinary least squares (OLS) for the period 2000-2015.

44. First, the chapter brings together several firm-level databases: the French customs data for exports at the firm-product-destination level, the FICUS and FARE databases provided by the INSEE for accounting and performance variables at the firm level, and the DADS data for information on workforce composition at the firm level. Second, the chapter relies on country-level databases: the WDI for information on GDP and population and the GeoDist and Gravity databases provided by the CEPII for information on gravity variables. Third, it uses the cultural distance database provided by Spolaore and Wacziarg (2016) and the linguistic proximity database from Melitz and Toubal (2014).

45. The baseline model shows that workforce composition, reflecting skilled labour, has a significant impact on both the intensive and the extensive margins of trade of French firms. First, firms with a higher share of skilled workers have a higher probability of exporting, exporting more products, and recording higher values of exports. Second, hidden sources of trade frictions, such as cultural differences between countries, negatively affect firms' exports. Third, the results highlight that the higher the share of skilled workers, the lower the negative effect of cultural distance on firms' exports.

46. In terms of policy recommendations, learning more than one foreign language, especially the languages of trading partners, could reduce frictions related to language and ease communications between French firms and their trading partners. Second, the development of a "culture" in international business that eases exporting activities requires skilled workers. It is, therefore, important to upgrade the skills of the French workforce by investing in primary and tertiary education.

Chapter 8. International Trade, Skilled Labour and Rent Sharing

47. The chapter estimates market imperfections in both the product and labour markets. Apart from providing measures of price-cost margins at the firm-year level, it distinguishes between firms that take the wage rate as given (wage taker), firms that enjoy monopsonistic power on the labour market, and companies that engage in rent sharing with their workers. Using a large sample of French manufacturing firms, it reveals substantial heterogeneity in firm-year-specific market imperfections across and within industries.

48. We focus on firms classified into an efficient bargaining regime, where workers enjoy significant bargaining power. The methodology we have adopted allows for the estimation of rent sharing between firms and workers. The chapter investigates how globalisation has affected the bargaining power of workers in an industrial economy such as France. Measures of import competition from different countries shed light on the role played by collective bargaining as a mechanism that links firm performance to earnings and, as a consequence, on the relationship between trade, wages and the labour share of income.

49. We have found that when controlling for a number of firm-level characteristics, such as productivity and size, import competition has a heterogeneous effect on workers' bargaining power, depending on both the source of imports and the characteristics of the firm in terms of skilled labour. Overall, our results can be summarised as follows: (i) the effect of OECD competition is always positive but starts to become weaker after the crisis, especially for firms with a larger share of skilled labour; (ii) low-wage countries have a positive impact on rent sharing, mainly because the strategy of French manufacturing firms is to avoid competition from these countries, thereby increasing their share of skilled labour; (iii) Chinese imports drive rent sharing down after the crisis; (iv) workers in high-technology sectors are immune from foreign competition; and (v) the effect of the crisis has globally worsened rent sharing.

Chapter 9. Policy Recommendations

Policy recommendation 1. Excessive concentration is likely to exert excessive market power on companies. As of 2013, France remains a highly regulated economy (see Figure 9.1) that suffers from excessive state control and excessive barriers to entrepreneurship.[1] These features hamper competition by protecting incumbents from

[1] State control includes public ownership of businesses and state involvement in business operations. Barriers to entrepreneurship include complexity of regulatory processes, administrative burdens on startups, and regulatory protection of incumbents. Barriers to trade and investment concern explicit barriers to trade and investment and other barriers to trade and investment. See Pratx and Daoudi (2017).

sheer competition by new players in the product markets. Hence, chief policy recommendations should aim to restore competition in product markets to limit the drawbacks of excessive concentration. Increased market concentration is a problem because it limits production and leads to diminished labour demand and higher markups and hence higher prices, which in turn lower the final demand and diminish social welfare. Overall, we view Macron's set of reforms as proceeding in the right direction to cope with this global trend.

Policy recommendation 2. The generosity of the French tax cut for R&D spending must be questioned. Although we encourage policies that aim to spur investments in R&D to encourage firms to enter into non-price competition, the sharp reduction in corporate taxes proportional to total investment in R&D gives rise to opportunistic behaviour by firms to artificially increase their overall R&D investments. This, in turn, significantly decreases both the efficiency of the R&D tax credit and the productivity of R&D itself. The efficiency of the CIR has been challenged in a series of statistical evaluations. First, tax reduction corresponding to the marginal increase in R&D has been shown to be more efficient in leveraging R&D investments. Second, in order for knowledge to be diffused more widely across public and private research organisations, a tax reduction corresponding to public and private research collaborations could be envisaged.

Policy recommendation 3. Basic education must be improved to counter the reduction of the relative position of French students in international comparison. The first issue that must be addressed is learning achievement inequalities. One way to solve the problem is to focus means on primary schools, as we have observed that secondary and tertiary schools fail to decrease inequalities. Therefore, the split in classes of the first year of primary school in poor areas (REP+) launched in 2017 by the government is a measure that moves in the right direction. However, it should not be at the expense of other areas and should be reflected by an increase in the stock of teachers and a real decrease in the teacher/student ratio in France. Furthermore, an extension of the measure to other areas (e.g., REP or other poor areas) should also be a way to achieve a decrease in school inequalities. Finally, teachers should be offered inducements, for example, higher wages, to work in poor areas.

Policy recommendation 4. Access to training via life-long learning must be facilitated for both employed and unemployed people. This implies a reform of the actual personal training account (Compte Personnel de Formation (CPF)), which appears far too complex. The reform presented by the French minister of labour, Muriel Penicaud, in March has strong implications for the French labour markets. First, systematic certification will be a means to increase the quality of training that is proposed for both employees and unemployed individuals. Second, the transformation of the personal training account (CPF) credited in euros rather than hours will decrease inequalities in training since training hours are more expensive for white-collar than for blue-collar workers. Our own assessment leads us to remain sceptical about the reform. First, this personal account, amounting to 500 euros for employees and 800 euros for the unemployed, remains low, especially because training prices are increasing. Second, the reform itself could be insufficient, and other forms of training should be developed, especially online training, which currently remains underdeveloped.

Policy recommendation 5. As the number of students has strongly increased over the past ten years and the budget devoted to tertiary education is stagnating, tertiary education must be fostered. It is therefore important for the government to increase public spending on tertiary education or to foster the private funding of tertiary education. The *Parcoursup* reform that is currently underway is far from sufficient to achieve the skills upgrading of students.

Policy recommendation 6. Beyond the supply of human capital, skills upgrading also concerns the series of teachers from primary through tertiary education. Access to training via life-long learning must be re-thought to encourage innovation in teaching and interactions amongst teachers and disciplines.

Policy recommendation 7. In addition to tertiary education, efforts must be made to improve managerial practices and economic literacy, as France performs rather low in both of these items. Although we are not sure how to improve such economic literacy, greater access to economic literacy could improve the social dialogue, management practices and awareness of the basic principles of a market economy. Moreover, substantially increasing union density should facilitate social dialogue by making unions more oriented towards the search for compromise.

Policy recommendation 8. We firmly believe that France must re-industrialise. First, manufacturing represents the bulk of investment in machines and equipment. Hence, re-industrialising is tantamount to modernising the supply side of the economy. Second, manufacturing industries represent more than 70% of overall private R&D investments and 70% of exports. If the country wants to restore its (non-price) competitiveness and its current account balance, it must contain de-industrialisation and identify industries in which a clear comparative advantage exists. Third, manufacturing sectors are important consumers of services, whether high-technology (R&D, marketing, engineering, etc.) or low-technology services (mainly back office). Re-industrialisation would increase private demand for such services. Fourth, France must keep strategic productive competencies in-house. We believe that separating production from such upstream activities with high value added may further weaken both the R&D end and the production end of the spectrum due to the permanent need for a two-way stream of ideas and competencies. Fifth, investments in sectors that generate externalities by diffusing them over the whole productive system must be encouraged. We mainly consider sectors such as energy, transportation, aeronautics, pharmaceuticals and, more generally, health. The absence of a strong French actor, and even a European leader, in digital business is likely to be harmful in the future.

PART 0
French Competitiveness under Scrutiny

CHAPTER 0

French Competitiveness under Scrutiny

Lionel Nesta, OFCE, University Nice Sophia-Antipolis, France

0.1 Setting the Scene

A decade after the 2008 economic crisis, economic recovery is far from accomplished in many European countries (OFCE 2016*a*). Growth differentials across countries persist, between, for example, the United States, which quickly recovered its pre-crisis production level, and a part of the European continent, which persistently lags behind. Within the Eurozone, Germany, exemplified for its exceptional performance in terms of job creation, manufacturing production and exports, contrasts with the countries of southern Europe (Blot et al. 2015). France in particular is still struggling to find a sustainable growth path; its unemployment rate remains high, and imbalances in the public and current accounts remain worrisome (iAGS 2015, 2016).

French economic recovery requires a competitive productive system. In what follows, we first examine the French economic performance relative to other major economies and then compare the price and non-price competitiveness of the French economy with those of three Eurozone countries, namely, Germany, Italy and Spain.[2]

A key feature of the French economy is the pronounced trend towards de-industrialisation and the associated servitisation. In 2013, the secondary sector accounted for 19% of the French GDP, and the manufacturing industry in particular[3], the one mentioned in discussions of de-industrialisation, represented approximately 11% of GDP (Figure 0.1). Services, including public services, accounted for approximately 80% of GDP. By comparison, in 2013, the manufacturing industry accounted for 22.6% in Germany, 15.3% in Italy, 13% in Spain and more than 16% in the Eurozone. The United Kingdom (10.5% in manufacturing) and the United States, both well known for financial services and high value-added services, exhibited a sectoral composition close to that of France. Japan had a vigorous industry, accounting for 18.5% of its GDP.

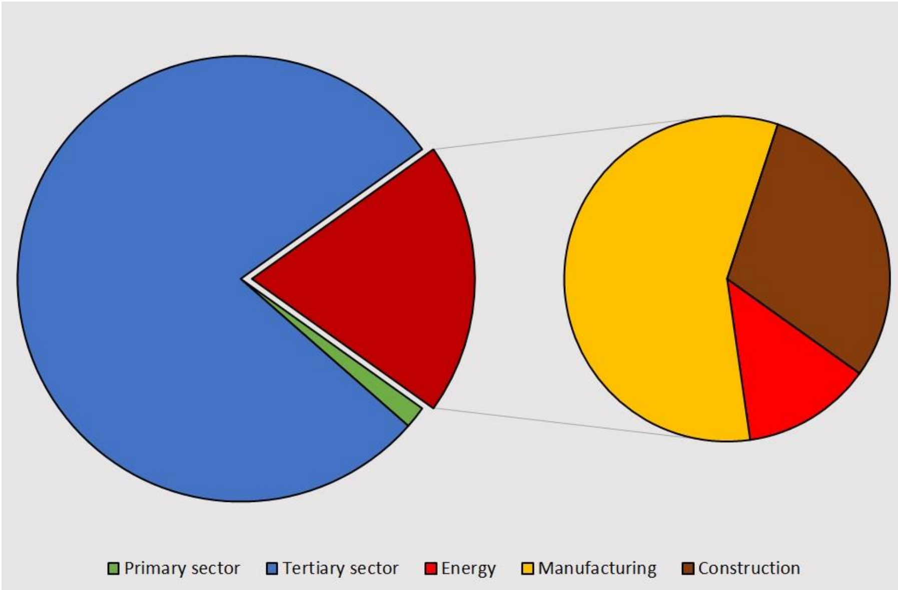
If we compare structural change in France and in its main economic partners (Figure 0. 2), we observe that de-industrialisation is occurring for all countries, and they are gradually moving towards a service economy. France is the only country to see a decline in both manufacturing and market services. This decline was offset by a corresponding increase in services in the economy.

Changes in the structure of value added imply similar shifts in the structure of jobs. For example, Guillou and Nesta (2012) note that between 1992 and 2008, France and Germany witnessed a 21% drop in manufacturing employment, and the United Kingdom and Japan experienced decreases of 31% and 28%, respectively. Meanwhile, the United States experienced a decrease of 18% and Italy 6%. These percentages conceal huge volumes of lost jobs. While France was destroying almost 900,000 jobs in manufacturing, Germany lost more than 2 million, the United States 3.3 million and Japan 4.3 million (OECD 2016).

[2] This part draws heavily on OFCE-DRIC (2016). Other benchmarks, such as the EU or the euro area, could also be used.

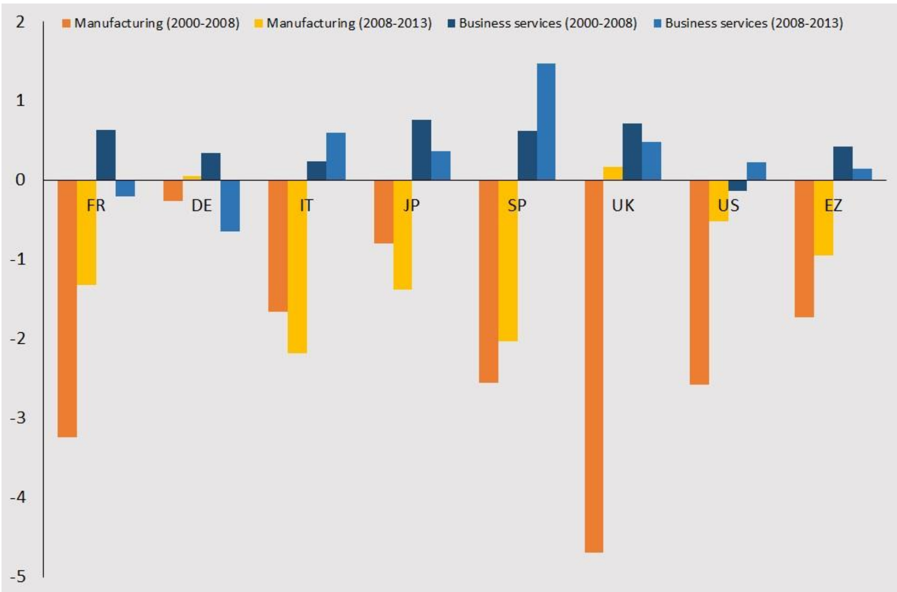
[3] The secondary sector includes energy, construction and manufacturing.

Figure 0.1: Composition of the French economy in 2013



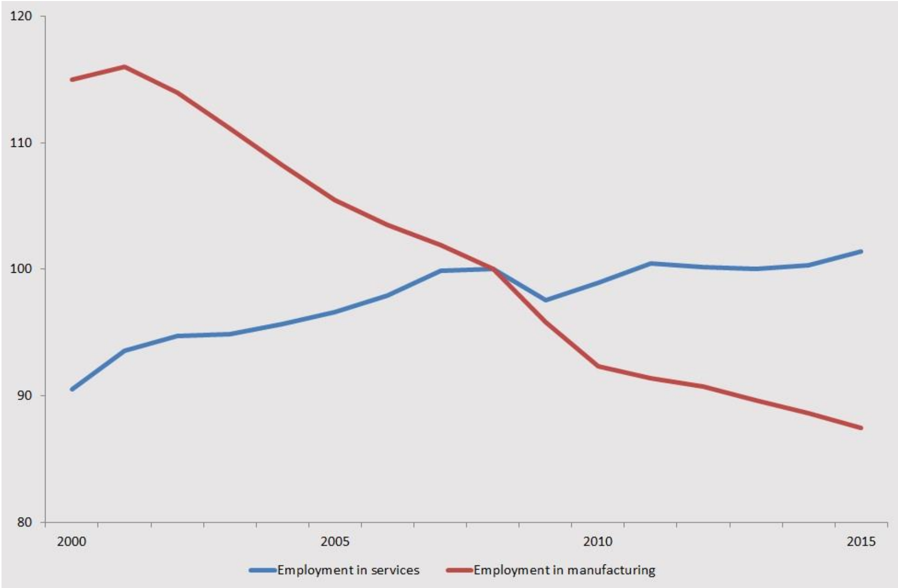
Source: OECD. Author's own calculation.

Figure 0.2: Structural change between 2000 and 2013 in selected OECD countries



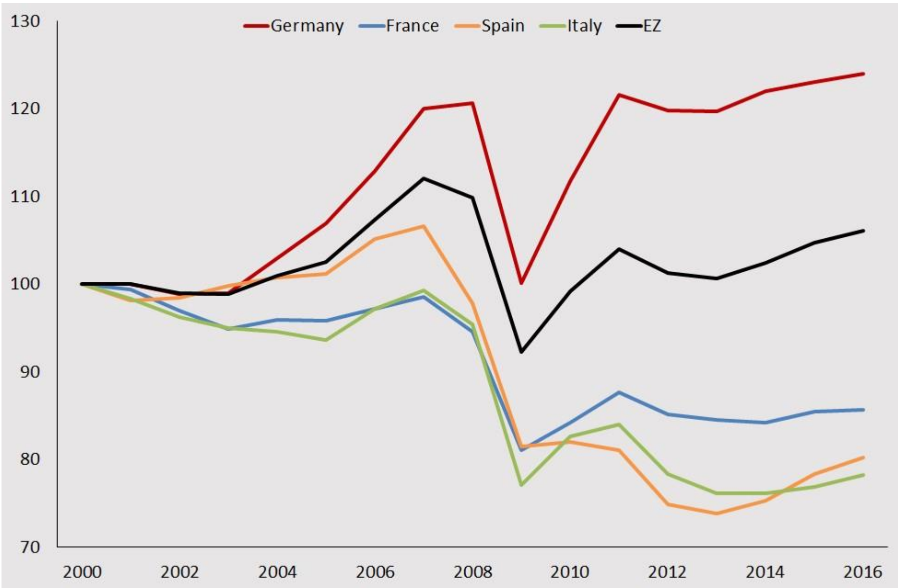
Source: OECD. Author's own calculation.

Figure 0.3: Employment dynamics in manufacturing and in services in France



Sources: INSEE. Author's own calculation. 2008 = 100.

Figure 0.4: Industrial production (excl. construction) in major Eurozone countries



Source: Eurostat. Author's own calculation. 2008 = 100.

The crisis has undeniably been a negative shock to manufacturing employment (Figure 0.3). The dynamic shows that between 2008 and 2013 only, the French manufacturing sector destroyed almost 500,000 jobs, which represents as much job destruction as in the previous – yet longer – period characterised by substantial growth. In fact, the surprise comes more from business services. While between 2000 and 2008, services created more than one million jobs, largely enough to absorb the jobs destroyed in the industry, job creation in services came to a halt after 2008. This may explain why de-industrialisation has become even more difficult to tolerate today than before.

In the same vein, the evolution of the industrial production index (Figure 0.4) shows that Southern European countries – France, Italy and Spain – had a productive performance below the Eurozone average, whereas Germany reached its pre-crisis level of industrial production by 2011. For France and its fellow Latin countries, more than a transitional effect, the crisis appears as a "change in constant" that has permanently affected the general level of industrial production. In this respect, the aftermath of the crisis appears to be a major shift in the position of France, which is increasingly moving towards a service economy.

Whether de-industrialisation is an issue is subject to controversy. Some argue that what matters is specialisation in comparative advantages, irrespective of their industrial nature. Others object that manufacturing differs from other sectors of the economy because its health conditions the wealth of most other sectors in the economy. Manufacturing is a major consumer of business services[4] and concentrates the largest share of both exports and business R&D investments (although services and the agro-food sector also contribute significantly to it). Hence, due to its pervasive role, de-industrialisation raises concerns about the vitality of the French economy.

Finally, the evolution of the French trade balance does not provide a more optimistic picture (Figure 0.5). The persistence of the French trade deficit suggests a sharp decrease in the competitiveness of French companies in international markets. While the recovery of the Spanish and Italian trade balance is mainly due to weak domestic demand (iAGS 2015, 2016), the growth in the gap between France and Germany casts doubt on the competitiveness of the French economy. In what follows, we examine the sources of this decrease and examine the role played by labour costs, productive investment, market strategies and finally barriers to the entry and growth of companies.5

0.2 Labour Costs

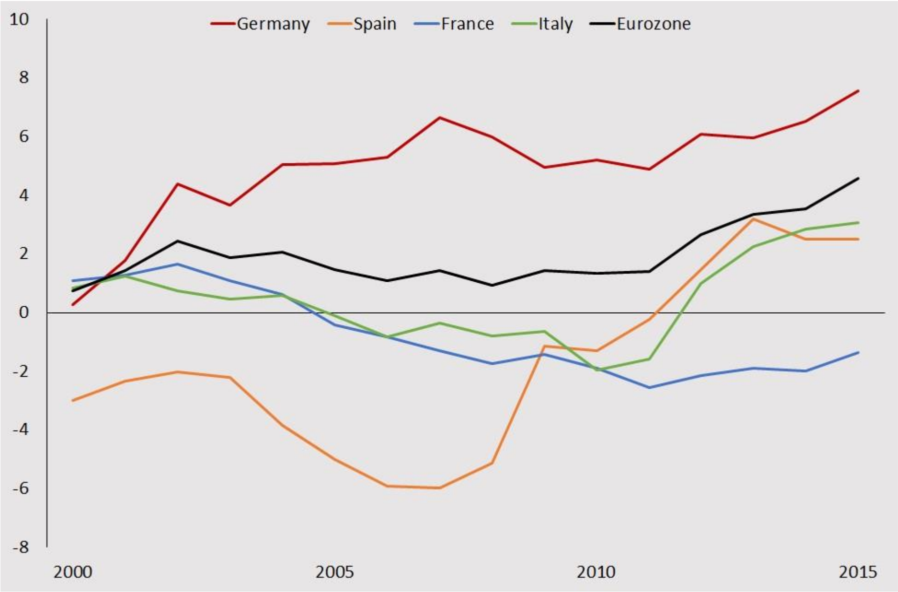
The question of labour costs is at the heart of the supply policy that aims to improve the margins of companies, to improve price competitiveness in international markets and finally to motivate the hiring of new workers whose labour costs may exceed their marginal productivity.

France is characterised by a high hourly cost relative to its trading partners (Table 0.1). In their comparison of labour costs in Europe, Borey et al. (2015) observe that the dispersion of hourly labour costs between countries is not well explained by equivalent differences in sectoral composition. Hence, it is mainly institutional reasons and wage dynamics, not sector composition, that explain differences in labour costs between countries. Moreover, among the four countries, France has the highest share of employers' contributions (Heyer 2015).

[4] The consumption of business services by manufacturing amounts to merely 80% of the wage bill of manufacturing, as is revealed by input-output tables for 2014 (INSEE sources). More specifically, the consumption of business services by manufacturing firms amounted to 105 billion euros, with a wage bill of 135 billion euros. Moreover, the reverse does not hold since the consumption of manufactured products by business services amounts to 17% of the wage bill.

5 The goal of this chapter is not to make a list of policy recommendations, which is done in Chapter 9.

Figure 0.5: Trade balance in major Eurozone countries



Source: Eurostat. Author's own calculation. % of GDP.

Table 0.1: Wage costs, employer costs and labour productivity in manufacturing and business services

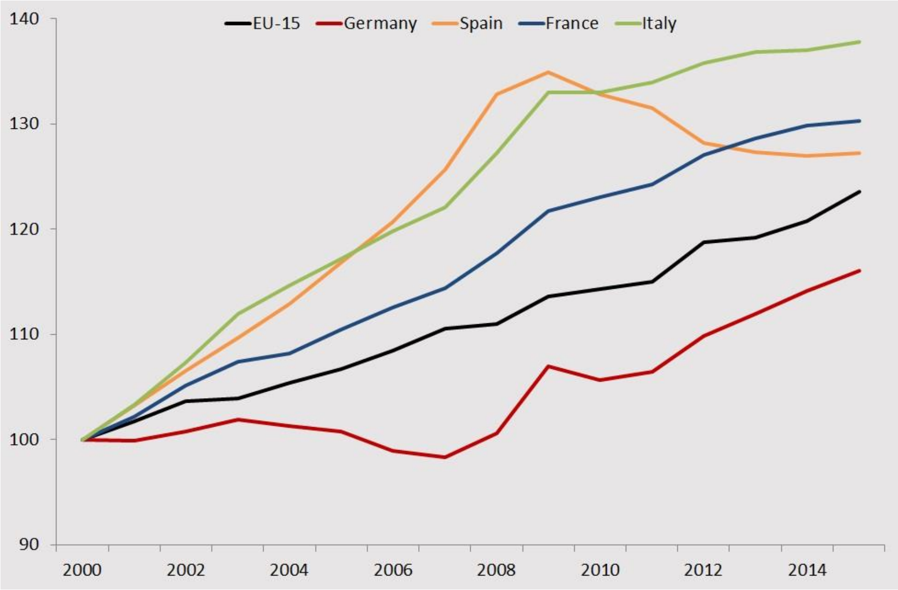
Countries	France	Germany	Spain	Italy
Labour costs	34.8	30.9	20.9	26.6
Share of employer's costs	33%	21%	27%	29%
Labour productivity	64.8	64.4	51.2	51.5

In euros per hour for labour costs. In value added per hour for labour productivity. Sources: INSEE & OECD.

According to the Macroeconomic Policy Institute (Herzog-Stein et al. 2016, IMK), the hourly labour cost in France exceeds that in Germany (which has stabilised at 32.7 euros). Under Hollande's administration, hourly labour costs rose from 2011 to 2014 and then stabilized.6 Importantly, it is the cross-sectoral wage gap that seems to be at stake. In German business services, the hourly wage cost is 8 euros lower than in the manufacturing sector (30 euros and 38 euros, respectively). In France, this gap is 1.40 euros (35.6 in services as opposed to 37 euros for manufacturing). Because manufacturing companies are large consumers of business services, this cross-country inter-sectoral gap seems decisive for the German competitive advantage. The gain in price competitiveness for German goods is not entirely located within the manufacturing sectors but partially stems from competitive – *cheap* – services. Le-Moigne and Ragot (2015) show that wage differences in the service sectors of France and Germany could account for almost half of the trade divergence between the two countries.

6 Although we do not formally show it, our view is that this is probably the result of various measures such as the CIR and the so-called "simplification shock" to decrease labour costs and reduce the administrative burden for companies.

Figure 0.6: Unit labour cost in major Eurozone countries (2000 = 100)



Source: Eurostat. Author's own calculation.

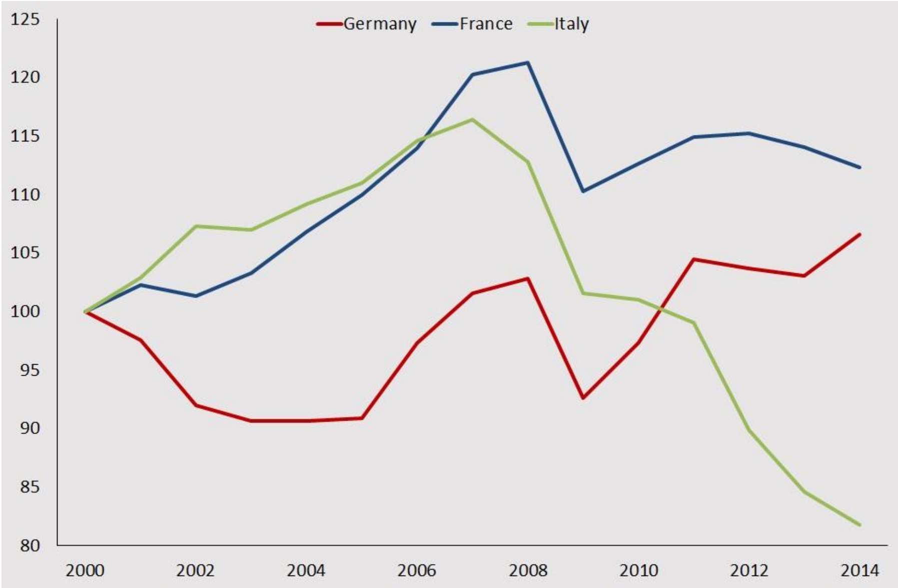
Figure 0.6 displays the evolution of the unit labour cost, defined as the hourly wage cost relative to hourly labour productivity. Before the crisis, the wage moderation practised by the Schröder government singled out Germany vis-à-vis its European neighbours (Dustmann et al. 2014). However, with the onset of the crisis, German unit labour costs started to catch up, first because of the transient decline in labour productivity and then because of the introduction of the minimum wage. Spain exhibited a converse dynamic with major wage adjustments. With the French and Italian persistent increase in unit labour costs, the overall picture is one of convergence of unit wage costs between France and Germany.

Overall, France's problem comes from a higher labour cost in manufacturing and essentially in market services, with the latter being an important input into the manufacturing industry. This may explain the loss of competitiveness of French exports, which, being in the same markets as those of Germany, mechanically lose their international competitiveness.

0.3 Investments

A usual suspect in the decline of French competitiveness is productive investments. However, in the manufacturing sector, in contrast to profit margins, exports and/or employment, investment is maintained. The persistence of investment while profit margins decline suggests that the credit crunch did not have a major impact in France. The fall in the cost of financing as well as all policies supporting investments such as the Crédit d'Impôt Recherche (See INSEE 2013 Business Survey) offset the scarcity of banking resources stemming from the financial crisis, if any. Working with firm-level data, Kremp and Sevestre (2013) do not find that credit constraints affected investment during the crisis, even for smaller firms.

Figure 0.7: Volume of investments in France, Germany and Italy



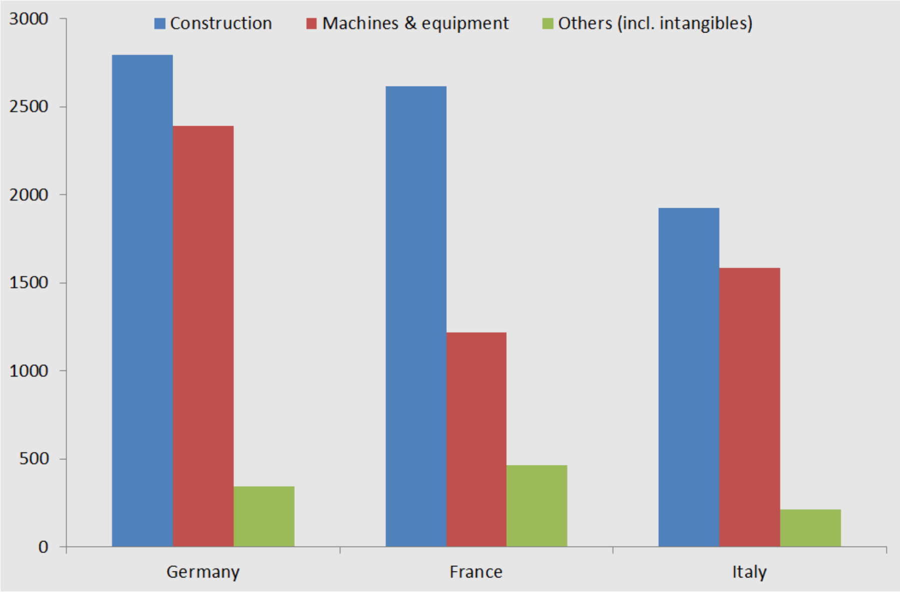
Source: Eurostat. Author's own calculation. 2000 = 100.

Together with a high level of investment (Figure 7), the French decline in competitiveness is puzzling. Hence, more than the level of investments, the lack of relationship between investment and productivity growth may stem from the nature of investment. Figure 8 breaks down the overall investments accumulated since 2000 in three components: machinery and equipment, construction and intangibles. The distinctive feature of France relative to other countries is that it exhibits over-investments in construction. The share of investment in machinery and equipment (including robots) is significantly higher in Germany and Italy (43% for both countries) and only 28% in France, while the share of investments in construction reaches 61% in France.

The sectoral composition of investment in France further confirms the prominence of the real estate sector in overall investments. Napoletano et al. (2015) show, for example, that the real estate sector has played a considerably more important role than the manufacturing sector. Aglietta and Ragot (2015) stress the high level of real estate prices in France (Figure 0.9). High real estate prices in France may affect investment decisions not only in forcing firms to allocate more financial resources to the acquisition of real estate but also in altering the profitability of productive investments, whereas the profitability of real estate investments remains high.

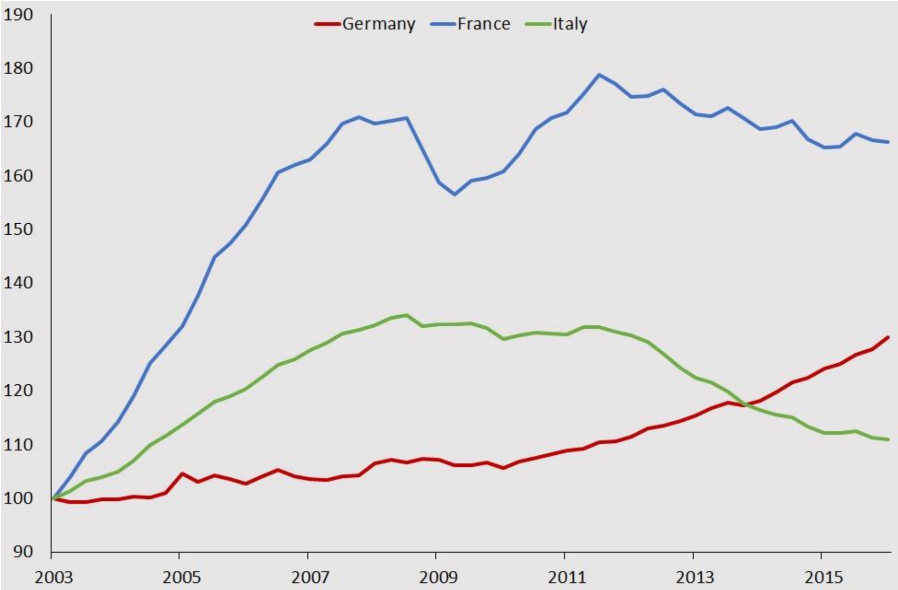
Because investments in machinery and equipment bring forth process and organisational innovation – which must eventually translate into productivity gain – insufficient overall investments can delay the diffusion of new technologies. Figure 0.10 displays the dynamics of total factor productivity for France, Germany, Italy, Spain and the United States. We observe that while all countries experienced a drop in their productivity level during the crisis years, Germany was recovering its pre-crisis productivity level as early as 2011. France is still struggling to recover its pre-crisis productivity level. The Italian and Spanish cases remain worrisome. Overall, productivity gains have remained very low since the crisis for all developed countries, instigating a lively debate over a possible *secular stagnation* (Gordon 2016, Le-Garrec & Touzé 2015).

Figure 0.8: Types of investments in France, Germany and Italy (2000-2012)



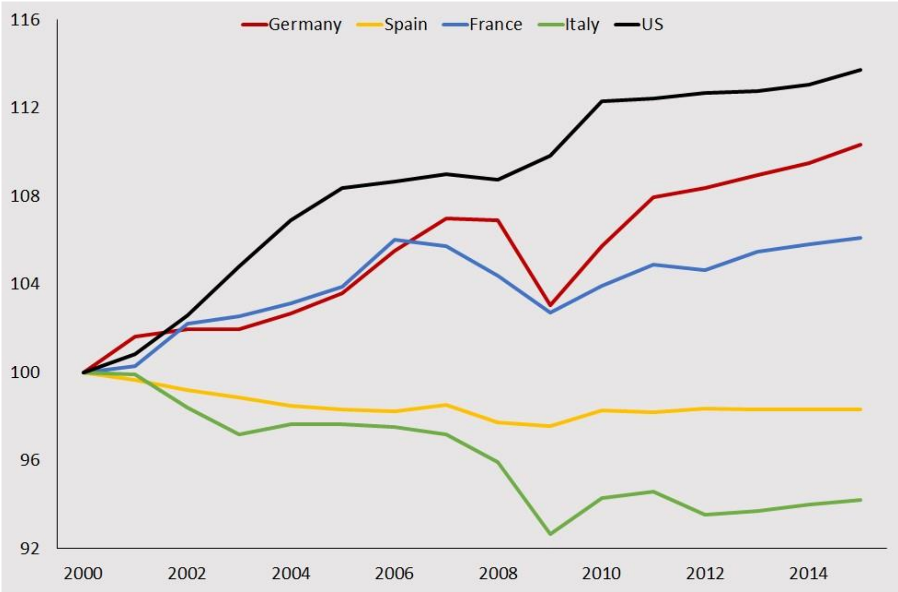
Source: Eurostat. Author's own calculation. 2005e

Figure 0.9: Real residential prices for France, Germany and Italy



Source: Bank for International Settlements. Data downloaded from FRED.
Authors' own calculation. 2003 = 100.

Figure 0.10: The dynamics of total factor productivity



Source: OECD. Authors' own calculation.

Of a different nature and not pursuing the same objectives as private investment, public investment must nevertheless be understood as a fundamental component of the productive capacity of countries. Seen from the supply side, public investment is analysed not for its ability to drive final demand but for the contribution of public infrastructure to wealth creation. Far from being isolated, companies in their daily operations benefit from public infrastructures such as road and maritime networks, the presence of international airports or all public facilities related to information technologies and communication. A superficial but informative way to characterise the different countries is to observe the share of public investment in GDP. In France, public investment accounts for almost 4% of the GDP over the entire period. This amount is twice as high as that in Germany (just over 2% over the entire period) and well above that in all countries over the last period. A recent report by the OFCE (2016*b*) estimated that in the manufacturing sector and in France, the contribution of public infrastructures to wealth creation is positive, with an output elasticity of approximately 5%.

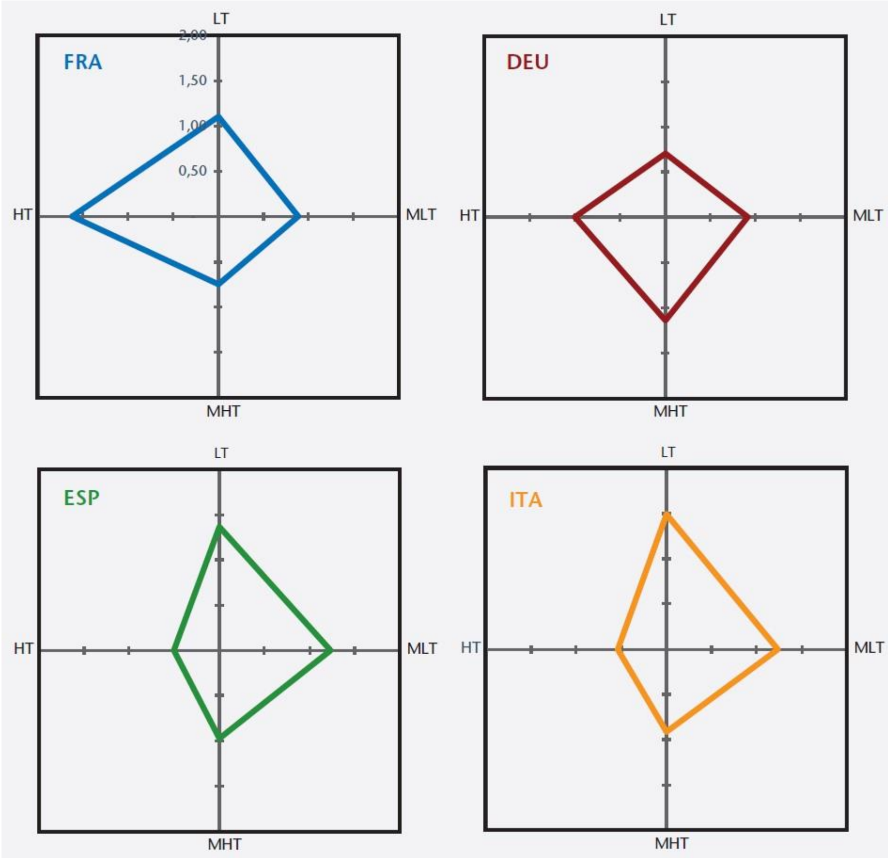
Overall, the volume of investment, whether public or private, is not at issue in France. It is the nature of investment that is at stake.

0.4 Non-Price Competition

Non-price competition is about the capacity of firms or countries to escape price competition by increasing the quality of their production. Although characterising product quality at an aggregate level cannot be performed immediately, one may appreciate product quality in various ways. First, one can examine exports in terms of the technological intensity of the exporting sector. Following the OECD classification, industries are then grouped into four categories ranging from low to high technology. Figure 0.11 shows the export specialisation of the four major European countries along these four types of sectors. The further the position of the country is from the point of origin, the more the country is specialised, using the Balassa index.[7] We observe that France exports mainly high-technology products stemming from aeronautics and pharmaceutical exports. However, recent trends show that between 2005 and 2011, the French economy was the only one to witness a decline in high-technology exports (-8%) in current dollars. Moreover, in the automotive sector, the 50% increase in Italian exports contrasts with the 16% decrease in French exports. France has also fallen significantly in other sectors, such as the manufacture of basic metallurgical products. Note that Italy and Spain almost doubled their exports over the same period.

[7] The Balassa index is computed as follows: $I_{is} = \frac{X_{is}/\sum_s X_{is}}{\sum_i X_{is}/\sum_{is} X_{is}}$, where X represents the exports of country i in sector s. Sector s can take four values: low technology, middle-low technology, middle-high technology and high technology.

Figure 0.11: Export specialisation by type of sector in 2015



Source: OECD STAN Database. Authors' own calculation. LT: low-technology sectors. MLT: middle-low-technology sectors. MLT: middle-high-technology sectors. HT: high-technology sectors. OECD

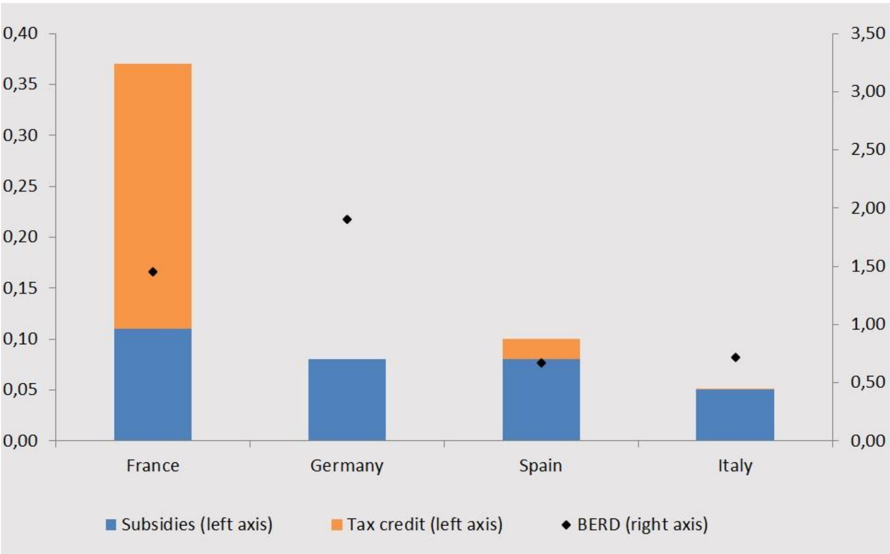
We now turn to input variables and examine R&D investments (Table 0.2). Since 2000, domestic expenditure in R&D (GERD) has increased in all countries with the exception of Spain. In France, business R&D (BERD) rose from 20.8 billion euros in 2001 to 31.1 billion in 2014. Although the private research effort by French companies exceeded that of Italy (11.5 billion euros) and Spain (6.8 billion), it represented only half of Germany's R&D effort (56.9 billion euros). Examining firm behaviour more particularly, we observe that the top 10 companies in Germany (45.4 billion euros) invested three times as much as the top French companies in R&D. Similarly, among the 100 most active R&D companies worldwide, 11 were German, and 6 were French.

Table 0.2: R&D expenses in euros and relative to GDP.

Countries	France	Germany	Spain	Italy	EU-15
GERD Volume	48.1	83.6	14.3	20.8	271.7
%GDP	2.26	2.87	1.23	1.29	2.12
BERD Volume	31.1	56.9	6.8	11.5	175.1
%GDP	1.46	1.95	0.65	0.72	1.36
Share 10	17.2	45.4	4.02	4.34	-
Top 100	6	11	1	1	-

GERD: Gross Expenditures in R&D. BERD: Business Expenditures in R&D. 2014 euros. Share 10: share of top ten firms in the country in overall BERD. Top100: number of firms in the top 100 firms investing in R&D worldwide. Source: European R&D Scoreboard

Figure 0.12: R&D subsidies, R&D tax credit and BERD relative to GDP in 2013 (2012 for Spain)



Source: OECD 2016.

Innovation policies include direct (competitive grants, financial resources towards specific research projects, etc.) and indirect (mainly tax credits) support. In France, overall support represents 0.37% of GDP in 2013 (0.11% subsidies and 0.26% for tax credits, the so-called Crédit d'Impôt Recherche – CIR), with the R&D tax credit representing the bulk of it. In the other three countries, direct subsidies are generally preferred. Germany has not implemented an R&D tax credit, whereas Spain and Italy still have a hybrid tax credit scheme. The surprise comes from the fact that despite the generous credit in France, business R&D in France barely outperforms the EU-15 average. Since 2008, the tax expenditure of the state has reached six billion euros. However, the effect of the CIR on BERD remains limited (Marino et al. 2016). One may wonder about the relevance of the CIR in view of its high cost and also of the coherence of these tax incentive policies with other policy innovations (Guillou & Salies 2015, 2016). On the positive side, by reducing the implicit tax rate, the CIR contributes to the attractiveness of France to foreign companies that internationalise their R&D (in 2015, the contribution of foreign companies to BERD amounted to 28%). The most surprising point in our view is the absence of a catching-up effect with Germany despite more generous policy support. Research activity requires potentially irrecoverable investments, whereas access to finance is decisive and prevails over policies supporting innovation.

Overall, more than a policy relying on artificially modifying consumers' preferences for French products (Gaffard et al. 2012), France needs to climb up the quality ladder to escape price competition by low(er)-cost countries. Although French companies make significant R&D efforts, private research remains quantitatively lower than in the most innovative economies, which translates into significant losses in market shares on international markets. This may be due to less efficient R&D, as exemplified by a lower patent rate (OFCE 2010). In the years to come, with the rise of new players such as the BRICS countries, the capacity to escape competition *via* product and process innovation will be key for the French economy.

Table 0.3: Industry structures by size classes

	Manufacturing				Business services			
	[0;9]	[10;49]	[50;249]	[250;+[	[0;9]	[10;49]	[50;249]	[250;+[
France	85.8	10.8	2.7	0.7	95.2	4.1	0.6	0.1
Germany	62.1	27.8	8.1	2.0	83.1	14.2	2.3	0.4
Spain	83.4	13.8	2.4	0.4	95.1	4.3	0.5	0.1
Italy	82.7	14.9	2.1	0.3	96.2	3.4	0.3	0.1
EU-15	80.1	15.6	3.5	0.8	93.1	5.9	0.8	0.2

Frequencies for 2012, based on the population of manufacturing and business service companies. Sources: Eurostat (2016). Authors' own calculation.

0.5 Creative Destruction

Another source of competitiveness is creative destruction, that is, the fact that companies enter markets, grow and contest the market shares of incumbents, while others exit the market. We focus here on the possible existence of barriers to entry and barriers to business growth. Various studies have already noted that pre-crisis entry and exit rates, compared to those of other countries, are high in France (Bartelsman et al. 2005). The post-crisis period shows that these rates are in line with those of France's main economic partners in the manufacturing industry as well as in services.

According to Eurostat, although survival rates are higher in France than in other major European countries, job creation is the lowest in France (Bartelsman et al. 2013). Therefore, younger and smaller companies may suffer from barriers to growth more than entry barriers. Table 0.3 shows that in France, the share of smaller firms prevails over that of other countries, whereas in Germany, larger companies represent a higher share. Bellone et al. (2008) show that the distortions of competition benefit incumbents more than new players. Asymmetric selection is in line with an industrial structure composed of large, stable firms with little risk of bankruptcy, combined with the presence of a multitude of younger, smaller, more productive firms with higher mortality rates.

Overall, the common vision that depicts France as a non-entrepreneurial country is false. Entrepreneurship remains attractive both in services and in the manufacturing industry. However, industry churning fails to renew in depth the productive system. This in turn may explain the decline in overall productivity. This anaemia can be justified in various ways: the weakness of the private research effort, remaining well below the targets set by the Lisbon agenda; the difficulty of translating R&D investments into real productivity gains; the failure of the selection mechanism, which does not contribute to industrial growth since the crisis; and distortions of the competition process.

0.6 Conclusion

This preliminary analysis of the French productive system points to the following conclusions:

1. *Labour costs*. France has an hourly wage cost close to that of Germany. France's problem comes from the wage differential in the service sector because manufacturing industries are important users of business services. Wage moderation policies in Spain were established as a response to the financial crisis.

2. *Productive investment*. The volume of investment, whether public or private, is not an issue. It is the nature of the investment that seems to be at stake. Business investment seems particularly geared towards real estate, because of high prices, rather than towards productive investments.
3. *Non-price competition*. France makes significant R&D efforts, but they are weaker than those in the most innovative countries, such as Germany. Returns to the French tax credit scheme in terms of business R&D seem unreasonably low with respect to the costs borne by the taxpayer.
4. *Creative destruction*. Overall, the common view that perceives a deficit of entrepreneurship in France is false. However, industrial turbulence fails to renew the productive system because of a competitive process that favours incumbents.

The combination of the structural weakness of productive and R&D investments on the one hand and increased price competition stemming from neighbouring countries such as Germany and Spain on the other hand represents a real threat for the competitiveness of the French economy. Fiercer price competition from both the higher-quality end (e.g., Germany) and the lower-quality end (e.g., Spain) of the market and the apparent anaemia of the research effort in France cast doubt on the capacity of the country to restore its competitiveness. The tax policies recently put in place (CICE, CIR) must translate into real gains in competitiveness, either *via* significant price reductions on the product market or *via* productive investments that modernise the French production system.

PART 1
Investment

CHAPTER 1

General Characteristics of French Investment

Sarah Guillou, OFCE SciencesPo

The objectives of this chapter are first to situate the French economy in terms of its business investment performance by using international aggregated data and second to document the heterogeneity and granularity in the investment behaviour by using French firm-level data. Both are necessary to pose a diagnosis of French investment. Both are necessary to establish a policy strategy to support investment.

The first part of the analysis uses the EU KLEMS data comparing France with its main economic partners. It intends to characterise the specificity of the French gross fixed capital formation (GFCF) relative to that of its partners. The second part uses only French firm-level data. These data are confidential and need to have special authorisation per country. The second part intends to refine the primary picture of aggregated investment. This disaggregated analysis is imperative when studying investment that has a non-linear and non-continuous as well as a very heterogeneous distribution among firms and time. This trait is absolutely not specific to France, and here, the objective is not to distinguish France from other countries. By giving a microeconomic description of investment behaviour, we intend to specify the aggregated results.

The analysis of the aggregated GFCF shows that France is not lagging behind its main partners in terms of the rate of investment in level and in growth. On the contrary, the French business economy shows a sustained investment rate and leadership in terms of intangibles investment. What is acknowledged to be the raw materials of the future growth of rich countries – mainly R&D, software and dataset – seems to be the main engine of the investment growth in France, whether in manufacturing or services. This type of investment is privileged at the expense of investment in machines and equipment. Nevertheless, the latter remains an important type of investment for the bulk of firms.

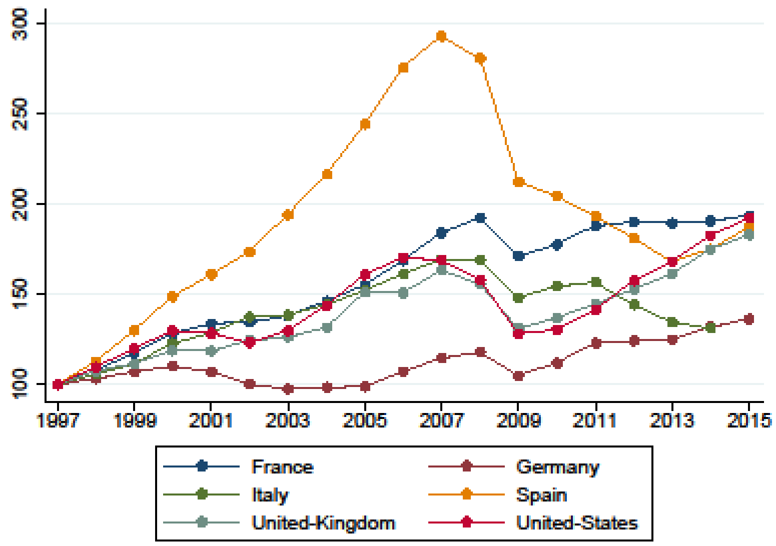
Only a few firms invest in R&D (less than 20,000), of which only a few perform the largest share of R&D, whereas investment in "machines and equipment" is a very pervasive motive across all business firms. This is certainly why, observing firm-level investment dynamics, we found very slow motion during the last 6 years and a replacement of physical capital that is hardly achieved. R&D as well as software and datasets are not fully accounted for by the private accounting books from which firm data come.

Investment is highly concentrated, though we cannot formally prove that this distinguishes France from other EU countries. The specificity of France is to accumulate a high concentration in investment and a type of investment that is, by nature, concentrated in the hands of a few firms, the high-tech firms. Meanwhile, the share of investment in machines and equipment declines as a destination of investment.

1.1 Characteristics of French private GFCF at the macro level

The GFCF of the French business sectors[8] amounted to 407 billion euros in 2015, which is less than the German spending of 624 billion but more than the amount of any other country in the EU. The growth during the past 20 years (1995-2015) has also been sustained relative to its partners. If each country invested 100 currency units in 1997, France would have reached 200 units in 2015, while Germany would have reached 150 and the US, Spain and the UK, to take a few examples, a little less than 200. The amount of investment as well as the pace of capital accumulation in France gives the picture of a well-growing economy. This picture is supported by the observation of the investment rate (GFCF over value added), which reached nearly 28% in France in 2015, the highest rate among the group of its main partners, Germany, Italy, United Kingdom, Spain and the United States.

Figure 1.1: GFCF in Business Sectors per country– 100 in 1997



Source: EU KLEMS 1995-2015.

It is, however, necessary to go further than the aggregate picture to understand the specificity of French investment and whether the GFCF could be better oriented or higher.

The first focus must be to stop the share of investment in construction. The structure of the French GFCF in 2015 is such that for 1 euro spent in GFCF, 0.51 is spent on construction (dwellings, buildings and structures), while it is 0.46 in Germany, 0.40 in the US and more than 0.5 in the UK, Italy and Spain.[9]

For rich countries, the three main destinations of total business investment are (i) construction, (ii) machines and equipment and (iii) intangibles. Figures 2 to 5 show the decomposition of the gross fixed capital formation of the business sector (GFCF)

[8] Business sectors refers here to the total economy minus O, P, Q, T and U (community social and personal services, activities of household and of extra-territorial organizations). The financial sector (K) and real estate (L), as well as leisure activities (arts, entertainment…R-S) are included. The market economy aggregate of EU KLEMS excludes L, O, P, Q, T and U. The difference between our definition of business sectors and the EU KLEMS market economy is that we include the real estate sector.

[9] If we refer to the tangible GFCF only, the share of construction is nearly 70% for France, 56% for Germany, 72% for the UK and 53% for the US. In terms of non-residential assets, the German and US business sectors have the lowest share in non-residential construction: 16% and 22%, respectively.

for France, the United Kingdom, Germany and the US based on the EU KLEMS data for the three main destinations (the residual to 1 consists of tangibles excluding machines and construction, e.g., transport). Construction is a main destination for all countries and is mostly – but not only – associated with the size and activity of the real estate sector. "Machines and equipment" is a type of asset that is associated strongly with the share of manufacturing in the GDP. The intangibles share is bounded not only to the manufacturing share, through its R&D aspect, but also to services, through their software and databases aspect.

Figure 1.2: Share of the three main types of investment in France, 1995-2015
In % of total GFCF

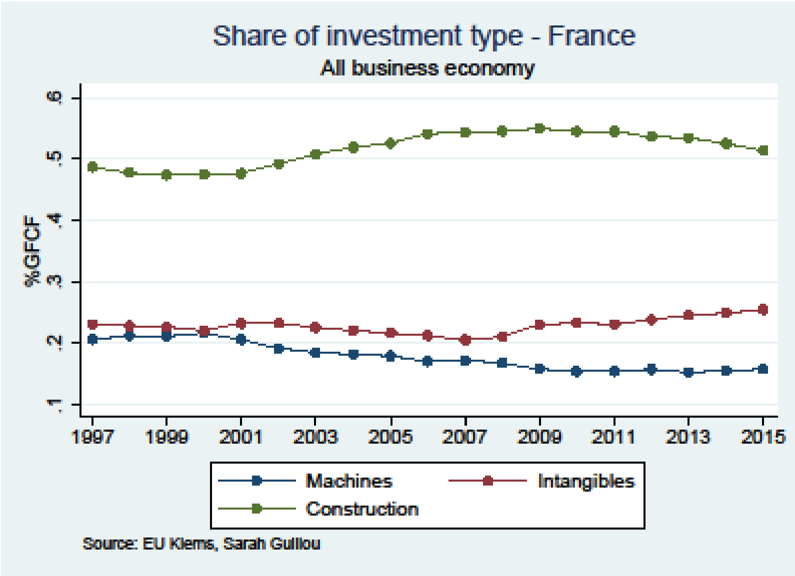


Figure 1.3: Share of the three main types of investment in Germany, 1995-2015. In % of total GFCF

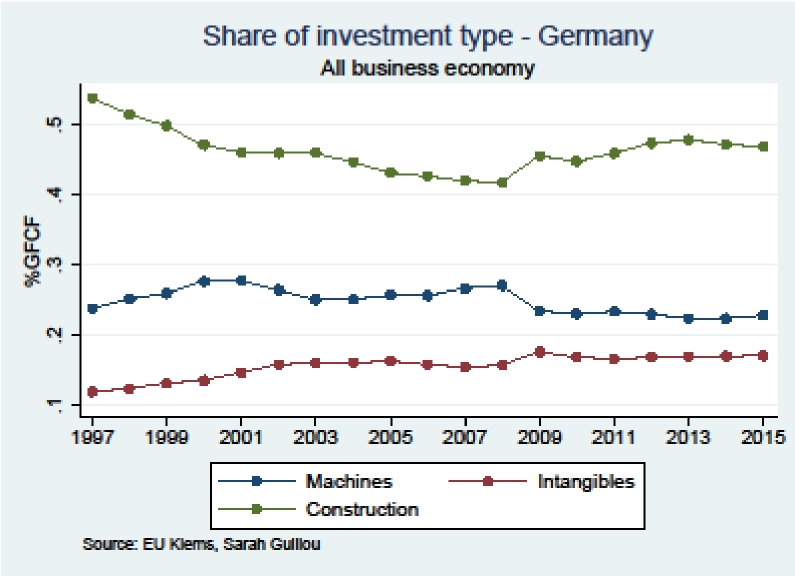


Figure 1.4: Share of the three main types of investment in the United Kingdom, 1995-2015
In % of total GFCF

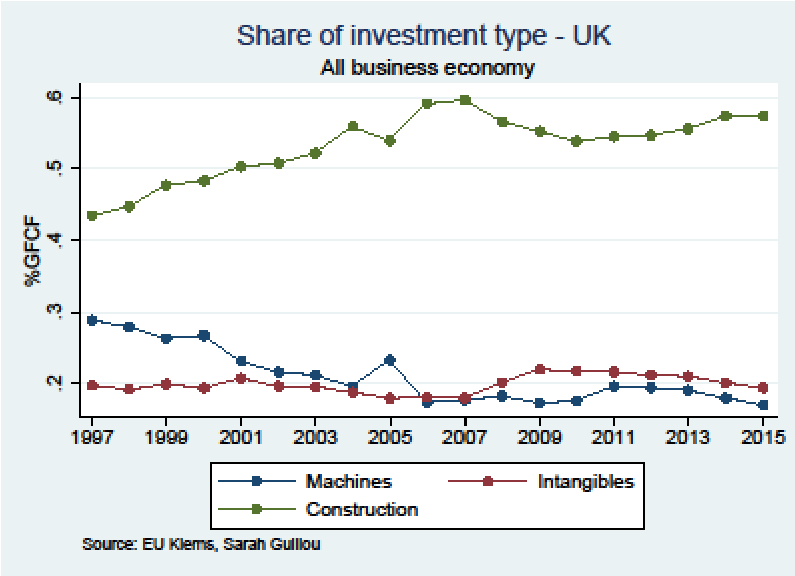
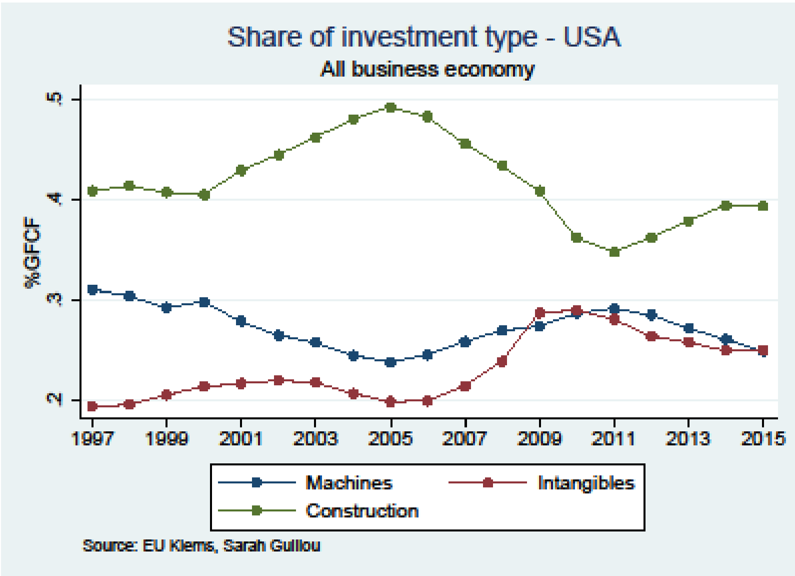
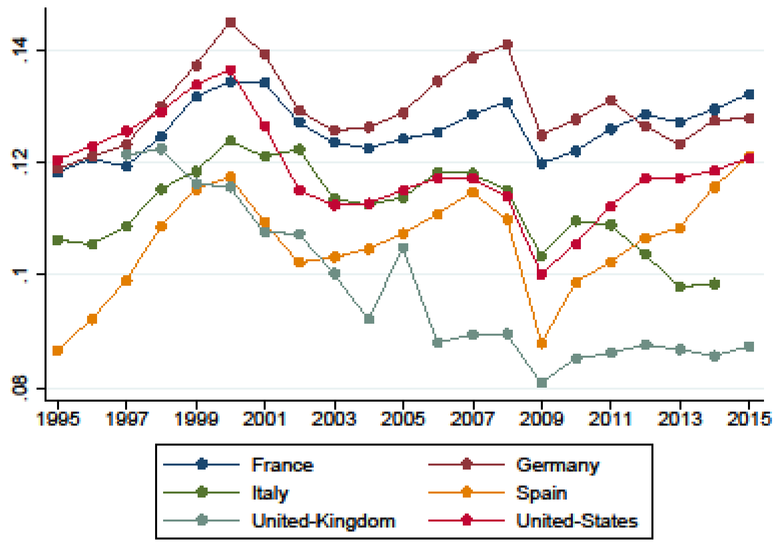


Figure 1.5: Share of the three main types of investment in the United States, 1995-2015
In % of total GFCF



If we remove the investment in construction, the French GFCF still ranks second in Europe, and its growth is such that 100 euros in 1997 leads to 180 euros in 2015. However, the investment rate excluding investment in construction is currently lower and below the German rate (except at the end of the period 2012-2015) while still higher than that of other close partners. The French rate of investment is very similar to the German rate, and the two cycles are also similar.

Figure 1.6: Investment rate (GFCF/VA) in business sectors per country



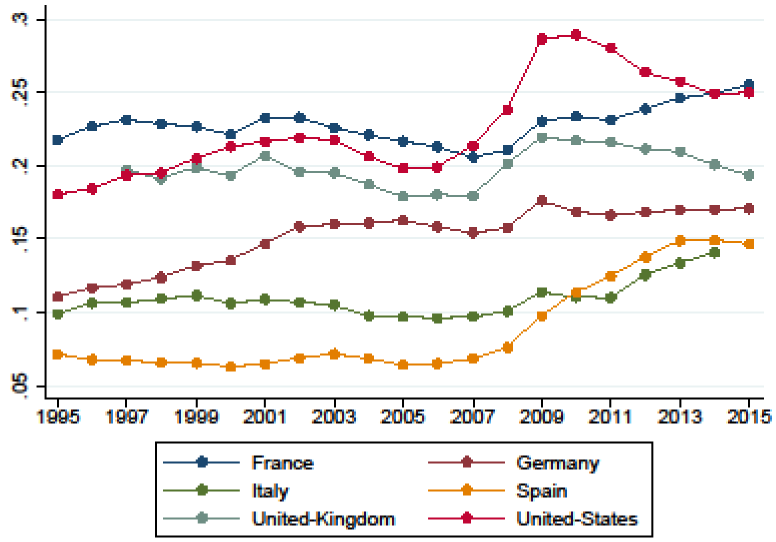
Source: EU KLEMS 1995-2015.

The assets in construction as well as the real estate sector often have a specific status in economic studies. The reason is first that the price in construction has a specific dynamic relative to the rest of the economy and second that the real estate sector is the main investor in residential construction. The importance of investment in construction is often associated with a large contribution of the real estate sector to the overall spending in investment. In France, the contribution varied by approximately 40% from 1995 to 2015, with the highest level in 2009 and a decline since. It is remarkable that the contribution of the real estate sector to the GFCF is the highest in France.

By excluding the real estate sector (L), nearly all of the GFCF in residential construction is also excluded. However, the non-residential construction caused by the business units from other sectors remains. Non-residential construction occurs mainly in 4 sectors: real estate (L), wholesale and retail trade (G), technical and scientific services (M-N) and financial activities (K), in which investment amounts altogether to 70% of the total investment in non-residential construction. Note that the real estate sector is identified as the culprit for the decline of the labour share by Gutierrez (2017) in all main economies except that of the US.

A deeper focus separates tangible and intangible investments. Tangible investments include machines and equipment, including ICT equipment, transport and construction. In contrast, the intangible assets group includes, for example, R&D, software and databases and intellectual property assets. The rise of intangible assets is a main feature shared by modern economies, and it impacts many dimensions of capitalism (Haskel and Westlake, 2018).

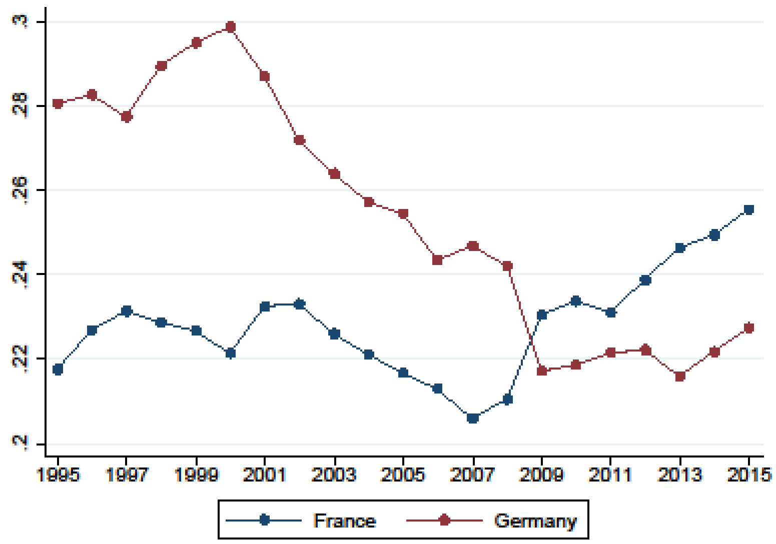
Figure 1.7: Share of Intangibles in total GFCF per country



Source: EU KLEMS 1995-2015

France shows a very specific profile among old industrialised countries, first with a rising share of intangibles that was among the highest in 2015 (see Figure 7*)* and second with a rise that enabled it to overtake the share of tangibles (excluding construction) in 2009 (see Figure 8). Neither Germany, which had the highest share in manufacturing among the richest countries and which drove the R&D volume, nor the US or the UK, which both experienced a decline in industry and a rise in the tech sectors, presented such a crossing, which signals a clear change in the nature of capital accumulation.

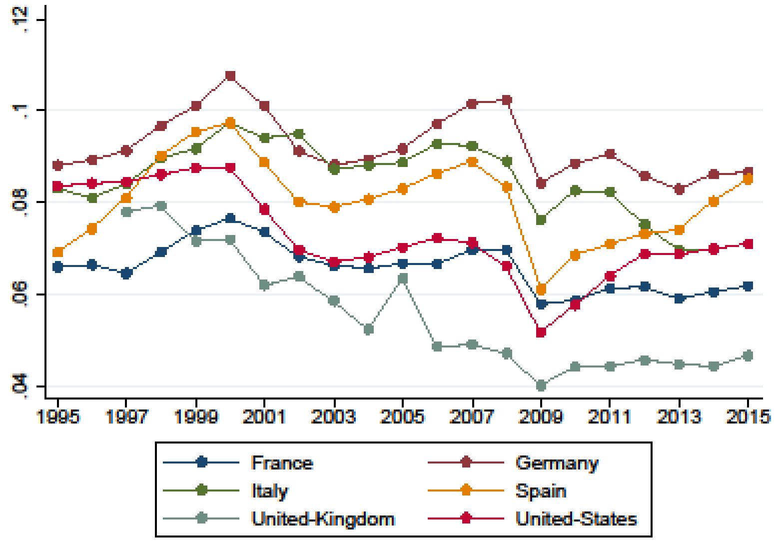
Figure 1.8: Share of intangibles and of tangibles (excl. construction) in total GFCF in France



Source: EU KLEMS 1995-2015.

The counterpart of the high proportion of intangible assets is poor investment in tangibles. If we compute the investment rate in tangible assets excluding construction (Figure 1.9.), France ranks just above Italy.

Figure 1.9: Tangibles (excluding construction) investment rate per country



Source: EU KLEMS 1995-2015

Thus, what mostly drives the French investment rate in tangible assets is investment in construction.

The latest focus must investigate the nature of investment in depth. The French GFCF is quite high relative to its partners, but it hides some peculiarities regarding the main components of investment spending. We have already pointed to the large role of construction, but this characteristic does not make France very different from its counterparts. We also noted the importance of intangibles relative to tangibles, excluding construction. The last trait is indeed relative to intangibles.

Overall, France does not differ from the other richest countries with regard to the first four main destinations of investment after construction: machines and equipment, transport, R&D, and software and databases. Instead, what is very specific to France are the three following facts:

1) The destination machines and equipment has strongly declined in parallel with the decline in the share of manufacturing in the GDP, and the share of machines and equipment is one of the lowest of the richest countries, along with that of the UK.

2) The destination software and databases is much more favoured than in other countries. It reached 13.6% in France and 4% in Germany, 11.4% in the US and 10.1% in the UK. The dominance of this destination was proven over 1995-2015.

3) The R&D destination is also a favourite destination of the French business sectors since France dedicates 11% of its GFCF to R&D purposes. It is near the rate found in Germany (12%) and in the US (11%). Thus, the specificity of France is that the high share of R&D in the GBFC is unexpectedly associated neither with a strong manufacturing sector (such as in Germany) nor with a strong digital sector (as in the US). The defence industry and the generosity of the R&D tax credit likely favour R&D spending.

2. General characteristics of French private investment at the micro level

2.1 From macro GFCF to firm-level (micro) investment

Micro investment from a firm's accounting books differs from the GFCF registered at the aggregated level. While it refers to the same economic concepts, which are physical assets used for more than one year in the economic production process, the boundaries of the two indicators differ.

There are two main differences. First, R&D spending is not fully included in firms' intangibles investment. Only part of the costs, such as the cost for patenting or the cost of machines dedicated to R&D purposes, may be included. Second, the spending in software and databases is also only partially tied to intangible assets.

Firm-level data are difficult to compare between countries because access to them is usually confidential and subject to administrative authorisation per country. More recently (since 2016), the European Investment Bank has implemented a survey that questioned firms about their investment behaviour and how they finance their investments. The 2016/2017 report (EIBIS, 2017) also provides information per country. However, the coverage is limited in terms of population and in terms of variables, and access is also not public.

The EIB survey and report show the strong interest that economic authorities and institutions have in private investment. The level of investment is a matter of concern to appreciate future growth.

Recently, the decline in the rate of investment has become an important topic in developed countries, while the stagnation of productivity is an increasing puzzle. Do developed countries switch to investment-less growth, as suggested by Guttierrez and Philippon (2017)? The decline in investment is basically conditional on the type of investment. For developed countries, the decline is broadly observed when focusing on tangible capital, excluding construction. Gutierrez (2017) shows that the exclusion of real estate – a main source of investment in construction – has a strong impact on the understanding of capital accumulation. Nonetheless, the decrease in tangible capital investment is itself worthy of concern, and it tells us a great deal about the new type of growth of the richest countries. The decline in the rhythm of the accumulation of capital is often associated with the decline in the rate of return of capital, which itself is the result of the decrease in the cost of capital. It has been clearly shown for the United States by Caballero et al. (2017) and Barkai (2017). The decrease in the cost of capital cannot be unrelated to the decline in the price of ICT capital, whether tangible (computers, microchips) or intangible (software, databases). While the rise in intangible capital is observed in all developed countries, as shown by Corrado et al., 2016, its impact on investment dynamics has just begun to be studied. Gutierrez and Philippon (2017) show that the rise in intangible capital is one of the explanations for the decline in investment. Koh et al. (2016) show that the intangible capital rise, measured by intellectual property rights, explains the decline in the labour share.

The following tables concern only French firms. When possible, we will refer to available results for other countries found in the literature to make comparisons. We study investment at the firm level using the quasi-universe of French firms from the source FARE-INSEE, which gathered the firms' accounting information from 2009 to 2015. All sectors except the banking and farm sectors are included. The rough dataset gathers more than 4 million firms in 2015, of which more than 3 million had fewer than 10 employees. We eliminated the finance sector, headquarters, and household economic activity. We then cleaned the dataset, first by dropping firms with both no employees and no investment over the period 2009-2015 and second by dropping firms with no capital. The description of the observations per firm's size category is provided in Table 1.1.

Table 1.1: Observations and share per size category

	# firms	<10	[10-50]	[50-150]	[150-250]	[250-5000]	>5000
2009	1,713,996	89	10	1	0.5	0.4	0.01
2010	2,206,488	91	9	1	0.4	0.3	0.01
2011	2,335,404	92	7	1	0.3	0.2	0.01
2012	2,768,887	93	7	1	0.2	0.2	0.01
2013	2,974,458	94	6	0.7	0.2	0.2	0.00
2014	3,264,987	94	5	0.6	0.2	0.2	0.00
2015	2,822,420	94	5	0.8	0.2	0.2	0.01
Total	18,086,450	93	6	0.9	0.2	0.2	0.01

Source: FARE-INSEE, French firms financial statements 2009-2015.

Table 1.1 shows the stability in the share of each size category. Most firms are small, which is not specific to France. What is specific to France is the share of firms with more than 250 and fewer than 5000 employees, which is smaller than that in Germany or Italy (source Eurostat). If we group firms by main sectors – agriculture, construction, industry, real estate, transport and other services – we observe in Table 1.2 that the smallest firms (<50) are concentrated in services.

Table 1.2: Share of firms' population per sector and size category in %

	<10	[10-50]	[50-150]	[150-250]	[250-5000]	>5000	All size
Agricul.	.23	.02	.00	.000	.0	.00	0.3
Construction	14	1	.1	.02	.01	.00	16.5
Industry	7.3	1.1	.2	.07	.07	.00	8.6
Real Estate	4.7	.1	.01	.01	.00	.00	4.9
Other Services	42.3	2.4	.4	.09	.08	.00	45
Trade	23.2	1.4	.2	.06	.04	.00	26
Total	92.5	6	.9	.24	.01	.01	100

Note: Agriculture (A and B), construction (F), industry (C, D, E), wholesale and retail trade (G), real estate (L), other services (H, M, N, I, J, P, Q, R, S). In 2015, the share in the total value added of the business sectors of each group was 0.2%, 8%, 27%, 4%, 39% and 22%, respectively. The main change from 1995 is a drop in the share of industry, to the benefit mostly of other services. Note that this percentage is computed relative to the total value added from firms in the database. Source: FARE-INSEE, French firms financial statements 2008-2015.

Now, using the same cross-table, we compute the share in tangible investment per group of size and sectors. Table 1.3 answers the question of which group is providing the greatest part of the French total tangible investment.

Table 1.3: Share of tangible investment per sector and size category

	<10	[10-50]	[50-150]	[150-250]	[250-5000]	>5000	All size
Agricul.	.0	.0	.0	.0	.0	-	.01
Construction	.02	.01	.0	.0	.0	.01	.04
Industry	.05	.02	.02	.01	.08	.1	.3
Real Estate	.08	.01	.03	.02	.06	-	.2
Other Services	.02	.02	.01	.01	.03	.02	.1
Trade	.11	.04	.02	.01	.09	.09	.36
Total	.29	.1	.09	.05	.26	.22	1

Source: FARE-INSEE, French firms financial statements 2008-2015.

While accounting for a small share of the firms' population (2%), firms larger than 250 employees are providing nearly 50% of the total tangible investment. The firms with fewer than 250 employees, accounting for 98% of firms, are providing the other half. The distribution of investment among firms is extremely skewed, which suggests a strong concentration, as we will confirm later. Given the importance of the sector 'other services' in the value added (39% in 2015), the share of investment is accordingly important. Industry contributes more to investment than it contributes to value added, as does the real estate sector.

Table 1.4 displays the amount of total investment and amount per type of assets from 2009 to 2015. It shows the increase in the value of investment from 2009 to 2015 with the highest level in 2011, regardless of the type of asset. We observe that investment in construction is between 1/5 and ¼ of the total investment, which is far less than the share we observe at the aggregated level. However, the two tangibles destinations, machines and construction, remain the two first destinations, followed by intangibles. The last rows indicate the share of firms for which investment is not null per year. Per year, between half and 70% of firms report a positive investment. The proportion of firms that invest in tangibles is higher than when the destination is intangibles. The proportion of positive investment increased between 1995 and 2015 except in intangibles and in machines and equipment. The probability that a firm had a null investment was closely linked to a firm's size. More than 98% of firms that declared a null investment in a year were firms with fewer than 10 employees. More precisely, based on the observed frequencies, the probability of having a null investment was 51% for firms with fewer than 10 employees, and it dropped to 12% for firms with more than 150 employees. Table 1.5 confirms that investment behaviour is positively correlated with size. The bigger a firm is, the higher is the probability that it invests. Given the skewness of the size distribution in the population, firms with fewer than 10 employees (90% of firms) realise one-fourth of investment spending. However, firms with more than 250 employees, which represent less than 1% of firms, realise 50% of investment spending.

Table 1.4: Investment (in billion euros) and share of positive investment per assets

	Total	Tangibles	Intangibles	Construc.	Machines
2009	222	177	45	49	54
2010	229	190	39	50	55
2011	261	205	56	60	65
2012	236	194	42	57	59
2013	242	192	50	52	63
2014	220	184	36	55	59
2015	235	191	44	58	61
Share of positive investment per asset type					
1995	56	55	17	25	33
2015	71	64	8	37	19

Source: FARE-INSEE, French firms financial statements 2009-2015.

Table 1.5: Observations per category of size

	2009			2015		
	% firms	% inv. >0	% Invest.	% firms	% inv. >0	% Invest.
<10	90	57	25	93	73	28
[10-50]	8.5	91	11	5.8	91	12
[50-150]	1.2	95	7	0.8	95	7
[150-250]	0.4	98	4	0.2	96	5
[250-5000]	0.3	98	23	0.2	97	23
>5000$	0.01	100	30	0.01	99	25

Source: FARE-INSEE, French firms financial statements 2009-2015.

Table 1.6 shows the relative stability of the overall economic performance of firms since the financial crisis of 2008. We observe a high point in 2012. Surprisingly, the share of tangibles has increased in the total investment of each firm (it is the yearly average of the share per firm). This is not coherent with the fact established at the macro level. It confirms that the accountability of intangibles at the firm level underestimates the intangible assets.

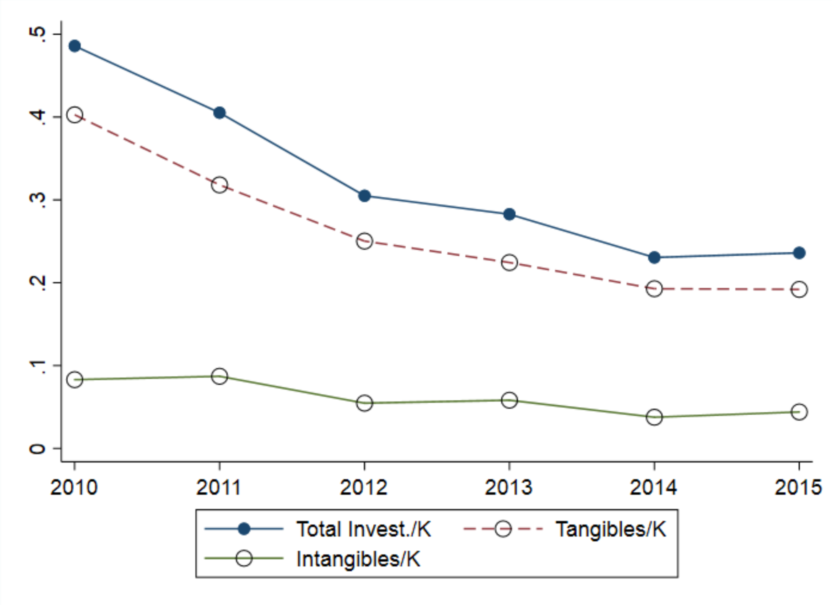
Table 1.6: Main indicators per year in billion euros

	Employment	Sales	Capital	Share Tangibles	Debt
2009	14	3 140	471	.89	1 070
2010	15	3 360	644	.88	1 180
2011	15	3 550	774	.88	1 220
2012	15	3 630	855	.92	1 330
2013	14	3 610	955	.93	1 290
2014	15	3 570	997	.94	1 290
2015	14	3 460	1040	.95	1 290

Note: Employment in million units, sales, capital and debt in billion euros. Source: FARE-INSEE, French firms financial statements 2009-2015.

Decomposing the total investment into tangibles and intangibles (Figure 1.10), we observe that while intangibles constitute the slimmest part of total investment (21-25%), this part has remained constant in relative terms while tangibles investment has declined greatly. Tangibles investments explain 81% of the variance in total investment.

Figure 1.10: Decomposition of total investment into tangibles and intangibles



Source: FARE-INSEE, French firms financial statements 2009-2011.

2.2 Concentration of Investment

Table 1.7 displays the Herfindahl index per year and per variable to provide information about the concentration over time in the business economy.[10]

Table 1.7: Herfindahl index per year and variable

	Employment	Sales	Investment	Tangible Investment	Intangible investment	Construct.
2009	1.1	1.3	5.4	3.6	3.6	2.3
2010	1.4	1.4	2.8	3.3	3.3	1.9
2011	1.4	1.4	12.5	6.1	6.1	15.8
2012	1.5	1.5	3.6	4.2	4.2	4.7
2013	1.4	1.3	5.9	3.8	3.8	4.1
2014	1.4	1.2	3.02	3.5	3.5	5.4
2015	.7	1.1	3.3	3.4	3.4	5.3

Note: For presentation, the Herfindahl index is multiplied by 1000. Then, a full monopoly will obtain an index value of 1000. Source: FARE-INSEE, French firms financial statements 2008-2015.

We observe a high point in 2011, but comparing 2015 to 2009 disallows the conclusion that the concentration increased with the exception of investment in construction. As the Herfindahl index is a broad index, we also compute the share of main variables accounted for by the top firms. It shows that the top 5000 firms, which are less than 1% of the total number of firms, account for more than half of sales, investment or capital and 44% of employment. We do not observe a clear increase in concentration. The variable that is the most concentrated is investment. When we divide investment by category, we retrieve the high concentration of investment in construction indicated by the Herfindahl index: the top 5000 firms contributed 89% of investment spending in 2015.

[10]The Herfindahl index sums the firm-year investment share squared for each type of asset. It varies between 10^{-9} and 1.

Table 1.8: Share of investment, sales, employment and tangible capital accounted for by the top firms

	2009			
	Investment	Employment	Sales	Capital Stock
Top 50 firms	0.31	0.16	0.19	0.22
Top 100 firms	0.37	0.19	0.24	0.27
Top 1000 firms	0.57	0.32	0.37	0.45
Top 5000 firms	0.75	0.44	0.57	0.58
	2015			
	Investment	Employment	Sales	Capital Stock
Top 50 firms	0.28	0.13	0.17	0.2
Top 100 firms	0.34	0.17	0.22	0.26
Top 1000 firms	0.58	0.31	0.41	0.46
Top 5000 firms	0.74	0.44	0.55	0.59

Source: FARE-INSEE, French firms financial statements 2008-2015.

Table 1.9: Share of investment per type of assets accounted for by the top firms

	2009			
	Tangible	Construction	Machines	Intangible
Top 50 firms	0.30	0.26	0.41	0.45
Top 100 firms	0.36	0.35	0.48	0.51
Top 1000 firms	0.62	0.70	0.69	0.70
Top 5000 firms	0.76	0.85	0.82	0.82
	2015			
	Tangible	Construction	Machines	Intangible
Top 50 firms	0.27	0.30	0.42	0.43
Top 100 firms	0.34	0.39	0.48	0.49
Top 1000 firms	0.60	0.74	0.69	0.70
Top 5000 firms	0.75	0.89	0.82	0.82

Source: FARE-INSEE, French firms financial statements 2009-2015.

In Table 1.9, we replicate the same exercise with respect to the type of investment. All types of assets show a strong concentration in the hands of few firms. The investment in construction is the most concentrated in the hands of the top 5000, and then comes the investment in intangibles.

2.2. Investment Lumpiness

Not only is investment highly concentrated in the hands of a few firms, it is also concentrated in a few episodes in the lifetime of a firm. While in the long term, the firm's decision to invest is constrained by its technology, the yearly decision mainly depends on the growth of demand it faces or expects, the fierceness of competition and the cost of investment, which all determine the opportunity to invest now and not in the future.

The cost of investment consists, on the one hand, of the investment price that includes the financing cost and, on the other hand, of the adjustment cost. The adjustment cost is the learning cost necessary to use new machines or new software or, more generally, the cost of adjustment of the old production system to new machines or new capital. The crucial question relative to this adjustment cost is whether it increases with an increasing rate or a decreasing rate, in other words, whether it is convex or non-convex. The non-convexity of the adjustment cost was first presented by Rothschild (1971) and then documented by many papers (Cooper et al., 1999; Cooper and Haltiwanger, 2006). This implies that the cost of investment increases less than proportionately or at a decreasing rate because of irreversibility or fixed costs. Then, it is rational to wait to adjust the capital instead of investing continuously. The existence of a non-convex adjustment cost is supported by the pattern of a firm's investment during its lifetime: it increases greatly once and then amounts to nearly nothing over a couple of years. Spikes in the distribution of firms' investment over time, which define lumpiness, have been observed in many countries. The identification of spikes is of great interest to understand the cyclicity of investment and its consecutive impact on the business cycle. There is a vast literature about the lumpiness of firms' investment to understand the cyclicity of aggregate investment (Doms & Dunne, 1998; Grazzi et al., 2016; Disney et al., 2018).

Gourio and Kashyap (1997) show for the US and for Chile that spike frequencies explain most of the variance in aggregate investment. The question of whether the number of spikes or the size of the spikes drives the change in the aggregate investment can then be addressed. Gourio and Kashyap (2007) show that the extensive margin – the number of firms implementing a spike – explains more of the aggregate variance than does the intensive margin – the size of the spikes. This means that what matters for the growth of the aggregate investment is the number of firms that simultaneously decide to implement a non-standard investment relative to their standard behaviour. This is actually why the study of lumpiness matters.

If a policy could increase the number of "spiking" firms, it would have a greater effect on the aggregated investment. In contrast, a policy that focuses on innovative firms or on those that already invest will have less impact on the aggregate.

2.2.1. Concentration of Capital Accumulation

To demonstrate the lumpiness of French investment, we begin by observing the capital accumulation pattern.

The capital stock of asset a is computed using the permanent inventory method leading to:

$$K_{it}^{a} = (1-\delta)K_{it-1}^{a} + I_{it}^{a}$$

where $a = t, b, m, i$ for, respectively, tangibles, buildings and structures, machines and equipment, and intangibles.

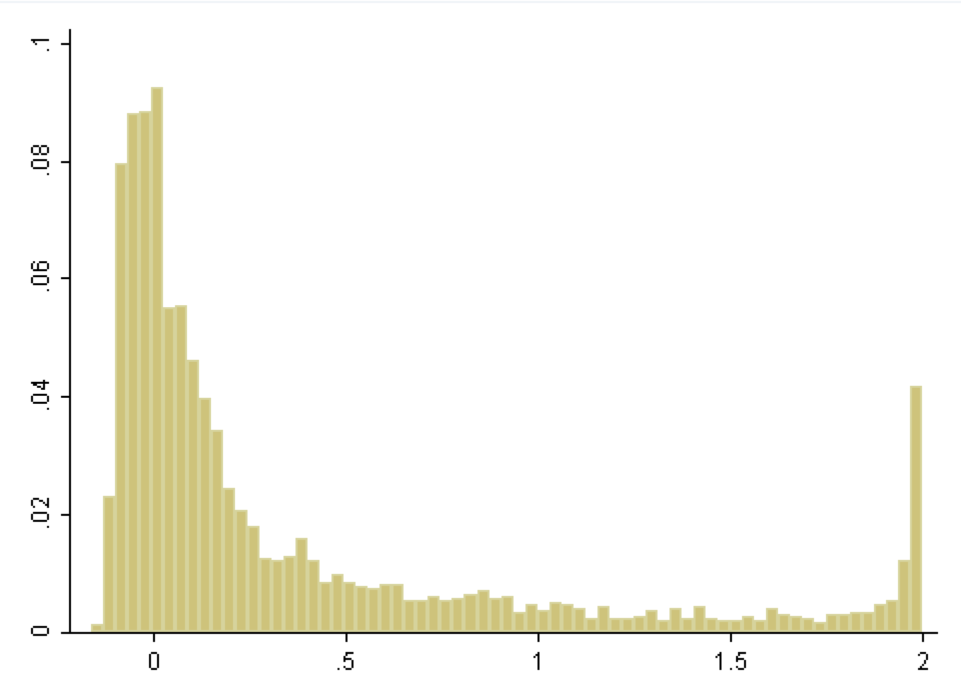
Not all firms have a continuous positive investment, I_{it}^{a}. As observed before, a large number of firms do not invest, and very heterogeneous behaviour exists among investors. The firms that constantly report a positive level of investment over the whole period from 2009 to 2015 account for between 25 and 35% of the population (the dataset is not balanced).

To document the granular pattern of the capital accumulation, we analyse the heterogeneity in the growth rate of capital. As in Doms and Dunne (1998), we define the growth rate of capital as follows: $GK = \frac{I_{it} - \delta K_{it-1}}{0.5*(K_{it-1} + K_{it})}$, where the numerator is simply the change in capital, $\mathrm{K_{it}^{a}} - \mathrm{K_{it-1}^{a}}$ (also the net investment), and the denominator is a mobile average that lessens drastic changes in capital. To exclude large changes in the capital accumulation that could stem from an acquisition, we dropped observations for which the rate of capital growth belongs to the 1% at the top of the distribution of the growth rate of capital.

The unweighted distribution of GK indicates that 50% of firms experienced a negative growth rate over the period, and less than 10% had a growth rate higher than 30%. The few firms that underwent large changes contributed significantly to the aggregate investment. Figure 2.2 shows the weighted distribution and indicates that more than 80% of investment is provided by firms that increased their capital stock by less than 25% in a year, whereas 5% increased their capital stock by more than 50%.

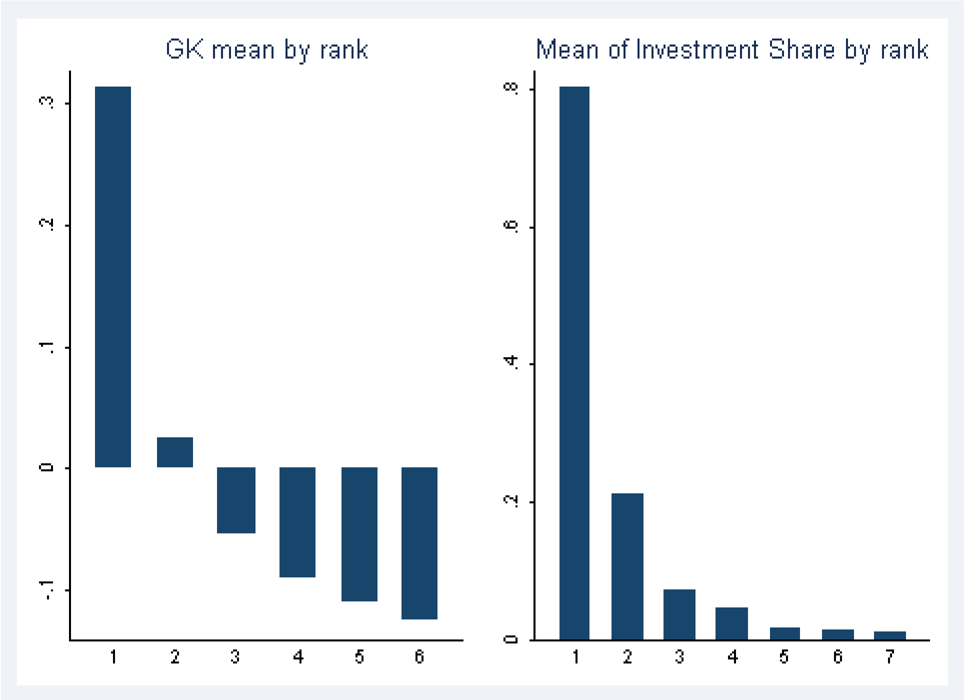
To further investigate the lumpiness of investment, we range the capital growth rate per firm over the period 2009-2015 and compute the growth rate average over the population by each rank. Hence, the maximum growth rate is ranked 1 for each firm down to the minimum growth rate, which is ranked 6. We also compute per firm the share of yearly investment over its total investment over the period and rank the shares per firm. The highest share is ranked 1 down to the lowest, which is ranked 7 (one more observation because of 7 years of observations). Figure 2.3 illustrates the lumpiness of firm investment: in the firm's life, investment is once very important relative to previous capital. The average highest growth rate is above 30%, and it plummets to less than 2% when averaging the second-highest growth rate for each firm. The mean of the highest share is on the verge of 80% if we consider all firms. These results confirm a high level of lumpiness during the period 2009-2015. It means the motive of replacement was dominant and that investment owing to capacity or made necessary by a strategic change (export, new products, new process…) occurred less frequently. The EIB survey also reports the dominance of the motive of replacement in 2016 among European firms (EIB, 2017).

Figure 1.11: Weighted (by investment) capital growth rate (GK) distribution



Source: FARE-INSEE, French firms financial statements 2008-2015.

Figure 1.12: Capital growth rate (GK) and share of investment means by rank



Source: EU KLEMS 1995-2015.

2.2.2. Investment lumpiness and aggregate investment

To relate lumpiness to aggregate investment, it is interesting to decompose aggregate investment into spike investments and non-spike investments. If spike investment is a strong part of total investment, then the cycle of aggregated investment will be linked to the number of firms that implement spike investment together.

Gourio and Kashyap (2007), Cooper et al. (1999), Cooper and Haltiwanger (2006) and Becker et al. (2006) define spikes as investment larger than 20% of the capital at the beginning of the period. We follow this definition.

By decomposing the total investment rate (sum of investment over sum of lagged capital by year), IK_t, into the investment from the spikes over the whole capital, IK_t^{high}, and the investment rate of remaining investors, IK_t^{low}, we observe that, in terms of level, the spike-investment rate, IK_t^{high}, represents between 26% and 40% (depending on the year) of the total investment rate. However, using the variance-covariance matrix, we found that 89% of the variance in the total investment rate is explained by the variance in the spike-investment rate.

Then, investment growth is driven by the growth of the spike-investment rate. To obtain the contribution of spike investment to the variation in total investment, we compute the ratio of the covariance to the variance, $cov(IK_t, IK_t^{high})/var(IK_t)$. Of the UK firms, Disney et al. (2018) found a rate of approximately 50%, while Gourio and Kashyap (2007) found 97% for the US and 86% for Chile. The French rate for the period 2009-2015 is similar.

To continue, we decompose the spike-investment rate into the intensive margin, I^{high}/K_t^{high}, and the extensive margin, K_t^{high}/K_t, such that

$$IK_t^{high} = I_t^{high}/K_t = \frac{I_t^{high}}{K_t^{high}}\frac{K_t^{high}}{K_t}$$

This allows us to know whether the change in the spike-investment rate is the result of an increase in the number of firms operating a spike investment (extensive margin) or of an increase in the average extent of the spike (intensive margin). The additive decomposition in logarithm shows that the extensive margin increased, while the intensive margin declined. The extensive margin explains the greater part of the spike-investment rate (55-66%), while the intensive margin explains the rest.

This means that changes in the spike-investment rate matter greatly for the change in the total investment rate and, more precisely, that it is the extensive margin of the spike-investment rate that is important. This result is consistent with Gourio and Kashyap (1997) as well as Disney et al. (2018), who also found a covariance greater than 1.

Figure 1.13: Decomposition of total investment into spike and non-spike investment

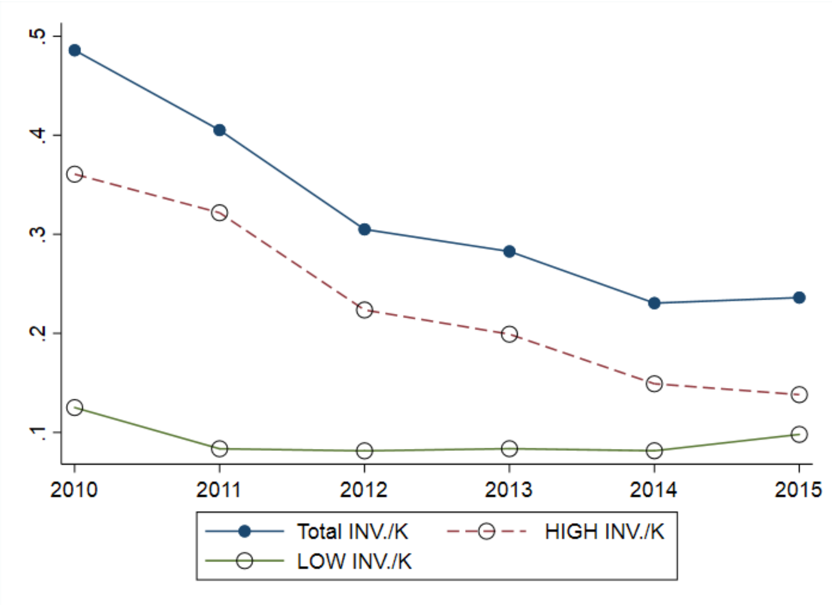


Figure 1.13 decomposes the total investment rate into spike investment (high) and non-spike investment (low). It confirms the importance of spike investment to explain total investment as well as investment growth. Note the increase in non-spike investment from 2014 to 2015 and its positive and clear impact on the total.

In sum, we have obtained the following micro evidence:

- Per year, between half and 70% of firms report a positive investment. The probability that a firm has a null investment is closely linked to firm size. The probability of having a null investment is 51% for firms with fewer than 10 employees, and it drops to 12% for firms with more than 150 employees.

- At the firm level, when focusing on the type of asset, it is, as expected, in tangibles that investment is the most frequent, while investment in intangibles is the least frequent. The increase in the frequency of positive investment since 2009 has been caused by tangible investment but not by an increase in investment in machines and equipment, which has declined as a destination of investment.

- We observe, at the firm level, stability in the share of each type of asset. On average, tangibles represent 77% of total investment, intangibles is the complement but reached a peak in 2011, construction (buildings and structures) is approximately 14% of the total and the machines and equipment share is nearly 30%.

- Given the skewness of the size distribution in the population, firms with fewer than 10 employees (90% of firms) realise one-fourth of investment spending. However, firms with more than 250 employees, which represent less than one percent of firms, realise 50% of investment spending.

- Investment is highly concentrated in the hands of a few firms. A small number of firms account for a relatively large share of investment. We observe no clear-cut increase in concentration from 2009 to 2015. Investment and capital are more concentrated than employment and value added. Among assets, the investment in construction is the most concentrated, followed by the investment in intangibles.

- The unweighted distribution of growth rate in capital indicates that 50% of firms experienced a negative growth rate over the period and less than 10% had a growth rate higher than 30%. The few firms that underwent large changes contributed significantly to the aggregate investment.

- Intangible investment, though representing 23% of total investment, explains 34% of the variation in the total investment.

1.3 Conclusion

We have two main results.

1. The French GFCF is high relative to that of its partners and has sustained its heading position during the last 20 years because of the importance of investment in intangibles (R&D and software and databases). The destination "machines and equipment" is less favoured than in other countries.

2. At the firm level, firms' investment is highly concentrated and lumpy, and the changes in aggregated investment are driven by the number of firms that simultaneously implement a non-standard or spike investment relative to their own path. The firms that invest in intangibles are even more rare, given the figures reported about the R&D tax credit beneficiaries.

The support of R&D through the generous R&D tax credit (CIR) must have positively impacted the rise in intangibles assets. This policy was born in 1984 and is one of the more stable policies among both tax and innovation French policies. Of course, the R&D tax credit policy was later reformed, and the 2009 tax credit policy is certainly the most important. Since 2009, the tax credit has been based on yearly spending and not on year-to-year increments. The reform has raised tax credit spending to approximately 6 billion euros. It is currently one of the three most generous R&D tax credits among OECD countries.

At the same time, it is possible that this stable tax incentive has been detrimental to tangibles investment, notably in machines and equipment, and has favoured the offshoring of physical capital through an increase in outward FDI. This is why tangibles investment did not increase much both at the firm level and at the aggregate level. The R&D tax credit has certainly introduced a bias towards intangibles assets, and firms may have invested in R&D and software much more than they would have done without it. As will be shown in the next chapters, this has not led to leadership in competitiveness, as we would expect, which is also a sign of overinvestment. In this respect, unlimited support of R&D is not a panacea.

The capital tax reform implemented by the government under President Macron by diminishing capital taxation is a way to rebalance the taxation of tangibles versus intangibles. However, the production capacity, which requires tangible investments, will not be rebuilt easily, while the skills necessary to physically produce have also vanished. Moreover, the lumpiness of investment implies that the consequences of a change in tax incentives can take time. Lumpiness is a hurdle for public policies because it reveals inertia, stickiness and firm-dependent dynamics. Investment is likely to be the less sensitive macroeconomic aggregate to policies. We cannot expect a rise in tangible investment in response to Macron's tax policies.

CHAPTER 2

The Lag Structure of Investment and Productivity Growth

Thomas Grebel, TU Ilmenau, Germany
Lionel Nesta, OFCE, University Nice Sophia-Antipolis, France

2.1 Introduction

"Growth is up", as the European Commission acknowledges (European Commission, 2017). Countries invest in their productivity. The European member countries have seemed to gradually overcome the burden of the financial crisis. However, the link between the type of investment and TFP growth is unclear. To shed light on this relationship, we investigate the following topics in this chapter:

- The time lag characterising the impact of investment (tangible, intangible, and ICT) on TFP.

- The total contribution of each type of investment to TFP in the long term.

Assuming a non-linear Poisson-lag structure model, we calculate lag structures for three types of investment and identify the following time-lag structures: tangible assets, approximately 8 to 9 years; intangible assets, approximately 12 years; and ICT, approximately 14 years. The investment lag for investments in tangibles appears robust for all the models we performed. For investments in intangibles and ICT, significant results can be detected only for the most innovative countries. France, mid-ranked in terms of innovativeness, according to the European Scoreboard (ESB), delivers no further evidence for shorter lag structures. There is no indication either for a higher impact of investment on TFP or for shorter investment lag structures. The results suggest that France invests excessively in intangibles. This finding challenges France's high public support of investments in intangibles.

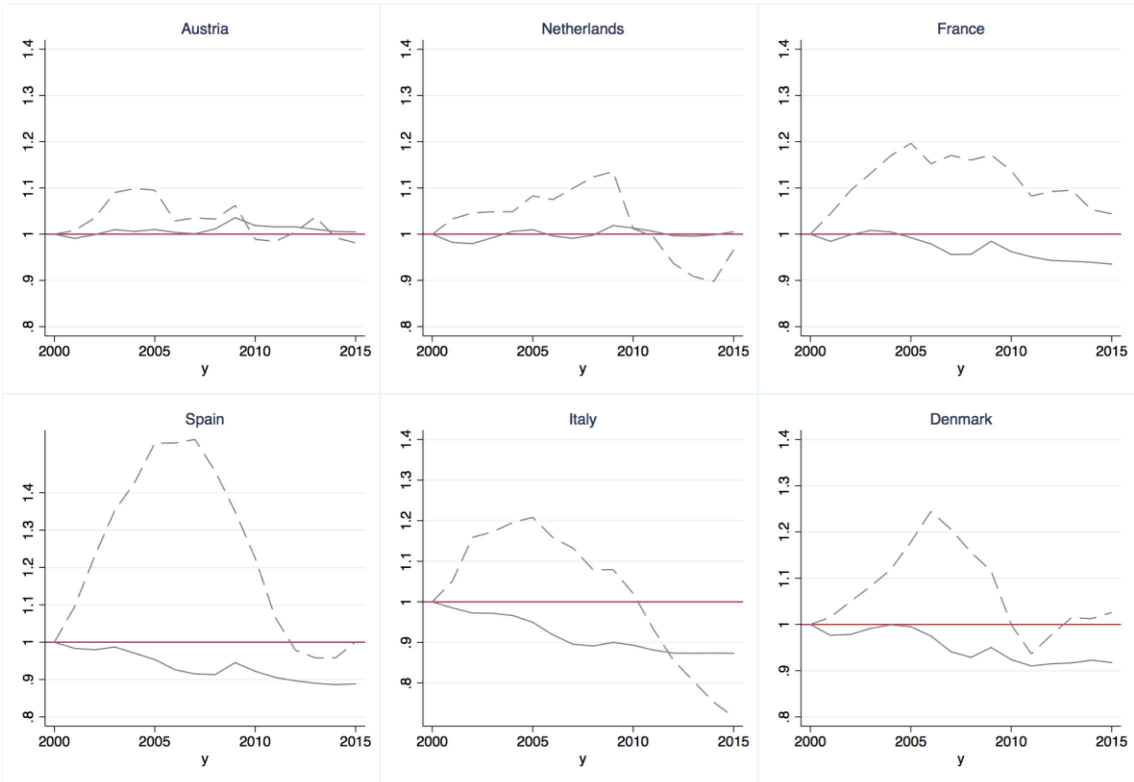
2.2 Investment and Productivity Growth

To date, Germany takes the lead in productivity growth. For this reason, we use it as a benchmark. Figure 2.1 illustrates the performance of various countries with respect to their productivity and investment growth relative to Germany as the benchmark.

In all six panels of Figure 2.1, the solid line represents countries' total factor productivity (TFP in the following, with 2000=100) relative to Germany's TFP (2000=100); the dashed line indicates countries' total investment (2000=100) relative to Germany's total investment (2000=100). Whereas Austria and the Netherlands closely follow Germany's TFP pattern, France, compared to Germany, has been facing a fall in relative TFP growth since the mid-2000s. This is puzzling when examining the relative investment index (dashed line) between France and Germany. France persistently made relatively higher investment efforts than Germany. Austria and the Netherlands, shown in the middle panel of the upper row in Figure 2.1, follow a pattern of TFP growth similar to that of Germany. Their relative increase in investment has also been slightly higher than that of Germany. The Netherlands reduced its investment sharply after the financial crisis while catching up in recent years. France, yet the third-largest economy in the EU, seems to have difficulties translating its investments into productivity gains, although its relative investment efforts were up to

20% higher than Germany's.[11] The three remaining countries, as depicted in this figure, show a similar evolution. The gradient of investment growth relative to Germany is higher for Spain, Italy, and Denmark; their productivity growth gradient, however, is lower. In Italy, investments apparently started to plummet after the financial crisis.

Figure 2.1: Countries' relative TFP (solid line) and relative total investment (dashed line)[12]



Source: EU KLEMS project

Not all countries invest in the same way, and not all manage to translate their investments in the same way into productivity (Castellani et al., 2016; Bacchiocchi and Montobbio, 2010). One possible explanation is the so-called *structural composition*. With regard to the composition of France's economy, as pointed out in Section 2.1, the manufacturing sector represents approximately 11% of GDP compared to that of Germany, with a share of 22.6%. As the manufacturing sector is more R&D intensive than the service sector, it is a matter of consequence that Germany should be investing more in R&D than France. A more challenging explanation, which we try to detect here, is the possible lack of capacity to translate investment into productivity (Ortega-Argilés et al. 2014).

The objective of this section is to investigate the differences in investment effects among European countries. With the econometric specification that we use, possible

[11] The term relative investment efforts takes the "fixed effects" of countries into account. This means that, for example, starting from a lower level of total investment in absolute terms, France increased its investment more intensively than Germany. Nevertheless, Germany, in absolute terms, spends more in investment than France.

[12] The solid line is the ratio between the TFP of the respective country and the German TFP. The TFP measure stems from the EU KLEMS data. It is an index (2000=100); thus, the ratio starts with 1 in 2000.

lag structures can be identified to reveal how much time it takes for investment to achieve its full effect. The duration between the time of investment and the resulting impact on productivity is unclear.[13] Some investments, such as investments in infrastructure to speed up transportation time, may have an immediate effect on productivity. The effect of other investment decisions will be less immediate and may not come to the fore in productivity statistics for years; the investment in R&D is one example.

To address this research question, we must ensure that the following requirements are met: (a) the data to be used must contain information on different types of investments, (b) the time span of the data must be sufficiently large to allow for a delayed effectiveness of investments as well as for a decay – in case the investment becomes obsolete over the course of time, and (c) the econometric specification must allow us to capture these mechanisms.

The database from the EU KLEMS project meets these requirements and is presented in s*ub-section B*. The empirical procedure, i.e., the distributed lag model, that we use to document the translational dynamics of investment into productivity (*sub-section C*), will allow us to model the cumulative effect of investment on productivity growth. The results are documented in *sub-section D*, in which we distinguish between the investment lag observed in investments in total assets and the different lags when decomposing investment into investments in tangible, ICT, and intangible assets.

As the results show, an investment lag can be identified, not only for total investment but also for sub-types of investment, that is, tangible, intangible, and ICT investments. The expected time of tangible investment's maximum effect is approximately 7 years. With respect to intangible and ICT investments, we could identify plausible investment lags only for the group of highly innovative countries. For these, the average time of maximum investment effectiveness is approximately 12 years for intangible investments and 14 years for ICT investment. Conversely, we could not find empirical evidence for decomposed investment types in the group of less innovative countries. Including France in the group of high-performing countries, an increase in the average investment lag, though not significant, could be detected. The results give some indication in favour of the hypothesis that France is possibly less successful in translating investment into productivity than the more innovative countries in Europe.

2.3 EU KLEMS Data

The data that we use stem from the Groningen project EU KLEMS (van Ark and Jäger, 2017). It offers the possibility of distinguishing ten different types of investments on the country level. It covers 12 countries of the European Union: Austria, Belgium, the Czech Republic, Denmark, Finland, France, Germany, Italy, Netherlands, Spain, Sweden, and the United Kingdom. The types of investment classes they offer are computing equipment, communications equipment, computer software and databases, transport equipment, other machinery and equipment, total non-residential investment, residential structures, cultivated assets, research and development, and other assets. We converted all variables into euros using OECD conversion rates.

To end up with the highest number of observations possible, we used the most fine-grained industry classification that the EU KLEMS data provide. The following

[13] Since France seems to invest significantly in ICT, we decided to specifically emphasise this type of investment. Therefore, we built three categories: tangible, intangible, and ICT.

industries were selected: food products, beverages and tobacco (10-12); textiles, wearing apparel, leather and related products (13-15); wood and paper products; printing and reproduction of recorded media (16-18); coke and refined petroleum products (19); chemicals and chemical products (20-21); rubber and plastics products, and other non-metallic mineral products (22-23); basic metals and fabricated metal products, except machinery and equipment (24-25); electrical and optical equipment (26-27); machinery and equipment n.e.c. (28); transport equipment (29-30); other manufacturing; repair and installation of machinery and equipment (31-33); wholesale and retail trade and repair of motor vehicles and motorcycles (45); wholesale trade, except for motor vehicles and motorcycles (46); retail trade, except for motor vehicles and motorcycles (47); transport and storage (49-52); postal and courier activities (53); publishing, audio-visual and broadcasting activities (58-60); telecommunications (61); IT and other information services (62-63); and professional, scientific, technical, administrative and support service activities (70-79).

The variables we employ in our production function estimation approach, presented in the next sub-section, concern the variables from the EU KLEMS project reported in

Table 2.1

Variable	Description	EU KLEMS Label
Y	Gross output, volume (2010 prices)	GO_QI
M	Intermediate inputs, volume (2010 prices)	II_QI
L	Total hours worked by persons engaged	H_EMP
I^{tot}	All assets*	Iq_GFCF
I^{ICT}	Computing equipment*	Iq_IT
	Communications equipment*	Iq_CT
I^{IN_TAN}	Computer software and databases*	Iq_Soft_DB
	Research and development*	Iq_RD
	Other IPP assets*	Iq_OIPP
I^{TAN}	$I^{tot} - I^{IN\_TAN}$	
$I^{TAN\_WO\_ICT}$	$I^{tot} - I^{IN\_TAN} - I^{ICT}$	
VA	Gross value added, volume (2010 prices)	VA_QI

** Real gross fixed capital formation volume (2010 prices)*

Table 2.1: Description of variables taken from the EU KLEMS database.

Variable	Description	EU KLEMS Label
Y	Gross output, volume (2010 prices)	GO_QI
M	Intermediate inputs, volume (2010 prices)	II_QI
L	Total hours worked by persons engaged	H_EMP
I^{tot}	All assets*	Iq_GFCF
I^{ICT}	Computing equipment*	Iq_IT
	Communications equipment*	Iq_CT
I^{IN_TAN}	Computer software and databases*	Iq_Soft_DB
	Research and development*	Iq_RD
	Other IPP assets*	Iq_OIPP
I^{TAN}	$I^{tot} - I^{IN\_TAN}$	
$I^{TAN\_WO\_ICT}$	$I^{tot} - I^{IN\_TAN} - I^{ICT}$	
VA	Gross value added, volume (2010 prices)	VA_QI

** Real gross fixed capital formation volume (2010 prices)*

In Table 2.2, we present summary statistics. When the most fine-grained disaggregation possible was chosen, more than 11 thousand observations could be retrieved.

Table 2.2: Summary statistics

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
ln(Y)	11,659	10.279	2.049	2.822	17.099
ln(L)	11,698	12.246	2.509	1.579	19.446
ln(M)	11,472	9.656	1.984	2.512	16.319
ln(I^{tot})	11,679	7.397	2.764	0.000	14.948
ln(I^{TAN})	11,469	7.099	2.743	0.000	14.721
ln(I^{INTAN})	11,469	5.562	2.824	0.000	13.567
ln(I^{ICT})	11,469	4.221	2.409	0.000	12.108
ln($I^{TAN\_WO\_ICT}$)	11,469	6.982	2.771	0.000	14.666
ln(VA)	11,730	9.482	2.124	-0.132	16.488

To provide an overview of the total investment of countries, the investment intensity of countries is reported in Table 2.3. The investment share in value added is calculated using the industry aggregation type of EU-KLEMS labelled "MARKT".[14] On average, 22% of value added (VA) accounts for total investment (I^{tot}), ICT investment (I^{ICT}) of approximately 1%, investment in tangible assets (I^{TAN}) of 17%, and investment in intangible assets (I^{IN_TAN}) of 5%. France's total investment share of 20% ranges in the middle, as does investment in ICT with a share of 1%. The investment of France in intangible and tangible assets amounts to 7% and 13%, respectively.

Table 2.3: Investment share in percent of value added (EU KLEMS type of aggregation: "MARKT").

In %VA	I^{tot}	I^{ICT}	I^{IN_TAN}	I^{TAN}	$I^{TAN\_WO\_ICT}$
Austria	23	2	5	19	17
Czech Republic	31	2	4	27	25
Germany	19	1	4	14	13
Denmark	22	1	6	16	15
Spain	23	1	3	20	18
Finland	20	1	7	13	12
France	20	1	7	13	12
Italy	21	1	3	17	16
Luxembourg	17	1	2	16	15
Netherlands	18	1	5	13	12
Sweden	26	2	10	16	14
Slovakia	26	2	2	24	23
United Kingdom	17	1	5	12	12
Mean	22	1	5	17	16

[14] This means the exclusion of the following sectors: real estate activities (L); public administration and defence; compulsory social security (O); education (P); health and social work (Q); activities of households as employers; undifferentiated goods- and services-producing activities of households for own use (T); and activities of extraterritorial organizations and bodies (U).

Because the objective of this exercise is to detect differences not only in investment lags among types of investment but also between countries, we intended to perform regressions on each country. However, single-country regressions did not render any significant results, possibly due to the low number of observations. Therefore, we used groups of countries to produce plausible results. The criterion for grouping countries is the country ranking by the European Innovation Scoreboard (EIS).[15] As investment is key to a country's innovativeness, and we thought it would be straightforward to group countries according to their innovativeness. The most innovative countries (*HIGH_SB*) according to the European Innovation Scoreboard are Austria, Denmark, Finland, Germany, the Netherlands, Sweden, and the United Kingdom. The group of low-performing countries (*LOW_SB*) in our sample consists of the Czech Republic, Spain, Italy, Luxembourg, and Slovakia. These two groups bracket France as a mid-performing country in terms of innovativeness.

2.4 Econometric Specification

With respect to the econometric specification, we follow a production function estimation approach. The traditional Cobb-Douglas production function reads as follows:

$$Y = AK^{\beta_K}L^{\beta_L}M^{\beta_M}$$

Since capital stock (K) is a compound measure of past investment, the time dimension may be lost in the aggregation process. Therefore, we adapt the production function to the following form:

$$Y = A\left(\prod_{\tau=1}^{\tau=T} e^{\omega_{t-\tau}} I_{t-\tau}\right)^{\beta_K} L^{\beta_L} M^{\beta_M} \qquad (1)$$

Instead of capital (K) as a stock variable, we use investment attached to a distributed lag structure. This ensures that we capture the time dimension of productivity effects from investment. Letter A in equation 1 denotes total factor productivity; Y, total output; L, labour; and M, material. The parameters to be estimated, which are associated with labour, material and investment, are labelled β_L, β_M, and β_K, respectively. Parameter ω indicates the weights of the time-dependent investment type, lagged by τ years. The optimal number of lags T must be determined in the regression procedure later.

The advantage of a distributed-lag-structure model is that it circumvents the autoregression problem faced in aggregated time series by imposing a specific lag structure. The drawback is that which parametric structure appears plausible for the effectiveness of investment must be decided beforehand. The literature on distributed-lag-structure models provides many conceivable specifications: Koyck (1954) proposes a structure with geometrically successively decreasing lags, Solow (1960) generalises Koyck's idea with a Pascal distribution, Almon (1965) implements a polynomial structure, and Gambardella (1995) and others use a Poisson structure. Each of the lag structures makes strong assumptions about the dynamic process, which can lead to quite implausible results. A polynomial lag of more than two degrees often leads to negative coefficients. Although it might be conceivable that investment might have negative effects on productivity at times, on an aggregate level, it seems rather implausible. Using a Poisson lag structure, negative effects are excluded by definition. In other words, a Poisson lag structure imposes the assumption that investments always have a positive effect on productivity. As we perform our analysis

[15] see http://ec.europa.eu/growth/industry/innovation/facts-figures/scoreboards_en

on an aggregate level, comparing productivity effects of investment across countries, we decided to make this strong assumption and use a Poisson lag structure.

To implement this approach, we take the log of equation 1. Lowercase letters indicate logged values. Therefore, the extended production function distributed lag structure, including an error term ε, reads as follows:

$$Y = a + \beta_L l + \beta_M m + \sum_{j=1}^{J} \beta_K^j \sum_{\tau=1}^{L} \omega_\tau \, i_\tau^j + \varepsilon \qquad (2)$$

To impose a Poisson lag structure, we substitute ω_τ for $e^{-\lambda}\lambda^\tau/\tau!$ and obtain equation 3 with the typical Poisson weights:

$$Y = a + \beta_L l + \beta_M m + \sum_{j=1}^{J} \beta_K^j \sum_{\tau=1}^{L} \frac{e^{-\lambda}\lambda^\tau}{\tau!} \, i_\tau^j + \varepsilon \qquad (3)$$

The different types of investment are denoted i^j. The weights $e^{-\lambda}\lambda^\tau/\tau!$ for the specific investment type j can be interpreted as the total resulting variation in output given one unit change in i^j. As the weights follow a Poisson distribution, a unit change may affect output immediately and decay over time, or it may initially increase and then decline after a given time.

For implementation purposes, the following steps are taken:

1. Subtract country-industry fixed effects, and add the overall mean of the logged variables.
2. Instrument labour (L), as it is an endogenous variable (1st-step regression).
3. Determine the optimal lag structure. (2nd-step regression).
4. Retrieve the mean time lag (λ) and the impact coefficient (β_K).
5. Compare the λs according to the selected classification of the investment and country groups.

This procedure was applied in all subsequent models. Note that lowercase letters indicate logged and demeaned variables. To instrument labour, we use a two-stage least-square approach: we regress the log of labour *(l)* on the log of material input *(m)*, the log of capital stock *(k)*, a full set of year dummies, and the contemporaneous and the first two lags of the differenced values of labour (*l*). We use the predicted values from the OLS regression as an instrument for labour in the successive estimation. Since the Poisson lag structure is non-linear, non-linear estimation techniques must be applied.[16] To determine the optimal lag length, we use the Akaike information criterion (AIC).

2.5 Results

2.5.1 The Lag Structure of Investment on Gross Output

[16] We use STATA 15 to perform all regressions. We start with two lags and use the estimates as initial values for the regression model with three lags, etc.

For a general picture of the investment lag structure across countries, we start with countries' total investment. The second-step non-linear regression model reads as follows:

$$Y = a + \beta_L * l + \beta_M * m + \beta_K^{tot} \sum_{\tau=1}^{T} \frac{e^{-\lambda}\lambda^{\tau}}{\tau!} i_{\tau}^{tot} + D + \varepsilon \qquad (4)$$

The constant is labelled *a*. We include the log of labour (*l*) with its associated parameter β_L as well as the log of material (m) with parameter β_M. As pointed out above, instead of capital stock, we use investment, i.e., the log of total investment (i^{tot}) with a Poisson lag structure. The lag-specific weights, denoted $e^{-\lambda}\lambda^{\tau}/\tau!$, depend on parameter λ, which reflects the mean number of years to pass until the maximum impact of investment takes effect. The optimal number of lags to use in the respective 2[nd] step regression is represented by *T*, whereas *D* stands for a full set of year dummies. The dependent variable *Y* stands for gross output.

Although not all of the regression runs are of interest, we report the regression results for a selected number of lags (see Table 2.4) to show the consistency of our regressions. When the regressions based on the AIC information criterion are compared, the lowest AIC value serves as the selection criterion for choosing the optimal lag length. The optimal number of lags to choose, in this case, appears to be 10 lags, as the model with 10 lags shows the lowest AIC value. The estimate of β_L suggests that approximately 37% of the output can be explained by labour, 53% by material, and approximately 9% by investment. The parameter of interest, i.e., λ, indicates approximately seven or eight years until an additional euro of investment unfolds its maximum impact on total output.

The estimates of the remaining regressions show that the estimates of β_L and β_M are quite stable despite using different time lags for investment. Parameter β_K^{tot}, which stands for the impact of investment on output, remains stable up to eleven lags (model 8). When the number of lags is increased beyond 11 years, the estimates skyrocket and become insignificant. Therefore, the AIC of the respective models tell us to reject lags longer than 10 years.

In Table 2.5, we repeat the same exercise with investments in tangible assets i^{TAN}. Recall that this variable does not contain investment in computer software, databases, research and development or investment in other IPP assets. The specification of the regression equation is as follows:

$$Y = cons + \beta_L * l + \beta_M * m + \beta_K^{TAN} \sum_{\tau=1}^{T} \frac{e^{-\lambda}\lambda^{TAN^{\tau}}}{\tau!} i_{\tau}^{TAN} + D + \varepsilon \qquad (5)$$

The selection of regression models with different lags, shown in this table, delivers a very similar picture. A lag of ten to eleven years provides the best estimation results. Compared to Table 2.4, the estimates of λ^{TAN} are slightly lower, reporting less than seven years. Note that when higher lags are used in this setting, the estimates of all coefficients remain stable. This finding suggests that the turbulence observed in the coefficient estimates with higher lag orders in Table 2.4 must be related to the investments in intangible assets.

Table 2.4: Lag structure of total investment and its impact on total output

Dependent Variable: ln(y)												
VARIABLES	2 lags	5 lags	6 lags	7 lags	8 lags	9 lags	10 lags	11 lags	12 lags	13 lags	14 lags	15 lags
β_L	0.305***	0.297***	0.299***	0.308***	0.328***	0.359***	0.373***	0.373***	0.377***	0.405***	0.421***	0.410***
	(0.028)	(0.028)	(0.027)	(0.027)	(0.027)	(0.026)	(0.025)	(0.025)	(0.026)	(0.028)	(0.028)	(0.028)
β_M	0.570***	0.561***	0.559***	0.554***	0.545***	0.533***	0.528***	0.528***	0.537***	0.539***	0.541***	0.550***
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.016)	(0.017)
β_K^{tot}	0.069***	0.074***	0.074***	0.076***	0.078***	0.086***	0.091***	0.091***	0.114***	1.717	2.906	4283972.7
	(0.012)	(0.009)	(0.008)	(0.008)	(0.008)	(0.009)	(0.009)	(0.009)	(0.027)	(4.135)	(10.985)	(0.000)
λ^{tot}	1.600**	2.858***	3.077***	3.650***	4.771***	6.724***	7.765***	7.765***	10.355***	18.505***	19.945***	41.533***
	(0.680)	(0.368)	(0.345)	(0.362)	(0.422)	(0.539)	(0.571)	(0.571)	(1.092)	(4.918)	(7.243)	(0.318)
a	0.744***	0.744***	0.721***	0.647***	0.490**	0.242	0.111	0.111	0.092	-0.104	-0.238	-0.120
	(0.199)	(0.196)	(0.195)	(0.194)	(0.192)	(0.189)	(0.188)	(0.188)	(0.201)	(0.219)	(0.223)	(0.217)
Observations	2,832	2,832	2,832	2,832	2,832	2,832	2,832	2,832	2,587	2,342	2,097	1,852
R^2	0.814	0.816	0.817	0.817	0.817	0.818	0.819	0.819	0.805	0.803	0.810	0.813
Min. year	2001	2001	2001	2001	2001	2001	2001	2001	2002	2003	2004	2005
AIC	-7978,68	-8010,84	-8014,97	-8020,21	-8025,65	-8035,1	-8045,88	-8045,88	-7618,9	-7212,15	-6737,69	-6286,26
RMSE	0.0588	0.0585	0.0585	0.0584	0.0583	0.0582	0.0581	0.0581	0.0552	0.0515	0.0481	0.0439
Adj. R^2	0.813	0.815	0.815	0.816	0.816	0.817	0.817	0.817	0.804	0.802	0.809	0.812
Numb. iterations	3	10	11	20	44	31	22	5	32	361	19	265

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

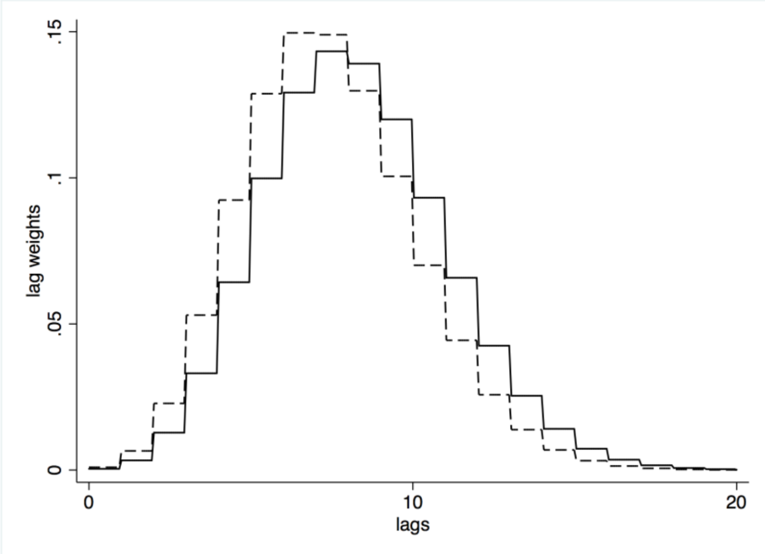
Table 2.5 Lag structure of investment in tangible assets (TAN) and the impact on output (y)

Dependent Variable: ln(y)												
VARIABLES	2 lags	5 lags	6 lags	7 lags	8 lags	9 lags	10 lags	11 lags	12 lags	13 lags	14 lags	15 lags
β_L	0.249***	0.237***	0.235***	0.237***	0.238***	0.238***	0.239***	0.239***	0.234***	0.247***	0.287***	0.319***
	(0.027)	(0.027)	(0.027)	(0.027)	(0.027)	(0.026)	(0.026)	(0.026)	(0.028)	(0.031)	(0.032)	(0.033)
β_M	0.611***	0.611***	0.613***	0.613***	0.612***	0.611***	0.611***	0.611***	0.614***	0.609***	0.594***	0.584***
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.016)	(0.018)	(0.019)
β_K^{TAN}	0.027***	0.041***	0.048***	0.064***	0.053***	0.048***	0.045***	0.045***	0.045***	0.046***	0.048***	0.052***
	(0.008)	(0.009)	(0.011)	(0.017)	(0.008)	(0.005)	(0.005)	(0.005)	(0.006)	(0.006)	(0.007)	(0.009)
λ^{TAN}	1.085	4.447***	5.555***	7.316***	7.054***	6.875***	6.970***	6.970***	6.989***	7.069***	7.449***	8.254***
	(0.849)	(0.868)	(0.920)	(1.054)	(0.798)	(0.643)	(0.569)	(0.569)	(0.612)	(0.647)	(0.756)	(0.944)
a	1.215***	1.262***	1.252***	1.204***	1.186***	1.179***	1.165***	1.165***	1.215***	1.112***	0.787***	0.533**
	(0.203)	(0.200)	(0.198)	(0.195)	(0.195)	(0.194)	(0.193)	(0.193)	(0.208)	(0.231)	(0.240)	(0.240)
Observations	2,732	2,732	2,732	2,732	2,732	2,732	2,732	2,732	2,487	2,242	1,997	1,752
R^2	0.817	0.818	0.819	0.820	0.821	0.821	0.822	0.822	0.812	0.810	0.810	0.814
Min. year	2001	2001	2001	2001	2001	2001	2001	2001	2002	2003	2004	2005
AIC	-7982,96	-8003,2	-8013,3	-8031,42	-8041,69	-8048,08	-8054,2	-8054,2	-7556,59	-7104,53	-6514,97	-5972,75
RMSE	0.0558	0.0556	0.0555	0.0553	0.0552	0.0552	0.0551	0.0551	0.0526	0.0493	0.0470	0.0436
Adj. R^2	0.816	0.817	0.818	0.819	0.820	0.820	0.821	0.821	0.811	0.809	0.809	0.812
Numb. iterations	6	15	12	13	8	7	8	2	7	6	7	8

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Figure 2.2 illustrates the results of a 10-year lag structure found in Tables 2.4 and 2.5. The solid line describes the lag structure of total investment. The dashed line depicts tangible assets, subtracting intangible investments, investment in computer software, databases, research and development, and investment in other IPP assets from total investment. Compared to investment in total assets, the dynamics of the effectiveness of tangible investments are slightly lower.

Figure 2.2: Poisson lag structure with $\boldsymbol{\lambda}^{tot} = \mathbf{7.77}$ (solid line) and $\boldsymbol{\lambda}^{TAN} = \mathbf{6.97}$ (dashed line)



2.5.2 The Lag Structure of Types of Investment on Gross Output

The decomposition of investment allows us to shed some light on the time lags of specific investments and their effect on output. To carve out certain types of investment, we decided to use the following classification: investment in tangible assets without tangible investment in ICT ($I^{TAN\_WO\_ICT}$), investment in intangible assets (I^{IN_TAN}), and investment in ICT (I^{ICT}). In principle, the estimation procedure is the same as above. After instrumenting labour in the first step, the second-stage non-linear regression equation is as follows:

$$Y = cons + \beta_L * l + \beta_M * m + \sum_{z=1}^{3} \beta_K^i \sum_{\tau=1}^{T} \frac{e^{-\lambda} \lambda^{i^{\tau}}}{\tau!} i_\tau^z + D + \varepsilon \qquad (6)$$

for $z = \{TAN\_WO\_ICT, IN\_TAN, \text{ICT}\}$. The results are gathered in Table 2.6, which summarises three groups of regressions. Each group contains the second-stage regression with two different lag lengths. Models 1 and 2, for example, are based on the same regression equation but with different time lags. Regression 1 assumes a lag of 10 years and regression 2 a lag length of 15 years.[17] According to the AIC, model 2 is the preferred model. The average time until the main effect of ICT investment unfolds is almost 17 years. The choice of the lag length also holds for models 4 to 6; the preferred lag length is 15 years. In model 4, λ^{ICT} is approximately 17 years. When including all three types of investment in a single regression, as in model 6, λ^{ICT} and λ^{IN_TAN} increase even more, λ^{ICT} to approximately 20 years and λ^{IN_TAN} to approximately 22 years, in contrast to $\lambda^{TAN\_WO\_ICT}$, which remains stable at approximately 7 years. The problem, however, is that the impacts of the investment in intangible assets $\beta_K^{IN\_TAN}$ and of ICT investment β_K^{ICT} are insignificant. Hence, a direct impact on output growth cannot be

[17] We performed several regressions with different lag lengths and chose the lag lengths with the lowest AIC.

corroborated. Only parameters $\beta_K^{TAN\_WO\_ICT}$ and $\lambda^{TAN\_WO\_ICT}$ remain robust, with approximately 0.05 and 7, respectively.

Table 2.6: Investment decomposition: tangibles, intangibles, and ICT.

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	10 lags	15 lags	10 lags	15 lags	10 lags	15 lags
β_L	0.324*** (0.031)	0.338*** (0.031)	0.303*** (0.033)	0.332*** (0.033)	0.294*** (0.032)	0.345*** (0.031)
β_M	0.597*** (0.018)	0.576*** (0.019)	0.592*** (0.019)	0.564*** (0.019)	0.611*** (0.018)	0.566*** (0.018)
$\beta_K^{TAN\_WO\_ICT}$	0.050*** (0.010)	0.050*** (0.007)	0.033*** (0.007)	0.040*** (0.006)	0.035*** (0.006)	0.042*** (0.005)
$\lambda^{TAN\_WO\_ICT}$	8.642*** (1.052)	7.714*** (0.459)	7.104*** (0.961)	6.920*** (0.551)	7.145*** (0.880)	7.089*** (0.493)
$\beta_K^{IN\_TAN}$	$539.1*10^3$ ($2.2*10^6$)	0.090* (0.054)			$2.3*10^6$ (0.000)	0.174 (0.767)
λ^{IN_TAN}	39.207 (55.643)	16.88*** (2.773)			41.355*** (0.475)	21.880* (12.207)
β_K^{ICT}			0.104 (0.097)	0.101** (0.043)	191.805 (2,290.826)	0.287 (0.221)
λ^{ICT}			13.18*** (2.837)	17.09*** (1.895)	27.941 (18.306)	20.36 *** (2.417)
a	0.273 (0.233)	0.136 (0.231)	0.627*** (0.243)	0.493** (0.239)	0.495** (0.231)	0.192 (0.225)
Observations	1,741	1,741	1,752	1,752	1,741	1,741
R^2	0.837	0.841	0.815	0.820	0.838	0.848
Min. year	2005	2005	2005	2005	2005	2005
AIC	-6163,91	-6202,5	-5980,56	-6026,86	-6169,67	-6280,4
RMSE	0.0408	0.0403	0.0434	0.0429	0.0407	0.0394
Adj. R^2	0.836	0.839	0.813	0.818	0.836	0.846
Numb. iterations	3321	40	26	46	1237	76

Standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

Next, we will investigate whether there is a difference in investment effects between the most innovative and the least innovative countries. A specific focus will be placed on France. As regressions for individual countries do not converge in most cases because of insufficient information, we decided to perform all regressions with and without France to test whether France makes a difference. With respect to the ranking of countries, the European Innovation Scoreboard is employed to obtain country rankings according to their innovative performance. As pointed out above, the high-performing countries contained in the EU KLEMS dataset are Austria, Denmark, Finland, Germany, Sweden, the Netherlands, the United Kingdom(, and France) (*HIGH_SB*), and the lower-performing group (*LOW_SB*) is the Czech Republic, Spain, Italy, Luxembourg, Slovakia(, and France).

Table 2.7: Investment lags of highly innovative countries.

	(7)	(7fr)	(8)	(8fr)	(9)	(9fr)
VARIABLES	without FR	with FR	without FR	with FR	without FR	with FR
β_L	0.370***	0.340***	0.354***	0.340***	0.386***	0.347***
	(0.032)	(0.031)	(0.045)	(0.041)	(0.043)	(0.039)
β_M	*0.487****	*0.528****	*0.498****	*0.531****	*0.482****	*0.527****
	(0.020)	(0.019)	(0.029)	(0.026)	(0.028)	(0.024)
β_K^{tot}	0.155***	0.169***				
	(0.020)	(0.033)				
λ^{tot}	8.989***	10.074***				
	(0.713)	(0.925)				
β_K^{TAN}			0.104***	0.094***	0.106***	0.097***
			(0.009)	(0.008)	(0.009)	(0.009)
λ^{TAN}			8.644***	8.655***	8.545***	8.561***
			(0.469)	(0.485)	(0.455)	(0.475)
$\beta_K^{IN\_TAN}$					0.048***	0.044***
					(0.012)	(0.014)
λ^{IN_TAN}					11.713***	12.741***
					(2.256)	(2.799)
β_K^{ICT}			0.128***	0.124***	0.113***	0.112***
			(0.013)	(0.014)	(0.015)	(0.017)
λ^{ICT}			13.839***	14.278***	14.311***	14.895***
			(0.672)	(0.754)	(0.888)	(1.037)
a	0.361	0.395*	0.350	0.270	-0.114	-0.033
	(0.234)	(0.224)	(0.299)	(0.288)	(0.302)	(0.285)
Observations	1,609	1,849	949	1,114	949	1,114
R^2	0.784	0.798	0.797	0.812	0.803	0.815
Min. year	2000	2000	2005	2005	2005	2005
AIC	-4804.58	-5615.04	-3375.04	-4043.08	-3396.4	-4055.23
RMSE	0.0539	0.0526	0.0401	0.0388	0.0396	0.0385
Adj. R^2	0.781	0.796	0.794	0.810	0.799	0.812
Numb. iterations	9	10	13	15	17	16

Table 2.7 reports the results when performing the above regressions on the sub-sample of the best-performing group of countries (HIGH_SB). Model 7 uses regression equation (4) and thus takes into account the investment in total assets of HIGH_SB countries when calculating the underlying lag structure. The optimal number of lags in this model is 10 years. The corresponding results indicate $\lambda^{tot} = 8.99$. Hence, the maximum effect of an additional euro, invested in HIGH_SB countries, can be expected after approximately 9 years. Adding France to this group renders column 7fr. As a result, λ^{tot} slightly increases to 10.1 years. In other words, the average investment effects slow down by one year. Unfortunately, there is no statistical evidence that this change is significant. A further decomposition of tangible investments into tangible investments without ICT ($I^{TAN\_WO\_ICT}$) and investment in ICT (I^{ICT}) discloses a significant gap in the time lapse of effectiveness between the two investment types.

Table 2.8: Explicit and accumulated lag weights (specification model (9))

lag	weight TAN	weight INTAN	weight ICT	weight TAN	weight INTAN	weight ICT
	a)	explicit weights		b)	accumulated weights	
1	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00
3	0.01	0.00	0.00	0.01	0.00	0.00
4	0.02	0.00	0.00	0.03	0.00	0.00
5	0.04	0.01	0.00	0.07	0.01	0.00
6	0.07	0.02	0.00	0.15	0.02	0.00
7	0.11	0.03	0.01	0.25	0.05	0.01
8	0.13	0.05	0.01	0.38	0.10	0.03
9	0.14	0.07	0.03	0.52	0.17	0.05
10	0.13	0.09	0.04	0.65	0.27	0.10
11	0.11	0.11	0.06	0.76	0.38	0.16
12	0.09	0.12	0.08	0.84	0.49	0.23
13	0.06	0.11	0.09	0.91	0.61	0.33
14	0.04	0.10	0.10	0.95	0.71	0.43
15	0.02	0.09	0.11	0.97	0.80	0.54
16	0.01	0.07	0.10	0.99	0.86	0.64
17	0.01	0.05	0.09	0.99	0.91	0.73
18	0.00	0.03	0.08	1.00	0.95	0.80
19	0.00	0.02	0.06	1.00	0.97	0.86
20	0.00	0.01	0.05	1.00	0.98	0.91
21	0.00	0.01	0.03	1.00	0.99	0.94
22	0.00	0.00	0.02	1.00	1.00	0.96
23	0.00	0.00	0.01	1.00	1.00	0.98
24	0.00	0.00	0.01	1.00	1.00	0.99
25	0.00	0.00	0.01	1.00	1.00	0.99
26	0.00	0.00	0.00	1.00	1.00	1.00

Model 8, not counting France among the group of high performers, shows that the expected time span until the maximum effectiveness of tangible investments is approximately 9 years, in contrast to investments in ICT, which take approximately five years longer.[18] Adding France to this group of countries increases λ^{ICT} again – though not to a significant extent. Model 9 disaggregates investment types into three categories ($I^{TAN\_WO\_ICT}, I^{IN\_TAN}$, and I^{ICT}). With all three types of investments included (model 10), investment in tangible assets has its largest effect after approximately 12 years, and ICT investments take approximately 14 years. When France is added, the time spans for intangibles as well as ICT investment slightly increase – but also not to a significant extent. The difference between Table 2.6 and Table 2.7 is that we leave out the less innovative countries. The exclusion renders the coefficients $\beta_K^{IN\_TAN}$ and β_K^{ICT} significant; hence, the group of high-performing countries provides evidence that investments in all three types of assets translate into productivity growth. Conducting the same exercise for the low-performing group of countries delivers neither plausible nor significant results. For this reason, we did not report those estimations.

For high performers, the evidence supports the intuition that investments increase productivity. The magnitude of the coefficients also indicates that there are different degrees of effectiveness. When France is counted among the group of highly innovative countries (model 9fr), $\beta_K^{TAN\_WO\_ICT}$ is approximately 0.1, $\beta_K^{IN\_TAN}$ is 0.04, and β_K^{ICT} is 0.11.

[18] In models 7 and 7fr, we use 10 lags, and in models 8, 8fr, 9, and 9fr, we use a lag of 15 years to estimate the lag structure of investment types. The lag length was decided based on the the AIC.

Suppose that investment increases by 10%; output will eventually increase by 1%, 0.4%, and 1.1% due to investment in tangibles, intangibles, and ICT, respectively. To illustrate the dynamics, Table 2.8 reports the corresponding lag-specific weights. The column "weight TAN" reflects the lag weights for tangible investment. We observe the highest lag weights for the lag of nine years with weight = 0.14; for intangibles, it is 12 years (weight INTAN = 0.12), and for ICT, it is 15 years (weight ICT =0.11). Accumulating each column of the explicit weights leads to the last three columns of that table. For tangible investments, 52% of the total effect is reached after 9 years, and after 18 years, the growth effect fades out; i.e., the accumulated weight reaches 1. For intangibles, 50% of the total effect is reached after 12 years with a fade-out of 22 years, and for ICT, the half-time is less than 15 years with a fade-out of 26 years. Whereas these weights indicate only the shares in the total effect of investment that sums up to one, they do not describe the actual growth effect. For this, the weights must be multiplied by their respective β-coefficients. The latter scale the timely effect of investment. Figure 2.3 illustrates the relationship between weights and impact parameters β.

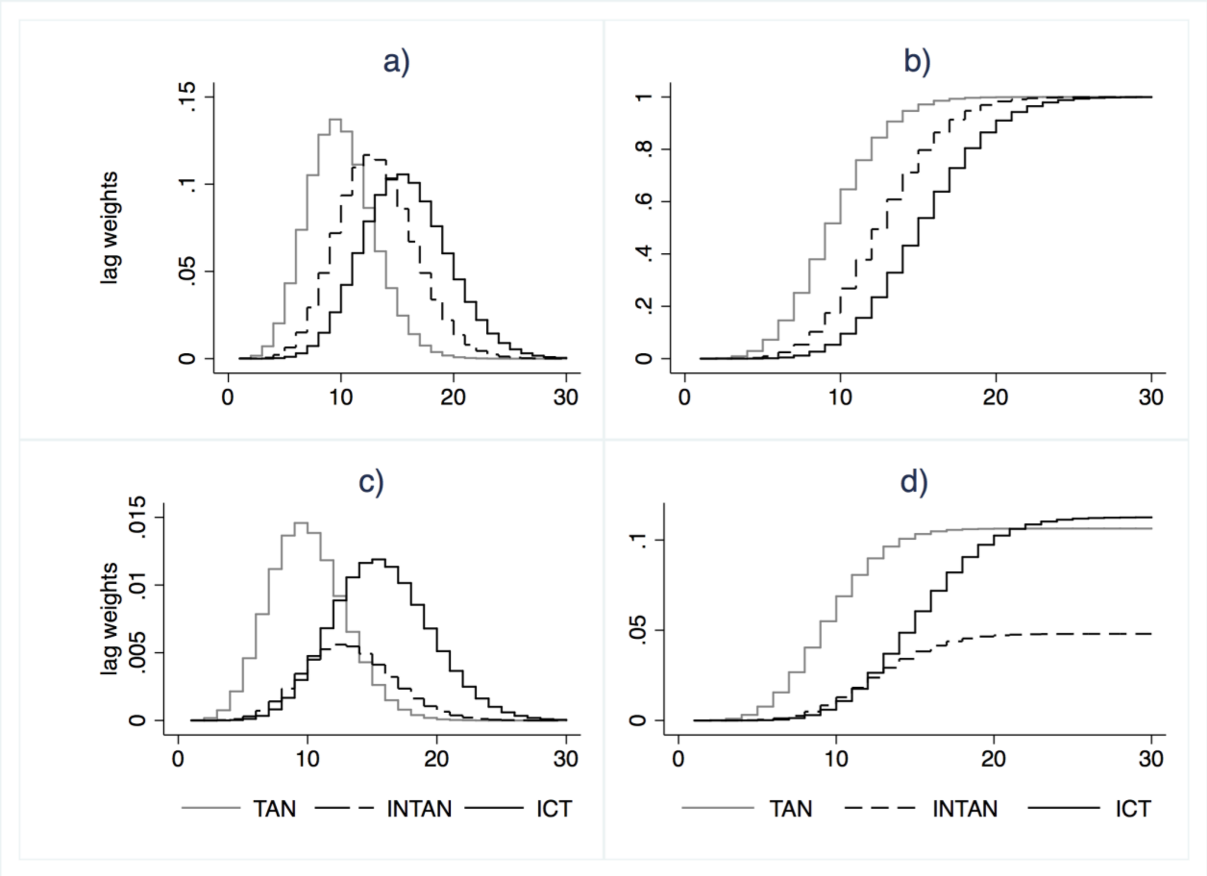
Panel a) illustrates the explicit weights, as reported in Table 2.8 (columns a). Panel b) depicts the last three columns, which are the accumulated counterparts (columns b). Multiplying the β-coefficients by their explicit weights rescales the weight distribution. The outcome is the actual effect of investment on output. This reduces the weights to 10% for tangible investments (grey line in panel a), to 4% for intangibles and to 11% for ICT. Panel c) illustrates the evolution of the actual impact of investment on productivity.

As the four panels point out, investments in tangibles have the most immediate effect on productivity growth, followed by investments in intangible assets and ICT investments. As far as the accumulated long-term effect of investment is concerned (panel d), the results suggest that the long-term effect of ICT investments is highest compared to investments in tangibles and intangibles. The effect of ICT investments is twice as high as that of investments in intangible assets. It is even slightly higher than the long-term effect of investments in tangibles.

These results support the findings of Thum-Thysen et al. (2017) and the work by Corrado et al. (2012, 2013). Thum-Thysen et al. (2017) underline the role of investments in intangible assets. As we use a Poisson lag structure estimation technique instead of a heterogeneous dynamic panel regression model (pooled mean group (PMG) estimation),[19] we obtain time lags for each type of investment. The discrepancy between their and our findings is that the effect of investments in intangibles is not three times as much as the effect of investment in tangibles. This is due to distinguishing three types of assets with ICT as a third category.

[19] The pooled mean group (PMG) estimation, which they use, is an error correction model that yields an average time span of investment effects on productivity growth. The Poisson lag structure allows us to distinguish different time spans between different kinds of investment in a single model.

Figure 2.3: Lag weights (a), accumulated lag weights (b), effective lag weights (c), and accumulated effective lag weights (d)



2.5.3. Scenarios

The results show that the type of investment is decisive in boosting output. The investment in tangible assets takes the largest share in total investment, whereas the impact on output is largest for ICT investments ($\beta_K^{ICT} = 11\%$), according to our model (9fr). Among the three types of investment, the investments in intangibles have the lowest impact, with $\beta_K^{INTAN} = 4\%$. Hence, the effect of one euro invested in ICT in total is almost three times as high as in the case of intangibles.

Given the robustness of the results, the investment strategy followed by France can be put into perspective. For one euro value added, France (Germany) invests 0.8% (*1.0%*) in ICT, 12.9% (*5.4%*) in intangibles and 10% (*14.0%*) in tangibles. To understand the extent to which this investment strategy matters in terms of output, we develop several scenarios. Using Germany as a benchmark, we calculate counterfactuals for France: What effect would a different investment strategy have on French output? The scenarios that we consider are summarised in Table 2.9.

Table 2.9: Scenarios for France using different investment strategies

		France	Germany
Level of Investment	France	Scenario S0	Scenario S2
	Germany	Scenario S1	Scenario S3

The scenarios include the following counterfactual items:

S0: Keep actual investment situation in France (base scenario)

S1: Adjust the French total investment per value added ratio to the German ratio

S2: Keep the French investment structure and impose the German investment level

S3: Adjust both the structure and the level of France's investment to the German structure and level of investment

The base scenario (S0) is calculated according to equation (7):

$$S0 = \beta_K^{TAN} \sum_{\tau=1}^{T} \frac{e^{-\lambda} \lambda^{TAN^{\tau}}}{\tau!} i_\tau^{TAN} + \beta_K^{INTAN} \sum_{\tau=1}^{T} \frac{e^{-\lambda} \lambda^{INTAN^{\tau}}}{\tau!} i_\tau^{INTAN} + \beta_K^{ICT} \sum_{\tau=1}^{T} \frac{e^{-\lambda} \lambda^{ICT^{\tau}}}{\tau!} i_\tau^{ICT} \quad (7)$$

For scenario S1, we rescale the investment variables $i_\tau^{TAN}, i_\tau^{INTAN}, and\ i_\tau^{ICT}$ so that the sum of all three types of investment reaches the relative investment level per value added of Germany while keeping the share of investment types (investment structure) constant. In scenario S2, the amount of the total investment of France remains unchanged, but the structure is adjusted to the German case. Scenario 3 combines the two manipulations with a rescaling and a restructuring of French investments to match the German case.

Having calculated all four scenarios, we compare scenarios S1, S2, and S3 with the base scenario, S0, by calculating the relative change in output yielded by each scenario. Table 2.10 collects the results. Comparing scenario S0 with itself generates trivia, as it renders a change of 0%, whereas changing only the structure of French investments to the German structure (S1) produces a change of 3.5%. Hence, output would increase by 3.5%. Adjusting the level of investments to Germany's investment level is tantamount to reducing French investments in all three types by the same proportion (S2). In this scenario, the French output would decrease by 2.9%. Combining both in scenario S3, that is, reducing France's investment level and adjusting its structure to that of Germany, would still induce an increase in output of 0.6%.

Table 2.10: Scenarios for France using different investment strategies

		France	Germany
Level of investment	France	0.0%	-2.9%
	Germany	3.5%	0.6%

Despite the fact that our estimations are based on aggregate data, which possibly do not capture all the relevant information about countries' output determinants, these results reveal that France does not necessarily have a general investment problem per se. It invests more per euro of value added than Germany does. Solely reducing investments would make the output situation worse, but changing the composition of investment could create a positive effect on output. According to the estimations, France could even reduce its investments without hurting output, provided that it restructured its composition of investments.

Furthermore, France invests more than twice as much as Germany, measured in value added, in intangible assets. Considering the relatively low impact (β_K^{INTAN}=4.4%) of intangibles on output, it seems that France invests excessively in intangibles. A euro invested in ICT or tangibles would have a much higher impact. Differences in the investment structure might be due to the differences in countries' sectoral composition. Nonetheless, it is doubtful whether the incentive to invest in intangibles in France can be explained solely by market forces. Figure 2.12 in chapter 0 substantiates this conjecture even further. In contrast to Germany, France supports private R&D with substantial tax incentives, yet its innovative output is lower than that of Germany (Grebel, 2017).

It must be emphasised that this study requires further research based on less aggregated data to provide a full understanding of the mechanism behind investment behaviour. What we may conclude from this study, however, is that France should reconsider its public R&D support.

2.6 Summary, Discussion, and Caveats

This chapter investigated the lag structure of investment. We applied a 2-stage non-linear least square estimation technique to estimate the lag structure of different types of investment in selected European countries. To cope with endogeneity, we instrumented labour in a first-stage regression. We used its predictions as instruments, which were inserted in the 2nd-stage non-linear regression model. The basic regression equation resembles a standard Cobb-Douglas production function estimation procedure. Instead of using capital as the typical stock of capital, we substituted capital for an investment lag structure. In doing so, we capture the dynamic effects of investment on output growth.

The data in this study stem from the EU KLEMS project. As these data are generated in a consistent way across a selection of European countries, they are predestined for this type of analysis. Furthermore, the EU KLEMS data offer a detailed classification of investment types, which we make use of in our study.

The results show that different lag structures for different types of investment can be identified. Tangible investment, intangible investment and ICT investment require different time spans to take effect. On average, tangible investments can be expected to unfold their maximum effect on output after approximately 8 to 9 years. With respect to investments in intangibles and ICT, the lag structure is equivocal when all countries are taken into account. Decomposing the sample into two sub-samples of more and less innovative countries also delivers significant results for the investment lag structures of intangibles and ICT. Accordingly, the time span of the effect of investment in intangibles is approximately 12 years, and that for ICT is approximately 14 years. The analysis of the low-performing country group does not provide significant results either for the lag structure of investment in intangibles or for investments in ICT. The estimate that seems robust across all regressions is the estimated time lag of investments for tangibles. As far as Solow's paradox is concerned, at least for more innovative countries, a significant though delayed impact of ICT investment on output can be detected.

Among the countries in the dataset, France is mid-ranked in terms of innovativeness. Since the early 2000s, France has made considerable efforts to increase its investments, and it systematically invests more per value added than Germany. The downside of this development is that France has difficulty translating investments into productivity. Compared to Germany, which increased its TFP by 5% within the time period considered, France has not managed to increase its TFP.

France is outstanding in its relative share of investment in intangibles. It invests more than twice as much in intangibles as Germany, notwithstanding the fact that this investment does not pay off: Setting aside the fact that the effectiveness of France's investment is lower than that of Germany's, the return on investment in intangibles is much lower than that for investments in tangibles and ICT, according to our study. Together with the generous tax incentives that France grants firms, our results clearly challenge this policy. France needs to reconsider its public R&D support.

In future research, there are several caveats to be considered. For estimating lag structures, longer time series data should be employed. Instead of using aggregate data, which blur the underlying mechanisms, we suggest performing this exercise with firm-level data. Firm-level data are available for most European countries. The challenge in this regard is to cope with the confidentiality restrictions of countries when trying to perform comparative studies. Finally, policy interventions should be taken into account as well. They tend to distort the link between private R&D investments and productivity growth. It would be interesting to determine whether France, when reducing its support for R&D investments, could eventually benefit from a higher efficiency of R&D investments.

CHAPTER 3

Private response to local public investment

Benjamin Montmartin, SKEMA Business School, OFCE, SciencesPo Paris, France
Lionel Nesta, OFCE, University Nice Sophia-Antipolis, France
Francesco Saraceno, OFCE, SciencesPo Paris, France

3.1 The Crisis and the Revived debate on Fiscal Multipliers

While fiscal policy disappeared from the toolbox of policy makers for more than three decades, the global financial crisis revived the debate on its effectiveness. In particular, the IMF drew much attention in the academic community and among policy makers with a box in its Fall 2012 World Economic Outlook that was later developed by its chief economist, Olivier Blanchard (Blanchard and Leigh, 2013). The IMF made an outright error regarding the size of fiscal multipliers: in a deep downturn and with monetary policy powerless because of the liquidity trap and the zero lower bound, fiscal policy is all but ineffective. The pre-crisis consensus stemming from DSGE model estimations gave a value of the fiscal multiplier of approximately 0.5. With such a value, the impact of fiscal policy on growth, whether expansionary or contractionary, is rather limited both when it is expansionary and when it is contractionary. The IMF argued that during the recession, the multiplier’s size had been closer to 2 than to the previously estimated value of 0.5. As a consequence, the recessionary impact of austerity had been larger than anticipated. Furthermore, the main objective of fiscal consolidation, public finances' sustainability, had also been missed: in many countries, the larger-than-expected drop in GDP had reduced the denominator of the debt-to-GDP ratio more than the consolidation had reduced the numerator (public debt). Austerity, concluded the IMF, had been self-defeating. Jordà and Taylor (2016) have recently confirmed Blanchard and Leigh's conclusions in a more systematic framework, pointing to estimation errors in previous works. Once corrected, these multiplier estimate errors tend to be much larger than was previously believed, particularly in the event of a downturn.

Since the crisis began, the debate on fiscal policy effectiveness has taken the shape of empirical investigations of the size of fiscal multipliers. In particular, attention focused on the multiplier of public investment, whose short-term Keynesian effect is believed to be complemented by its positive impact on long-term potential growth.

As is often the case in economics, empirical work on the multiplier size in ‘normal times’ is far from being in consensus. Nevertheless, the meta-analyses of Gechert and Will (2012) and Gechert (2015) manage to extract a number of broad conclusions from the abundant literature.

First, taking the average of the many studies that they analyse, public expenditure multipliers are close to 1; this value is significantly larger than the 0.5 value that was taken as the basis of fiscal consolidation programmes in Eurozone crisis countries.

Second, consistent with the standard Keynesian argument, the spending multipliers are larger than the tax and transfer multipliers.

Finally, the public investment multipliers are even larger than the overall expenditure multipliers (see below).

It is important to note, nevertheless, that these average values hide a very strong variability; this is not truly surprising, as theoretically, the value of the multiplier crucially depends on a number of factors: first is the degree of openness of the economy, which determines how much of the additional expenditure will be oriented towards domestic production, thus boosting GDP, and how much will benefit trading partners through increased imports. Second is the distance of the economy from the natural equilibrium, the 'output gap'. Regarding the latter, the debate on the effectiveness of macroeconomic policy often neglects the fact that Keynesian theory applies only when there is slack in the economy, i.e., when market equilibrium leaves idle resources that public expenditure can mobilise. On the other hand, if the economy is at full employment, in Keynesian as well as in neoclassical theory, the value of the multiplier will be zero, and crowding out will be complete.

Attempts to estimate a time-varying value for the multiplier that depends on the cyclical position of the economy are not numerous. Creel et al. (2011) use a structural Keynesian model and find that, consistent with the intuition, when the output gap is significantly negative, the value of the multiplier is much larger than when the economy is working near its full employment equilibrium. More recently, using a different model (an 'atheoretical' VAR model), Glocker et al. (2017) confirm that even for the United Kingdom, the multiplier is larger in periods of crisis; however, they also find that the zero lower bound does not have a significant impact on the effectiveness of fiscal policy (which, according to Keynesian theory, should instead be greater when monetary policy does not work as it should). Estimating a similar model for Germany, Berg (2015) finds that the cyclical position of the economy has a marginal impact on the size of the multiplier, which on the other hand changes over time and tends to be larger when agents are pessimistic or when the government can easily finance its expenditure (so that debt sustainability is not in doubt). Contradicting most of the previous literature, a very recent work by Ramey and Zubairy (2018) based on US data finds that the multiplier is generally less than unity even in periods of recession; only when the economy is at the zero lower bound can the multiplier, in some cases, be much larger.

These few examples show that the estimation of multipliers is complex and subject to many imponderable factors. This should lead policy makers to caution in embracing both austerity and expansionary policies without a careful assessment of the likely impact on the economy. One size does not fit all. In this chapter, we aim to shed light on the private response to variations in public investments by examining the spatial effects potentially implied by the public infrastructure. The next section is a literature review on the importance of public investment and its impact on GDP in general and on private investment in particular. Section 3.3 presents the data and provides preliminary evidence on local public and private investments, total factor productivity (TFP) and increased spatial concentration. Section 3.4 presents and discusses the results of a spatial econometric specification examining the determinants of local private investments. Section 3.5 provides policy recommendations.

3.2 On the Importance of Public Investment

3.2.1 The impact of public investment on GDP

Since the seminal work of (Aschauer, 1989a), public investment has been considered to have a dual role of short-term aggregate demand support and of production factors that contribute to long-term productivity and potential growth.

At a times when growth is still weak and with interest rates at record low levels, the advantages of stimulus through public investment are even more evident: on the one hand, borrowing costs are low; on the other hand, the depletion of public and private capital stocks during the crisis makes investment particularly productive and the multiplier large. This is why, based on a large sample of developing and advanced countries, the (IMF, 2014) spoke of a 'free lunch': public investment is currently cheap, and by boosting growth and fiscal revenues, it could pay for itself and ultimately reduce public debt.

The estimate of public investment multipliers crucially depends on two variables: the first is the productivity of public capital. This variable is particularly impervious to assessment, as measuring public capital itself is rather complicated (Kamps 2006). Estimates of private production elasticity to public investment exhibit the same degree of variability as the broader multiplier estimates contained in the text.

The second relevant variable is time to build, i.e., the time it takes for capital to evolve into productive capacity. Once the productive capacity is operational, public investment will influence productivity and supply, but how this will affect short-term multipliers is more ambiguous. Think, for example, of the central bank. Under normal conditions, if it observes an increase in aggregate demand, it should react with a monetary restriction to avoid an inflation increase. However, if the increase in demand stems from investment, this can lead to increased future productivity, which tends to have a deflationary impact (through reduced production costs); the central bank, then, can decide to be less aggressive against current inflation, anticipating future deflationary pressure. The short-term investment multiplier therefore could also be larger than the multiplier of current expenditure.

The meta-analysis of (Bom and Ligthart, 2014) reports elasticities of private production to public capital. This elasticity is used in standard models to determine the multiplier of public investment. Consistent with the intuition, the multiplier (even the short term one) increases in size when public capital is more productive and when time to build is shorter (so that future increases in productivity are nearer in time). In these cases, the positive, purely Keynesian short-term demand shock is quickly associated with the positive supply-side impact on productivity. This is because the subsequent deflationary impact on supply makes the central bank reaction to current inflation milder or even unnecessary, thus amplifying even the short-term multiplier.

Therefore, the multiplier associated with public investment is larger than the overall expenditure multiplier. This is particularly true in times of crisis, when the economy is, as it is currently, at the zero lower bound. Interestingly, in these cases, projects with a longer time to build should be preferred: when the economy is at the ZLB, monetary policy reaction is muted, and the only way to decrease real interest rates is inflation. The supply-side deflationary impact of public investment is therefore problematic because it increases the real interest rate, and when it is delayed, public investment becomes more effective in lifting the economy out of the zero lower bound (Le Moigne et al. 2016).

3.2.2. The impact of public investment on private investment

The specific focus of the current chapter is the relationship between public and private investment. Does public investment crowd in or crowd out private investment? The literature on this specific topic is more limited than the broader literature on fiscal multipliers, and in the past, it has mostly dealt with developing countries. For the issue of the productivity of public capital, the seminal contribution on public and private investment is that of (Aschauer, 1989b), who, based on US data, finds evidence of crowding in: public investment, especially in infrastructure, has a significant positive impact on private investment by increasing productivity. Other studies, mostly focusing on developing economies, find a similar positive impact (Blejer and Khan 1984; Greene and Villanueva 1991). However, complementarity is far from leading to unanimity (see, e.g., Evans and Karras, 1994). More recently, Erden and Holcombe (2005) conclude in favour of complementarity between public and private investment when the former, given the low level of public capital, has a strong impact on private expenditure productivity. For advanced economies, crowding out is more likely to occur, as the public capital stock is larger so that the contribution of public investment to productivity is lower. A recent work by Creel et al. (2015) assesses the relationship between public investment and the stock of public capital on the one hand and investment by private firms on the other. The purpose of their work is, similar to the present chapter, to check whether public investment generates the crowding in or crowding out of private investment. Creel et al. consider four OECD countries: Germany, the United States, France and the United Kingdom. In the case of France, particular attention is paid to the effects of the levels of public investment and capital. Their paper offers a number of insights:

1. For the four countries considered, in general, the crowding-in effect of public investment on private investment dominates in relation to the crowding-out effect;

2. Crowding out dominates only for high levels of public investment;

3. Crowding in is larger for large negative values of the output gap, i.e., at the bottom of the cycle; and

4. Public investment seems more effective in driving private investment when it adds to an already large stock of public capital.

The latter result is particularly interesting because it contradicts the results of Herden and Holcomben (2005). It is one of the issues that we assess in the following pages using data at the department level.

3.3 The agglomeration of private and public investments in France

3.3.1 Data Sources

The FICUS and FARE databases contain the financial statements of all enterprises (with the exception of microenterprises and agricultural holdings) active between 1997 and 2011 whose turnover exceeds 75000 euros. All nominal variables are deflated using the appropriate deflators made available online by the INSEE, the French national statistical office: deflators of production, value added, intermediate consumption, investment, and hours worked. It is from these deflated data, and therefore by volume, that the levels of labour productivity and total factor productivity are calculated. Although they contribute to GDP, companies with no employees are excluded from the analysis because it is not possible to compute their productivity index. This exclusion reduces the number of observations from 32 million to approximately 16 million. This significant reduction in the number of observations is equivalent to excluding a mass of companies representing 7% of the total value added.

It is important to emphasise the importance of the minimum threshold of 75000 euros to the contours of the activities analysed. With more than 16 million companies included in the analysis, we remain confident about the economic coverage of the database. However, this threshold induces a selection against "young high-tech companies" that do not generate revenue in the first few years of operation. This is the case for digital or biotechnology companies, which, although located at the scientific frontier of their industry, are struggling to become profitable. Although meaningful, these companies are discarded from the analysis.

There is another pitfall for the analysis. The year 2008 launched two important changes that affect data quality. The first concerns the change in industrial nomenclature. This classification change necessitated the implementation of a data harmonisation procedure by retro-polating the new nomenclature to observations prior to 2008. In the absence of a bijective relationship between the old and the new nomenclature, this effort requires a degree of arbitrariness and ad hoc choice that we do not report here. The second change concerns the definition of the unit of analysis, which moved from the legal unit to the economic unit. For the INSEE, "The legal unit is a legal entity governed by public or private law and may be: (i) a legal person whose existence is recognised by law independently of the persons themselves; (ii) a natural person, who, as an independent, may carry on an economic activity." This definition of the legal unit should not be confused with that of the enterprise, the latter having been considered the relevant economic unit in the analysis from 2008 onwards. This economic unit – the enterprise – is defined as a decision-making unit for the affection of current and strategic resources. This second definition has been adopted since 2008, leading to variations in the number of observations and associated economic quantities unrelated to actual business cycles.

Finally, the location of firms is not necessarily equivalent to the location of production activities because the latter pertain to the establishments themselves. Although the vast majority of companies have only one establishment (93.5% of the companies in our sample), multi-establishment firms represent in our base 53% of total value added and 56% of total employment. Hence, these multi-establishment companies include a sizeable bias towards heavily agglomerated territories. Larger companies tend to settle their headquarters near major administrative, political and economic centres. Consequently, the tendency is to overestimate economic activities towards agglomerated areas and underestimate economic activities in more rural areas. To correct for this geographical bias, we use establishment-level data (the annual Declarations of Social Data (DADS)). Such data make it possible to know, for each company, the location of manpower by establishment. Since these establishments are geographically located by municipality, and under the assumption of a proportional relationship between the proportion of staff per establishment and all other production variables (turnover, value added, investment, capital stock, and intermediate consumption), it is possible to correct the aggregation bias mentioned above.

Overall, the proposed analysis is based on data including more than 3.5 million establishments from 2000 to 2011, equivalent to more than 18 million observations. We choose to focus on the contribution of public capital in the context of manufacturing production. This choice is motivated by the fact that the measurement of productivity is more reliable for manufacturing production activities. This choice reduces the number of observations to less than 3 million over the entire period. Finally, the establishments are aggregated at the departmental level.

Public investments and public capital stock at the administrative level of the department (NUTS3) level are built in two steps. First, we consolidate investments by all the layers involved in public investments: the central state, regions, departments, public institutions of inter-municipal cooperation (EPCI) with their own taxation, and municipalities. We then consolidate public investment at the NUTS3 level. Second, these investment flows are then used to construct an approximation of the capital stock using the permanent inventory method.

Data were provided by the General Directorate of Public Finance (DGFiP), which provides the financial statements of the central government and all local authorities. Capital expenditures are grouped into three categories: (1) capital expenditures; (2) equipment subsidies; and (3) repayment of loans and of similar debts. The first category includes expenditures such as the acquisition/renovation of public buildings and the construction of roads and water and electricity infrastructures; it is therefore the creation or maintenance of public assets. This first category is used as a measure of public investment. It is important to note that we exclude subsidies paid to private firms for investment (e.g., R&D). These subsidies have an impact on private investment but do not constitute public investment *per se,* which increases public capital stocks.

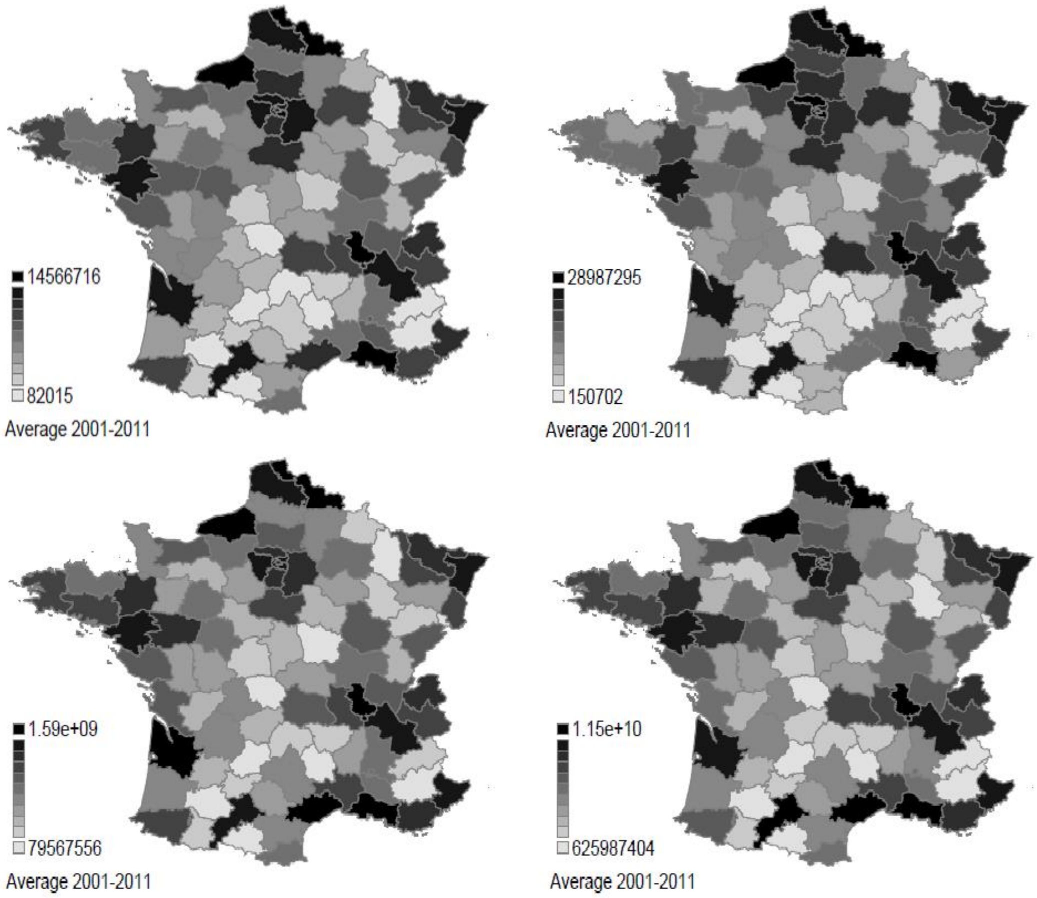
The main problem for data consolidation lies in the allocation of the investment made to the EPCIs, which sometimes include municipalities belonging to different departments. The choice is made to allocate these expenses to the different municipalities in proportion to their population and then to re-aggregate them at the department level. The population is also used as a criterion for the distribution of regions' expenditures between the departments that compose them. It is highly questionable, for example, whether the investment of the state in a large energy infrastructure can be allocated to all departments in proportion to their population. For this reason, the study excludes central government investment, and the highest level of aggregation is the region. However, all transfers from the state to local authorities are included in the stock, which is then used by the latter to make investments.

An additional difficulty lies in the temporal coverage of investment series, which may differ according to the sources. For municipalities, for example, the time span covers the period 2000-2014, while at the NUTS2 and NUTS3 levels, the data coverage ranges from 2008 to 2014 (2007-2014 for the EPCIs). Therefore, we use the observed strong correlation between the various local series and that of the municipalities to rebuild the total investment from the public investment of the latter. The time horizon therefore has to be extended, leading to an additional assumption: Since municipal investment accounts for an average of 52% of total public investment over the 2008-2014 period, this share is almost constant. It is assumed that it was also constant in the past. The series of total public investment for each NUTS3 for the period 2000-2014 were therefore reconstructed from the series of municipalities. These series are available for the 101 departments of metropolitan France and overseas.

3.3.2. Preliminary Spatial Evidence

The maps below represent the average level of private investment and private capital stock over the last decade (2001-2011). These two maps clearly highlight the strong spatial concentration of private investment and private capital stock. This is a reflection of the strong concentration of economic activities in France. This very unequal distribution across the French territory highlights four main clusters of NUTS3 regions in which the majority of private investment is concentrated: the "big north", including Ile-de-France, northeast, northwest and southeast. We also must include two other specific NUTS3 regions: Gironde (including Bordeaux city) and Haute-Garonne (including Toulouse city), which are both located in the southwest but far from each other; i.e., they are not clustered.

Figure 3.1: Private investment (left, upper panel) and private capital (right, upper panel) and public investment (left, lower panel) and public capital stock (right, lower panel) stock in French regions

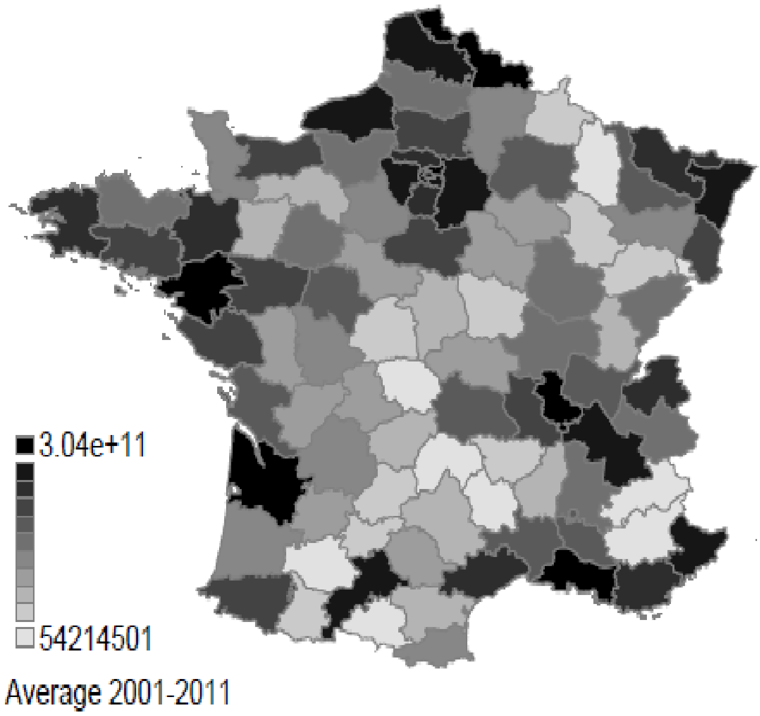


Source: FARE-INSEE, French firms financial statements, 2001-2011. Computation of the authors.

After examining the geography of private investment and capital stock, we replicate the same on public investment and public capital stock. If we compare the two maps in Figure 3.2 with the previous maps, we observe that they are almost identical. In other words, the geographical distribution of public investment and public capital stock across the French territory follows the geographical distribution of private investment and private capital stock. Consequently, investment and capital stock (both public and private) are highly concentrated in a few French regions that are geographically clustered.

Finally, Figure 3.2 represents the geographical distribution of total factor productivity (TFP). We can see that the spatial distribution of TFP is similar to that observed for private and public investment.

Figure 3.2: TFP level in French regions

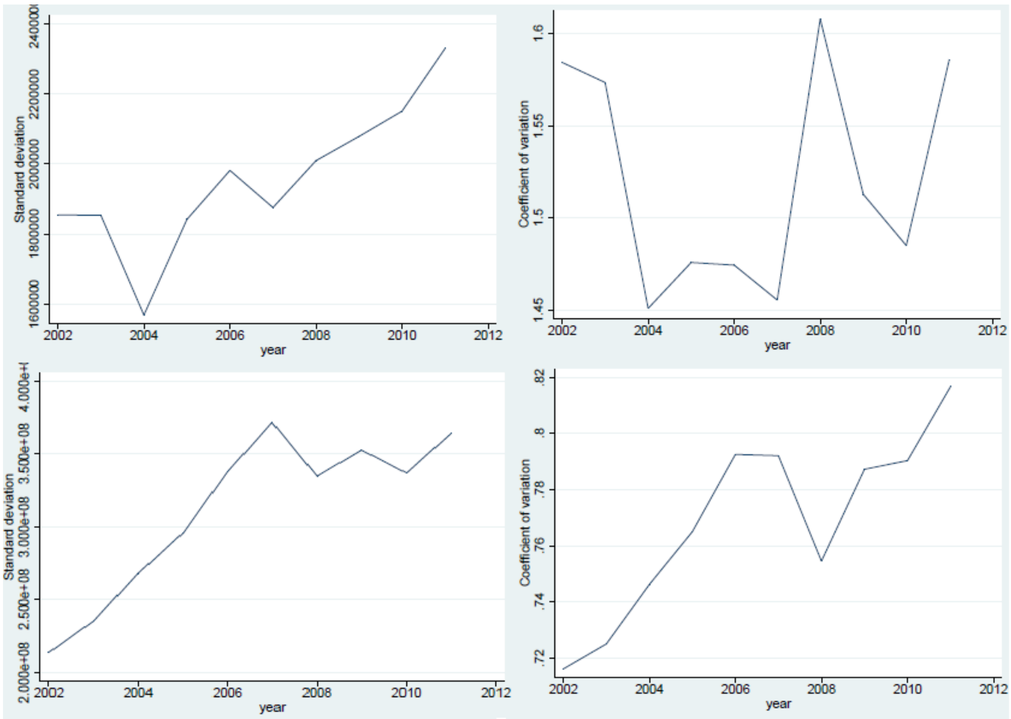


Source: FARE-INSEE, French firms financial statements, 2001-2011. Computation of the authors.

These figures provide clear evidence of the spatial concentration of private and public investment. Nevertheless, they do not allow us to appreciate the evolution of this concentration over time. To provide elements to judge the dynamics of concentration, we analyse the evolution of two statistics: the cross-section standard deviation and the coefficient of variation (standard deviation divided by mean). Figure 3.4 provides these two statistics for private investment.

The graph on the left represents the evolution of the standard deviation of private investment over time. It clearly shows an increasing heterogeneity of private investment among French regions in the last decade. Nevertheless, this trend is less clear when we take into account the mean of private investment (see the graph on the left). In any case, these two graphs highlight an increasing absolute heterogeneity over time between French regions. We replicate the analysis of public investment in Figure 3.3. Concerning the evolution of public investment heterogeneity among French regions, the two statistics lead to the same conclusion. Indeed, both standard deviation and coefficient of variation have strongly increased during the last decade. This result is surprising when compared with that for private investment. Indeed, the heterogeneity of public investment among French regions has increased more than the heterogeneity of private investment in the last decade.

Figure 3.3: Heterogeneity in private (top panel) and public investments (lower panel) and capital stocks in terms of standard deviation (left panel) and coefficient of variation (right panel).



Source: FARE-INSEE, French firms financial statements, 2001-2011. Computation of the authors.

3.4 Econometric results

3.4.1 The empirical model

Our main objective is to better understand the response of private investment to public investment and public capital stock at the regional level. Consequently, we first define the following model for a region i at time t:

$$\ln\ I_{it} = \beta_1 \ln\ G\,I_{it} + \beta_2 \ln\ G\,K_{it-1} + \beta_3 \ln\ K_{it-1} + X_{it}\beta + \eta_t + \alpha_i + \varepsilon_{it} \qquad (1)$$

where I represents private investment, *GI* public investment, *GK* public capital stock and *K* private capital stock. X represents a set of control variables, including the value-added growth rate (GVA), the number of entries and exits (EN and EX), the average wage (WAGE), the share of firms with more than 100 employees (LFIRMS), the share of publicly subsidised firms (SUB) and the Herfindahl index (HHI) of industrial activities, which is a measure of territorial specialisation. Finally, α_i represents the regional fixed effect and η_t represents the time fixed effect. We can view this first model as naive because we do not model any relationship between regions. Within the same country, it is difficult to imagine that the level of private investment in a region is completely independent from what happens in neighbouring regions. This is especially true for two main reasons: (1) the spatial distribution of private and public investment is highly agglomerated in a few French regions that are geographically clustered, and (2) French regions implement increasing numbers of public incentives to attract private investment.

The spatial econometrics literature allows us to include an estimate of the existence of spatial dependence between regions in model (1). This spatial dependence can be local (the neighbour values of independent variables influence the focal region), global (the neighbour values of the dependent variable influence the focal region) or both. This is a very important element to take into account because an aspatial model leads to inconsistent estimates when spatial dependence is present.

To use spatial econometrics models, we must construct a spatial matrix describing the link between French regions. In this report, our spatial matrix uses two criteria to weigh the link between two regions. First, we calculate a matrix of economic similarity between regions. The economic similarity between region i and region j is measured by the sum of the inverse of the Euclidean distance between their share of valued added in agriculture, industry and services. Second, we use a contiguity matrix that we combine with the economic similarity matrix. Consequently, in our final spatial matrix, two French regions are linked if they are contiguous and if the weight of this link depends on the economic similarity between the two regions. We refer to this spatial matrix as W. To detect the presence of spatial dependence, we test three different spatial models. The first is called the spatial lag of X (SLX) and tests the presence of local spatial dependence through public investment and public capital stock:

$$\ln\ I_{it} = \beta_1 \ln\ G\,I_{it} + \beta_2 \ln\ G\,K_{it-1} + \beta_3 \ln\ K_{it-1}$$

$$+\rho_{GI} W \ln\ G_{it} + \rho_{GK} W \ln\ G\,K_{it-1} + X_{it}\beta + \eta_t + \alpha_i + \varepsilon_{it} \quad (2)$$

The second is called the spatial autoregressive model (SAR) and tests the presence of global spatial dependence through private investment:

$$\ln\ I_{it} = \rho_I W \ln\ I_{it} + \beta_1 \ln\ G\,I_{it} + \beta_2 \ln\ G\,K_{it-1} + \beta_3 \ln\ K_{it-1}$$

$$+X_{it}\beta + \eta_t + \alpha_i + \varepsilon_{it} \quad (3)$$

The last is the spatial Durbin model (SDM), which tests the presence of both local and global spatial dependence (a combination of the two previous models):

$$\ln\ I_{it} = \rho_I W \ln\ I_{it} + \beta_1 \ln\ G\,I_{it} + \beta_2 \ln\ G\,K_{it-1} + \beta_3 \ln\ K_{it-1}$$

$$+\rho_{GI} W \ln\ G\,I_{it} + \rho_{GK} \ln\ G\,K_{it-1} + X_{it}\beta + \eta_t + \alpha_i + \varepsilon_{it} \quad (4)$$

In what follows, we present the estimations of these four models.

1. 3.4.2 Testing the effect of public investment on private investment

We start by presenting the simplest models (1 and 2), which can be consistently estimated by an OLS estimator on panel data. The results are presented in Table 3.1.

Table 3.1 shows that both models lead to similar conclusions concerning the impact of public capital and public investment on private investment. Indeed, in both cases, we find a significant positive effect of public capital stock on private investment, whereas public investment generates a nonsignificant negative effect. These results highlight that public infrastructures significantly increase private investment but that public investments are not able to do the same. Focusing on the SLX model, which tests the presence of local spatial dependence through the neighbour values of public investment (WGI) and public infrastructure (WGK), we obtain weak evidence in favour of a local spatial dependence. Indeed, the public capital stock of the neighbouring regions (WGK) has a nonsignificant positive effect, and the public investment of neighbouring regions (WGI) has a weak significant negative effect. When we test the total impact of public investment, i.e., the combined effects of GI plus WGI, we reject a significant effect at 10 g of the role of private capital stock, and we find evidence in both estimations that the capital stock of the region drives private investment. Thus, the unequal distribution of capital stock among French regions (see Figure 3.1, map b) is likely to increase the heterogeneity of French regions in terms of private investment over the long term.

Finally, focusing on control variables, we detect a significant positive effect of the growth rate of value added and the average wage in the region.

Table 3.1: OLS and SLX models

	Model 1: OLS				Model 2: SLX			
Variable	Coeff.	s.e.	t-stat	P-Value	Coeff.	s.e.	t-stat	P-Value
Variables of interest								
GI	-0.069	0.047	-1.46	0.148	-0.059	0.047	-1.25	0.216
GK	0.175	0.079	2.22	0.029	0.161	0.082	1.96	0.053
K	0.137	0.049	2.76	0.007	0.137	0.050	2.73	0.008
WGI					-0.171	0.090	-1.90	0.061
WGK					0.265	0.224	1.18	0.239
Control Variables								
GVA	0.383	0.179	2.14	0.035	0.380	0.178	2.14	0.035
EN	0.069	0.134	0.51	0.609	0.086	0.133	0.64	0.521
EX	0.069	0.106	0.65	0.515	0.062	0.102	0.60	0.547
WAGE	0.630	0.119	5.31	0.000	0.623	0.117	5.31	0.000
SUB(%)	0.064	0.167	0.38	0.703	0.045	0.169	0.26	0.793
LFIRMS(%)	0.115	0.078	1.48	0.143	0.113	0.080	1.41	0.161
HHI	0.054	0.112	0.48	0.633	0.055	0.112	0.48	0.629
Efficiency criteria								
AIC	-1239.76				-1240.74			
BIC	-1140.94				-1132.034			

Source: FARE-INSEE, French firms financial statements, 2001-2011. Computation of the authors.

We now turn to the two spatial models, (3) and (4). The idea is to test the presence of global spatial dependence through private investment itself. The estimations of models (3) and (4) are presented in Table 3.2. Note that in contrast to models 1 and 2, Table 3.2 does not directly provide the marginal effects. Indeed, when we model global spatial dependence, the private investment in a region i is influenced by the private investment in neighbouring regions, which are themselves influenced by private investment in region i. We present the marginal effects obtained from the spatial models in the next table.

If we compare the estimates of Table 3.2 with those of Table 3.1, we find very similar coefficient values and significance. Indeed, we still find a significant positive effect of public capital stock on private investment, whereas public investment has no significant effect. Private capital stock drives private investment, as found in the OLS and SLX models. We also reject the presence of local spatial dependence through public investment and/or public capital stock. Indeed, the coefficient related to neighbourhood levels of public capital (WGK) is nonsignificant, and the coefficient related to neighbourhood levels of public investment (WGI) is weakly significant. Moreover, the efficiency criteria (AIC and BIC) show that SAR fits the data better than SDM, suggesting the absence of local spatial dependence through public investment and/or public capital stock.

Table 3.2: SAR and SDM models

	Model 1: SAR				Model 2: SDM			
Variable	Coeff.	s.e.	t-stat	P-Value	Coeff.	s.e.	t-stat	P-Value
Variables of Interest								
GI	-0.055	0.047	-1.16	0.246	-0.046	0.047	-0.98	0.325
GK	0.163	0.079	2.08	0.038	0.152	0.083	1.83	0.067
K	0.128	0.049	2.62	0.009	0.128	0.049	2.60	0.009
WGI					-0.151	0.090	-1.67	0.095
WGK					0.229	0.227	1.01	0.312
Global Spatial parameter								
r_I	0.167	0.043	3.88	0.000	0.162	0.043	3.74	0.000
Control Variables								
GVA	0.394	0.185	2.13	0.033	0.391	0.184	2.13	0.033
EN	0.091	0.133	0.69	0.0.493	0.106	0.132	0.80	0.422
EX	0.048	0.105	0.46	0.647	0.042	0.101	0.41	0.678
WAGE	0.612	0.122	5.04	0.000	0.606	0.119	5.05	0.000
SUB(%)	0.064	0.163	0.39	0.697	0.047	0.165	0.28	0.777
LFIRMS(%)	0.107	0.079	1.35	0.176	0.106	0.082	1.30	0.195
HHI	0.063	0.112	0.56	0.575	0.064	0.113	0.56	0.574
Efficiency criteria								
AIC	37.652				41.652			
BIC	96.947				110.829			

Source: FARE-INSEE, French firms financial statements, 2001-2011. Computation of the authors.

Nevertheless, our main objective with these two spatial models is to detect the presence of global spatial dependence through private investment. Both models clearly highlight the presence of global positive spatial dependence, as the ρ_I coefficient is strongly significant. This implies that the geography of private investment among French regions results in the clustering of regions with a similar profile. In other words, regions with high (low) private investment levels tend to cluster geographically. This positive global spatial dependence effectively traduces the observed geography of private investment among French regions. This is an important result, as the OLS estimator is biased in the presence of global spatial dependence. As the SAR model seems to be the appropriate spatial model, we need to compute the marginal effects of this model by comparing them with the second-best specification, i.e., the OLS estimation of model 1.

Table 3.3: Marginal effects of OLS and SAR models

	Model 1: OLS				Model 2: SAR			
Variable	Coeff.	s.e.	t-stat	P-Value	Coeff.	s.e.	t-stat	P-Value
Variables of Interest								
GI	-0.069	0.047	-1.46	0.148	-0.068	0.055	-1.24	0.215
GK	0.175	0.079	2.22	0.029	0.199	0.096	2.07	0.039
K	0.137	0.049	2.76	0.007	0.160	0.059	2.69	0.007
Control Variables								
GVA	0.383	0.179	2.14	0.035	0.487	0.235	2.07	0.038
EN	0.069	0.134	0.51	0.609	0.116	0.159	0.73	0.465
EX	0.069	0.106	0.65	0.515	0.063	0.122	0.52	0.605
WAGE	0.630	0.119	5.31	0.000	0.728	0.144	5.06	0.000
SUB(%)	0.063	0.167	0.38	0.703	0.068	0.182	0.38	0.707
LFIRMS(%)	0.115	0.078	1.48	0.143	0.134	0.092	1.45	0.147
HHI	0.054	0.112	0.48	0.633	0.077	0.135	0.57	0.567

Source: FARE-INSEE, French firms financial statements, 2001-2011. Computation of the authors.

When we compare the two panels of Table 3.3, we immediately see the consequence of neglecting positive global spatial dependence, which leads to underestimating the effect of "significant" variables. Indeed, the positive effect of public and private capital stock is higher for SAR than for OLS. Nevertheless, our preferred model (SAR) leads to similar conclusions: if public investment does not seem to generate a significant short-term effect on private investment, then we obtain evidence that public capital stock drives private investment. In other words, it seems that only public investments that contribute to increasing public capital stock generate a positive effect on private investment in the long term.

3.5 Policy recommendations

To provide policy recommendations, we summarise our main findings as follows:

1. The spatial distribution among French regions of public investment and private investment is similar.

2. The spatial distribution of private investment is highly concentrated in a few French regions that are geographically clustered.

3. The heterogeneity among French regions in terms of public and private investment increased during the last decade.

4. We detect a positive global spatial dependence of private investment among French regions; i.e., regions with similar profiles in terms of private investment are geographically clustered.

5. We find that public capital stock is a driver of private investment, whereas we find no significant impact of public investment.

In the pages above, we detect a positive global spatial dependence for private investment. This means that regions with similar profiles are geographically clustered, but it also implies that a region indirectly benefits from private investment made in neighbouring regions. We also detect increasing heterogeneity in the distribution of public investments over time, which implies an increasingly important share of public investment is concentrated in large regions. Thus, to limit the heterogeneity, our results suggest allocating more public investment to regions with low private investment levels. Indeed, in doing so, those laggard regions will be able to increase their public capital stock more quickly and attract private investment. As those laggard regions are geographically clustered, public investment in one laggard region will also benefit its similar neighbours.

Our results also show that the stock of public capital has a positive impact both locally and on neighbouring regions, while the flow of investment may have a (weakly) negative impact. This suggests that the flow of public investment should be kept constant at moderate levels to build a large and stable stock of capital over time. Variations in the flow of investment (for example, caused by a downturn) disrupt the accumulation of public capital stock and therefore should be avoided. This is an especially important policy prescription: it is well known that public investment is more sensitive to business cycle variations than current expenditure, as it is less politically sensitive and therefore can more easily be cut in times of austerity and/or of binding budget constraints.

PART II

Industry Turbulence

CHAPTER 4

The Micro-foundations of Aggregate Productivity

Margarita Lopez Forero, OFCE SciencesPo
Lionel Nesta, OFCE SciencesPo, University Nice Sophia-Antipolis, France

4.1 Introduction

Aggregate productivity growth is closely related to changes in productivity at the firm level; however, there is growing empirical evidence of significant heterogeneity among firms even when sectors are narrowly defined. In this sense, it is crucial to understand how firm-level productivity relates to aggregate productivity, as strong firm heterogeneity implies that identical aggregate average figures may come from very different distributions. This has important policy implications because different distributions call for different policy choices. For example, weak average productivity growth can be related to poor allocation of resources among firms, weak market selection or slow innovation adoption. In the first case, we would observe that firms with high productivity are unable to grow; in the second case, we would observe many firms with low productivity entering the market; and in the third case, we would observe very few firms at the top of the distribution. Hence, policy responses should adapt to each of these different scenarios.

Different tools have been developed in the literature to analyse firm heterogeneity and its relation to aggregate outcomes. For instance, the literature on resource allocation and misallocation has shown not only that lack of innovation can hinder aggregate productivity but also that production factors allocated inefficiently among firms can preclude productivity growth at the aggregate level. Additionally, this literature has shown that market distortions, recessions and regulation influence the way in which resources are allocated among firms.

We therefore intend to develop several measures of firm-year-specific productivity and to evaluate the aggregate changes in productivity growth over the past 15 years. Additionally, we account for the micro-determinants of these aggregate changes with the help of aggregate productivity decompositions. In this sense, we assess to what extent productivity changes at the aggregate level come from changes in the efficiency with which firms use technology, to what extent they come from changes in the efficiency with which the market assigns resources among firms and to what extent they are driven by firm entries and exits (i.e., market selection). Finally, in chapter 5, we further examine changes in the levels and distribution of firm productivity for the overall economy and for the main broad sectors (which will additionally be linked to labour market outcomes).

Our motivation is manifold. First, we are particularly interested in the effect of the financial turmoil of 2008 on the dynamics of productivity and on the underlying causes of the crisis. At the aggregate level, as is shown in sub-section 0.3 on investments, the transitory productivity slowdown may conceal various underlying reasons: (i) all firms stayed in the market, but due to a significant but transitory decrease in demand, productivity mechanically decreased and then increased with the upsurge of demand, and (ii) the least productive firms exited the markets, allowing the firms that remained to eventually recover their initial level of productivity. The use of firm-level data allows us to address these issues and provide evidence of the cleansing effect of the 2008 economic crisis.

4.2 Data and Measures of Productivity

The FICUS and FARE databases contain the income statements and balance sheets of all enterprises (with the exception of microenterprises and agricultural holdings) from 1997 to 2015 whose turnover exceeds 75000 euros. All nominal variables are deflated using various deflators made available online by the INSEE: deflators of production, value added, intermediate consumption, investment, and hours worked. It is from these deflated data, and therefore by volume, that the levels of labour productivity and total factor productivity are calculated. Businesses without employees (self-employed craftsmen in general) are excluded from the analysis, even though they contribute to the national added value. This selection is motivated by the impossibility of calculating the productivity indexes. Of the 45 million observations over the period in the database, approximately 23 million remain after such a selection. This reduction by half in the number of observations is equivalent to excluding a mass of companies representing less than 7% of the total value added.

The minimum threshold of 75000 euros has consequences for the analysis. With more than 23 million companies included in the analysis, we remain confident in the economic coverage of the database. However, this threshold admittedly induces a selection against smaller companies, such as auto-entrepreneurs and also some "young high-tech companies" with virtually no revenue in the first years of their existence. For example, although biotechnology companies are at the scientific frontier of the pharmaceutical industry, they struggle to generate revenues and to become profitable. There is another pitfall for the analysis. The year 2008 was a pivotal year for data producers. A major change may have strongly influenced the quality of the data for this particular year, as it concerns the change in industrial nomenclature. This classification change necessitated the implementation of a data harmonisation procedure by “retro-polating” the new nomenclature to observations prior to 2008. In the absence of a bijective relationship between the old and the new nomenclature, this effort requires a degree of arbitrariness and ad hoc choices that we do not report here.

Importantly, the location of firms is not necessarily equivalent to the location of production activities, as the latter pertain to establishments. Although the vast majority of companies have only one establishment (93.5% of the companies in our sample), multi-establishment firms represent 53% of the added value and 56% of the employment in our base. From a geographical perspective (chapter 3), these multi-establishment companies include a sizeable bias for the benefit of heavily agglomerated territories since companies prefer to have their headquarters near major administrative, political and economic centres. To correct the geographical bias, the annual Declarations of Social Data (DADS) of the companies are used, making it possible to determine each company’s workforce by establishment. Since these establishments are geo-located by municipality, and under the assumption of a proportional relationship between the proportion of staff per establishment and other production variables (turnover, value added, investment, capital stock, and intermediate consumption), it is possible to correct the aggregation bias mentioned above. A valuable piece of information provided by the DADS data is the composition of the workforce.

Finally, for each geo-located establishment, the level of productivity (whether labour productivity or TFP) of the parent company prevails. This is consistent with the idea that productive efficiency can be grasped at the level of companies as a whole and would have little economic meaning at the plant level. The same applies to participation in international trade: an establishment is considered an exporting establishment if the enterprise as a whole declares that it exports part of its turnover. Once again, the strategic choices of a company are deemed to govern the characterisation of its establishments.

All nominal output and input variables are available at the firm level. Industry-level information is used for price indexes, number of hours worked and depreciation rates of capital. Our output variable, Q, is revenues corrected by variations in inventories. Nominal values are deflated by sector-specific price indexes that are available at the 2-digit level from the INSEE (the French national statistical office). We define our labour variable, L, as the number of effective workers multiplied by the number of hours worked in a year. The annual series for worked hours are available at the 2-digit industry level and are provided by the Groningen Growth Development Centre (GGDC). This choice is made because there are no data on hours worked in the original datasets. Capital stocks, K, are computed using information on the investment and book value of tangible assets (we rely on book value reported at the end of the accounting exercise) following the traditional permanent inventory methodology: $K_t = (1 - \delta_{t-1})\ K_{t-1} + I_t$, where δ_t is the depreciation rate and I_t is real investment (deflated nominal investment). Both investment price indexes and depreciation rates are available at the 2-digit industrial classification level from the INSEE data series. Intermediate inputs, M, are defined as purchases of materials and merchandise, transport and travel, and miscellaneous expenses. They are deflated using the sectoral price indexes for intermediate inputs published by the INSEE. To compute the revenue share of labour, we rely on the variable *wages and compensation*. This value includes total wages paid in salaries plus social contributions and income tax withholding.

The preferred way to measure productive efficiency at the firm level is to compute labour productivity (LP) and total factor productivity (TFP). *Labour productivity* is defined as the log-ratio of real value added on labour:

$$\ln LP_{it} = \ln \left(\frac{V}{L}\right)_{it}$$

where *V* denotes the value added of firm *i* at time *t* deflated by the sectoral price indexes published by the INSEE (French System of National Accounts) and *L* is the number of hours worked. The advantage of using value added instead of gross output or total revenues in this measure is that it controls for the usage of intermediate inputs. For instance, for firms in the retail sector whose activity is based on reselling goods, gross output-based LP will appear to be very high. As value added is measured as the difference between output (or sales) and intermediate inputs (e.g., resold goods), value added-based LP allows controlling for differences in intermediate input intensity across firms. Nonetheless, value added-based LP does not control for differences in capital intensity between firms, and neither do differences in other inputs that are not accounted for in the value added.

Total factor productivity (TFP) measures allow this problem to be alleviated, as they control for a broader set of inputs, particularly capital. We compute *TFP* using the so-called *multilateral productivity index* first introduced by Caves *et al.* (1982) and extended by Good *et al.* (1997). This methodology consists of computing the TFP index for firm i at time t as follows:

$$TFP_{it} = ln\, Y_{it} - \overline{ln\, Y_t} + \sum_{\tau=2}^{t}\left(\overline{ln\, Y_\tau} - \overline{ln\, Y_{\tau-1}}\right) - \left[\begin{array}{c} \sum_{n}^{N} \frac{1}{2}\left(S_{nit} + \overline{S_{nt}}\right)\left(ln\, X_{nit} - \overline{ln\, X_{nt}}\right) \\ + \sum_{\tau=2}^{t}\sum_{n}^{N} \frac{1}{2}\left(\overline{S_{n\tau}} + \overline{S_{n\tau}}\right)\left(\overline{ln\, X_{n\tau}} - \overline{ln\, X_{n\tau-1}}\right) \end{array}\right]$$

where *Y* denotes the real gross output using the set of *N* inputs *X*, where input *X* is alternatively capital stocks (*K*), labour in terms of hours worked (*L*) and intermediate inputs (*M*). Variable *S* is the cost share of input *X* in the total cost (see Appendix A for a full description of the variables). Subscripts τ and *n* are indexes for time and inputs, respectively, and the upper bars denote sample means[20]. Importantly, this index is transitive, which allows the comparison of any two firm-year observations. Applied to our dataset, the multilateral index reveals strong cross-sectoral variations in productivity growth over the period. In the remainder of this work, we trim the dataset by screening out observations located in the top 1% and the bottom 1% of the TFP distributions to control for the presence of outliers, which could alter the results of the subsequent calculations.

These two productivity measures are used throughout chapters 4 and 5, where TFP is privileged and, for the sake of robustness, LP results are included in the appendix. However, it should be kept in mind that these two measures do not necessarily need to coincide in the results of the analyses. Even if they are highly correlated, they may differ, particularly for capital-intensive firms and sectors. As previously mentioned, TFP measures control for a broader set of inputs than LP, which is why we privilege a TFP-based analysis over an LP-based analysis.

4.3 The exercise of productivity decomposition

A crucial question about productivity changes is whether they stem mostly from generalised changes in productivity (i.e., the average firm is becoming more productive at constant market shares), from the reallocation of market shares to the most productive firms (at constant productivity levels) or from firms entering and exiting the market. Additionally, the financial crisis is expected to have significantly affected each of these components of aggregate growth by influencing market selection and the reallocation of resources through the so-called "creative destruction" process. In this sense, we apply a productivity decomposition to aggregate productivity changes before and after the crisis following Melitz and Polanec (2015).

The existing literature on productivity decompositions applied to France finds that aggregate productivity growth is mostly explained by technical efficiency.[21] The novelty of our work is that we observe the universe of French firms over the period studied and therefore are able to perform the decomposition à la Melitz and Polanec (2015), which is a refined measure of the Olley-Pakes (OP) decomposition. The basic OP decomposition reads as follows:

$$\Phi = \underbrace{\left[\frac{1}{N}\sum_{i}^{N}\phi_i\right]}_{\{\text{Technical efficiency}\}} + \underbrace{\sum_{i}^{N}(s_i - \overline{s})\,(\phi_i - \overline{\phi})}_{\{\text{Allocative efficiency}\}},$$

where aggregate productivity Φ is decomposed into a within-firm component (first term) and a between-firm component (second term), which is the covariance between the market share of the firm, s_i, and its productivity, ϕ_i. The dynamic OP decomposition (DOPD) stems from a simple time difference, $\Phi_t - \Phi_{t-n}$, where t is a given year and n is a positive integer. It reads as follows:

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[20] Note that Eq. (2) implies that reference points $\overline{\ln Y}$ and $\overline{\ln X}$ are the geometric means of the firm's output and input quantities, respectively, whereas the cost shares of inputs for the representative firms $\overline{S}$ are computed as the arithmetic means of the cost shares for all firms in the dataset.

[21] Berthou and Sandoz (2014), Osotimehin (2017) and Sandoz (2017).

$$\Delta\Phi = \underbrace{\Delta\phi_S}_{\{\text{Within-firm}\}} + \underbrace{\Delta\text{cov}_S}_{\{\text{Between-firm}\}} + \underbrace{S_{Et}(\Phi_{Et} - \Phi_{St})}_{\{\text{Entrants}\}} + \underbrace{S_{X,t-n}(\Phi_{S,t-n} - \Phi_{X,t-n})}_{\{\text{Exitors}\}}$$

where the change in aggregate productivity, Φ, of individual firms, ϕ_i, in a given sector between year $t-n$, and year t is decomposed into four terms to account for the contributions of survivors (subscript s), exitors (subscript X) and entrants (subscript E). The first term is the within-firm contribution and is the average productivity change of surviving firms in the two periods (S); the second term is the measure of the between-firm contribution and is the change in the allocation of market shares among the survivors measured as the covariance between firm market shares and productivity; the third term is the contributions of entrants (E), which by definition are observed only in year t where the productivity reference is that of surviving firms in year t; and the fourth term captures the contributions of exitors (X), which are observed only in year $t-n$ and whose productivity is compared to that of the surviving firms in year $t-n$.

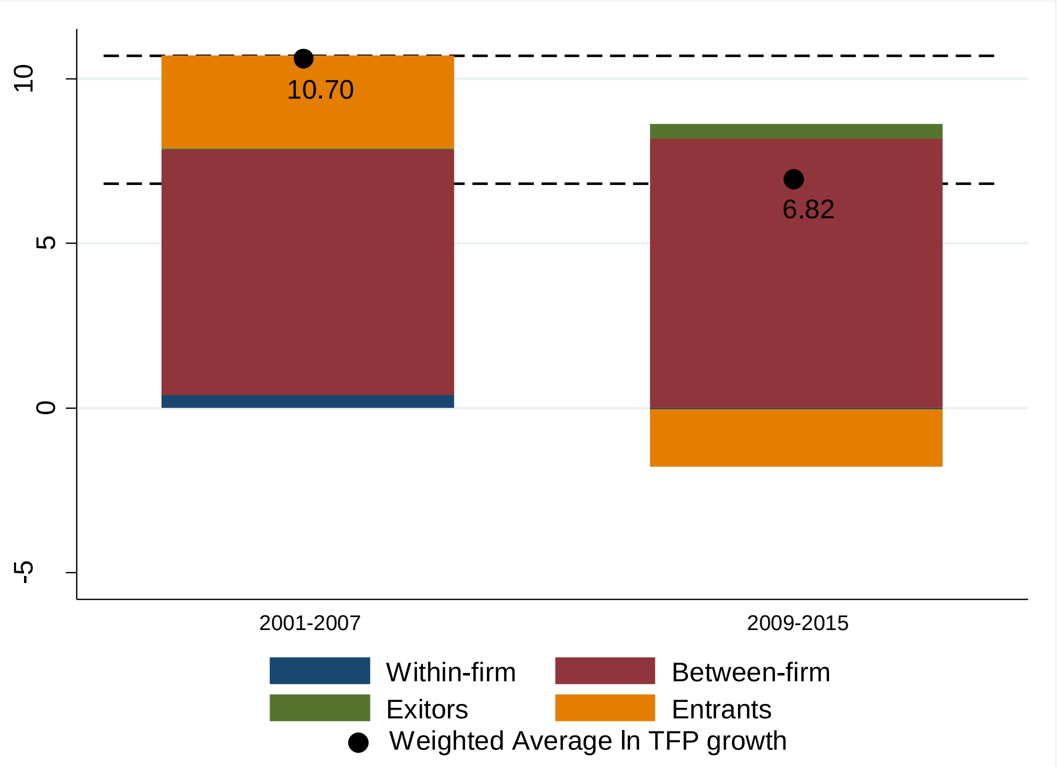
The above decomposition depicts the microeconomic sources of aggregate productivity growth. The advantage of this decomposition is that it reduces the biases due to not accounting for entries and exits (relative to the basic OP of 1996) and using the same reference productivity level for the contributions of survivors, entrants and exitors – i.e., the decompositions based on Baily (1992), Griliches (1995), and Foster (2001). Melitz and Polanec (2015) show that the consequence of these biases is an underestimation of the contribution of an improved allocative efficiency (between firm components).[22]

4.4 Results

We begin by evaluating changes in ln TFP levels for the market economy, for which we depict the decomposed variation over two different periods in Figure 4.1. We exclude the year 2008 and evaluate the variation over 2001-2007 and over 2009-2015. Although the aggregate ln TFP level in the market economy is higher in the second than in the first period (see Figure 4.1 in chapter 5), the rate at which productivity increased was stronger before than after the 2008 crisis (10.7% versus 6.8%). Thus, we find a strong negative effect of the crisis on overall productivity growth, with a 3.9% growth difference between the first and second periods.

[22] Although our preference is for the decomposition of Melitz and Polanec (2015), we intend to carry out those of Baily (1992), Griliches (1995), and Foster (2001) for the sake of comparison.

Figure 4.1: Aggregate ln TFP growth decomposition (DOPD)



Sources: French administrative firm datasets (FICUS-FARE) from the INSEE for 2001-2015.

Figure 4.1 also shows that, contrary to most literature on decompositions, aggregate productivity changes (in both periods) are mostly accounted for by variations in the allocative efficiency term. This is in line with Melitz and Polanec (2015), who argue that other decompositions underestimate the contribution of the between-firm component (reallocation of resources between firms) and that the decomposition that they propose corrects for this bias. Interestingly, the technical efficiency term or the within-firm learning effect (in absolute terms) barely contributes to aggregate productivity changes in France over these periods. This is also the case for exits, while entries account for a significant share (again, in absolute terms) of the aggregate TFP variation. In the figure, it is also noticeable that the contribution of the within-firm learning term (technical efficiency) after the crisis period becomes negative – although very small – meaning that the average firm experienced a slowdown of its TFP growth. Although the slowdown was relatively small, the contribution of the within-firm learning of the surviving firms to aggregate TFP growth was positive over the years preceding the crisis. Hence, it seems that the crisis had a negative and long-lasting effect on the average productivity growth of the survivors.

In addition, a change in signs from one period to another is also observed for the contribution of entrants, which is the term that contributes the most to aggregate changes after the between-firm component. The fact that this term is negative means that the average productivity of entrant firms is below the average productivity of survivor firms.[23] Hence, new firms in the market economy brought increases in productivity growth over the years prior to 2008, but the financial turmoil seems to have released market opportunities to less productive but financially unconstrained firms.

[23] This is also the case for Slovenian firms analyzed by Melitz and Polanec (2015).

We find that the allocative efficiency term, which is the main driver of productivity growth, as indicated by our decompositions, becomes stronger after the financial crisis. This shows that very productive firms increased their market shares in comparison to exitors and less productive survivors, suggesting a more concentrated market after 2008. This observation is in line with the results of productivity distributions described in the next chapter, where the market share ratio of less to more productive firms (as classified by productivity quartiles) almost doubled in the last period examined compared to the first period.[24] This can also be connected to the stronger dispersion of productivity among firms after the crisis described in chapter 5, where the tail at the bottom of the distribution is more important than the upper tail.[25] The decompositions allow us to say that this result is explained by a negative shock to the average survivor and the fact that relatively less productive firms entered the market after the crisis.

Finally, the positive sign of the contribution of exitors points to a small and partial "cleansing effect" of the financial crisis, where the least productive firms were forced to leave the market. We call this a partial "cleansing effect" because, despite the positive contribution of exits and allocative efficiency after the crisis, the contribution of entries to aggregate productivity growth is negative. For a complete cleansing effect, the least productive firms would exit the market and free market shares for more productive firms, whether new firms or incumbents. Indeed, the positive contribution of exitors means that on average, less productive firms were forced to exit, but this seems to have created market opportunities for relatively less productive new firms as well. As discussed in detail later, when each sector is analysed separately, no complete cleansing effect seems to have taken place in any sector of the economy after the financial crisis (i.e., where market reallocations, entries and exits contribute positively to aggregate TFP growth). In fact, it is notable that a positive contribution of exits after 2008 is found for only 3 of the 6 broad sectors examined (and this contribution is actually less important in magnitude after the crisis for the manufacturing sector).

Table 4.1 disentangles these productivity changes in the whole market economy by showing the results of the decomposition for each broad sector included in our analysis, and Figures 2-7 graphically display these results. The most remarkable result of the decompositions comes from the finance and real estate sector, whose productivity growth between 2001 and 2007 was approximately 58%, clearly reflecting the bubble that the sector was experiencing. Moreover, this huge productivity growth was greatly led by new firms (59%) and partly by the reallocation of market shares to productive firms (12%), while the average firm experienced an important productivity growth slowdown (9%) over the period that preceded the financial crisis. The period following the financial turmoil for this sector is characterised by positive but much milder productivity growth (7%); thus, it displays a 51% percent difference in TFP growth from one period to another. Additionally, there is no sign of a cleansing effect, as the contribution of exitors is negative and relatively strong (3.6%). The rest of the components of the decomposition appear to contribute positively to aggregate growth. This is particularly the case for the within-firm term, which makes a sizeable contribution to the aggregate evolution of TFP, although its contribution is less than that of allocative efficiency (3.7% and 4.7%, respectively). Entries also appear to contribute positively to aggregate productivity, being the only sector in which this phenomenon seems to occur after the crisis. The remaining sectors of the market economy experienced a negative contribution of new firms to their aggregate changes in productivity.

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[24] See Table 5.3 in Chapter 5.

[25] See Figure 4.5.3 in Chapter 5, which plots the market economy cumulative distribution function (CDF).

Table 4.1: Aggregate ln TFP growth decomposition in the market economy and broad sectors

TFP		Δ Aggregate Productivity	Technical Efficiency	Allocative Efficiency	Exitors	Entrants
2001-2007	Construction	-2.95	-5.11	2.13	0.08	-0.05
	Finance & Real Estate	58.24	-9.33	12.07	-4.00	59.50
	High-Tech Services	15.52	4.75	14.00	-0.30	-2.93
	Low-Middle-Tech Services	7.48	0.75	4.84	-1.72	3.61
	Manufacturing	11.62	6.16	4.75	0.73	-0.02
	Other Services	2.40	0.36	1.69	0.99	-0.63
	MARKET ECONOMY	10.70	0.40	7.43	0.04	2.82
2009-2015	Construction	-4.52	-5.50	1.20	0.41	-0.62
	Finance & Real Estate	7.20	3.74	4.65	-3.59	2.41
	High-Tech Services	11.33	-0.71	16.16	-1.01	-3.11
	Low-Middle-Tech Services	5.79	-1.80	8.62	-0.89	-0.13
	Manufacturing	4.21	-0.95	5.72	0.46	-1.01
	Other Services	7.49	3.24	4.51	2.63	-2.90
	MARKET ECONOMY	6.82	-0.04	8.19	0.42	-1.76

Sources: French administrative firm datasets (FICUS-FARE) from the INSEE for 2001-2015.

Another sector experiencing specific evolutions is the construction sector, as it is the only sector in which a negative change in productivity growth is observed. Although the sector was already experiencing a negative productivity growth trend over the 7 years that preceded the financial crisis, the crisis deepened this slowdown, and the trend decreased from -3% to -4.5% growth after 2008. The negative evolution in both periods is almost entirely driven by the negative contribution of the within-firm component (approximately -5% and -5.5% before and after 2008) at the same time as new less productive firms entered the market. The latter factor had a stronger effect in the second period (-0.05% vs 0.6%). On the other hand, the allocative efficiency term – contributing positively – was significantly more important before the crisis than after 2008 (2% vs 1%). In other words, not only did the average surviving firms experience negative learning before and after the crisis but resources were also less directed towards more productive firms after 2008. A positive contribution of exitors in both periods is observed, however, which is very close to zero in the first period and increases after 2008. Therefore, a relatively small and partial cleansing effect (0.08% vs 0.4%) exists.[26]

The sector that displays the strongest aggregate productivity growth in the years following the crisis is the high-tech services sector. Nonetheless, the sector also experiences a productivity growth slowdown in the years prior to 2008 (15.5% in the first period vs 11.3% in the second). As in other cases, most of the contribution is accounted for by the allocative efficiency term, which actually improved after the crisis (increasing from 14% to 16%). The contribution of the within-firm term, which had an important and positive effect in the first period, became negative in the years following the crisis – although this contribution is not very important in magnitude (decreasing from 4.7% to -0.7%). Finally, the contribution of exits and entries is negative in both periods but becomes higher in magnitude after 2008, with a stronger absolute contribution of entrants than of exitors each time. However, the change in contribution triples for exitors, while that of entrants barely increases (in absolute terms). This means that firms exiting the market were not, on average, relatively less productive than entrants and

[26] We call this a partial cleansing effect as even if less productive firms exit the market, the contribution of entrants is negative and stronger.

surviving firms. The fact that the nature of this sector probably requires important investments before firms can generate enough cash flow may have forced productive firms to exit the market because they found themselves under financial stress during the financial crisis.

The low-middle-tech services sector also experiences a slowdown in its productivity growth after 2008, decreasing from 7.5% to 5.8%. Although the allocative efficiency term is more important (and positive in both cases) in the second period (4.8% vs 8.6%), the within-firm learning, which contributes positively before the crisis, becomes negative and relatively strong after 2008 (decreasing from 0.75% to -1.8%). In this sector, new firms in the market contribute positively and strongly to TFP growth before 2008 (3.6%), but after the financial turmoil, their contribution becomes negative, although relatively small (-0.13%). Interestingly, the contribution of exitors in this sector, which is negative in both periods, becomes less important after the crisis (-1.7% vs -0.9%). This indicates a less important effect of financial constraints on relatively productive firms exiting the market, as was the case for high-tech services.

The manufacturing sector evolution matches those of the whole market economy in terms of the signs of each contribution. However, in terms of magnitude, this is the only sector for which we observe a stronger contribution to the aggregate productivity growth of the within-firm component than the between-firm component. In the 7 years preceding the financial crisis, the technical efficiency term contributes up to 6%, while the allocative efficiency accounts for 4.8%. Nonetheless, the positive contribution of the average survivor becomes negative after the crisis (approximately -1%), while the reallocation of market shares to more productive firms modestly improves from one period to another (increasing from 4.8% to 5.7%). No signs of the cleansing effects of the crisis appear in the manufacturing sector as, despite a positive contribution of exits after the crisis (0.46%), its contribution is smaller than before 2008 (0.73%). At the same time, the negative contribution of new firms is small in the first period, while it is 5 times larger after the crisis (-1%). This suggests that while a modest reallocation of resources left by exitors went to more productive survivors, exitors also left market opportunities for new less productive firms.

Finally, other services (which includes the trade sector and accommodation and food services) is the only sector for which we observe improved growth in its aggregate weighted mean TFP over the 7 years after the crisis compared to the previous 7 years, increasing from 2.4% to 7.5% and hence more than tripling from one period to another. This improvement is led by an improvement in all terms expect for the contribution of entrants, which is negative and actually offsets the positive contribution of exitors. This sector has the strongest contribution of exits after the crisis (2.6%) and is one of the few in which the within-firm component is positive and relatively high after 2008 (3%).

4.5 Conclusion

First, we conclude that productivity growth suffers a slowdown after the financial crisis. Second, the sectors are very heterogenous, and aggregate changes are mainly due to between-firm reallocation of market shares among the surviving firms, as this term is the only one that always displays a positive contribution to aggregate TFP growth.[27] Moreover, this term tends to become stronger after the crisis, which means that allocative efficiency improves after 2008. Nonetheless, this may also indicate that markets become more concentrated after the financial turmoil[28]. Additionally, we find

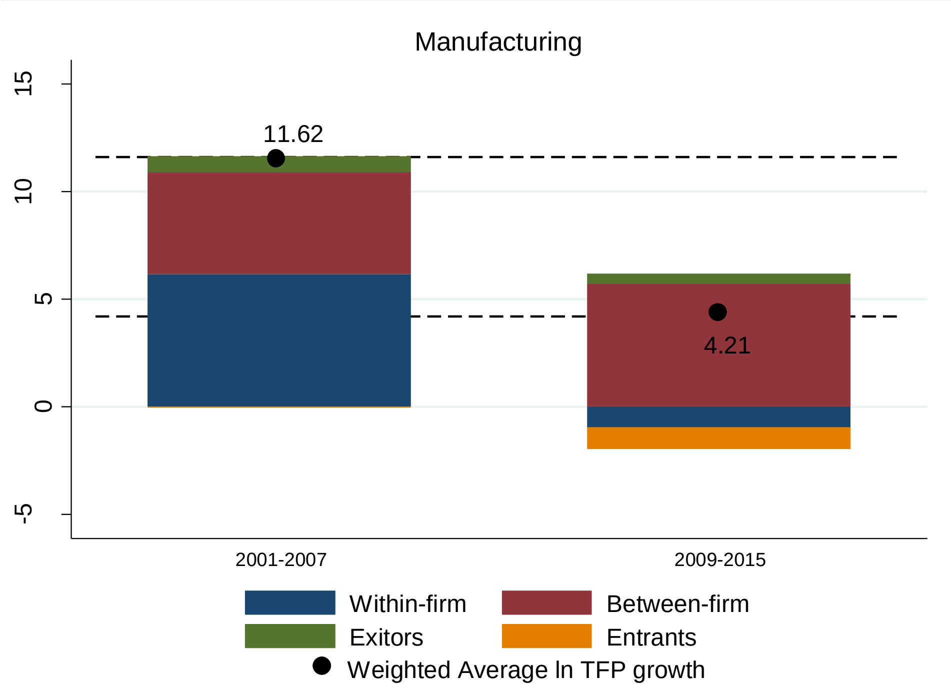
[27] Melitz and Polanec (2015) show that other decompositions overestimate the contribution of entrants and underestimate that of the between-firm component.

[28] Increased market concentration is corroborated by the results shown in Table 5.3 in Chapter 5.

that the contribution of the technical efficiency term to these changes is relatively small and that its sign tends to become negative after the crisis. Finally, the contribution of new firms in the market has an almost invariably negative effect on aggregate productivity after the crisis (with the exception of finance and real estate, possibly because stronger regulation imposed in the sector after the financial turmoil made entries more difficult). This may be explained by the relatively low interest rates that prevail after the financial crisis, allowing firms with relatively low productivity to enter the market.

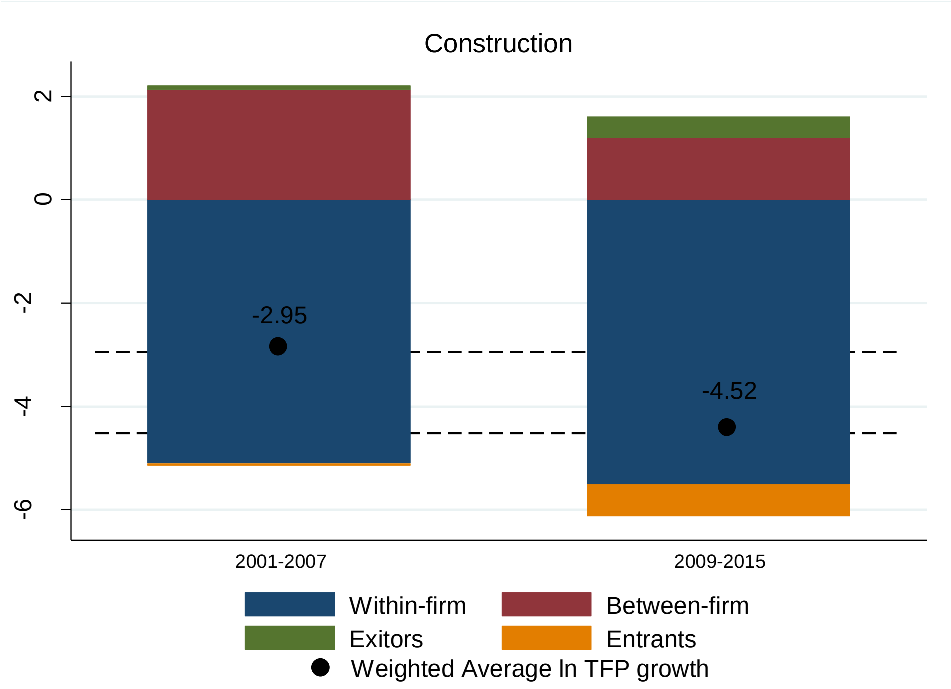
The possible policy conclusions of this chapter are that market selection should be closely watched given the negative contribution of new firms in the market to aggregate productivity. In addition, policies should be implemented to promote faster adoption of technology given the negative contribution of within-firm efficiency to aggregate changes in productivity.

Figure 4.4: Sector aggregate ln TFP growth decomposition (DOPD)



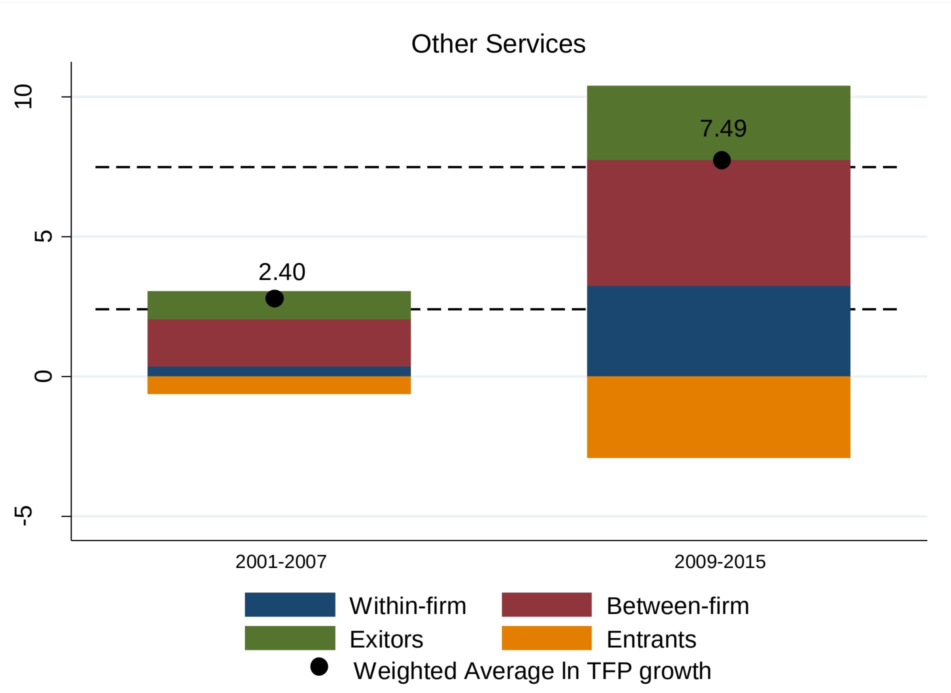
Sources: French administrative firm datasets (FICUS-FARE) from the INSEE for 2001-2015.

Figure 4.5: Sector aggregate ln TFP growth decomposition (DOPD)



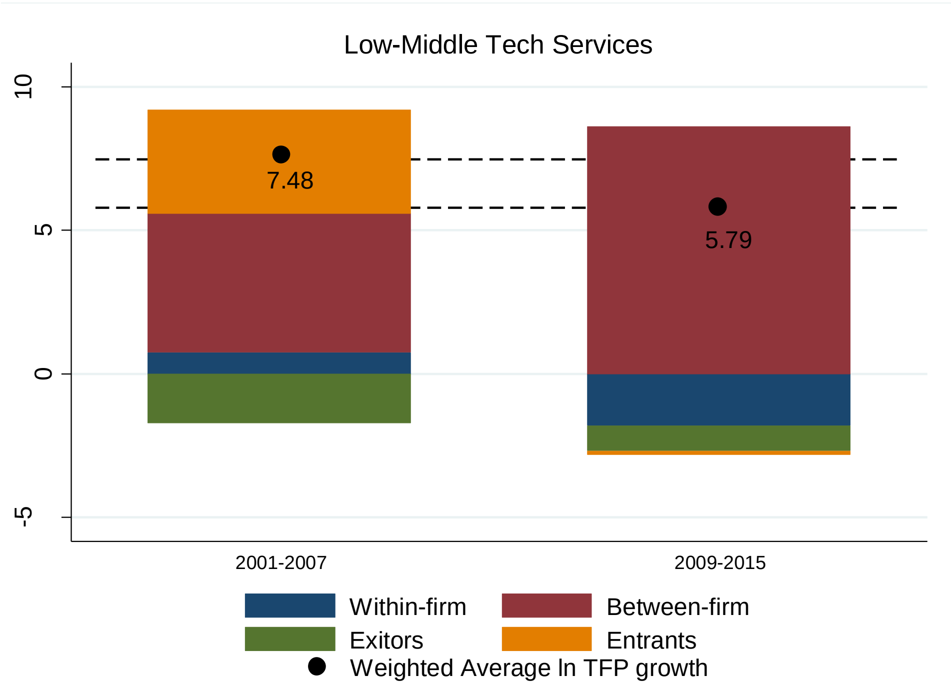
Sources: French administrative firm datasets (FICUS-FARE) from the INSEE for 2001-2015.

Figure 4.6: Sector aggregate ln TFP growth decomposition (DOPD)



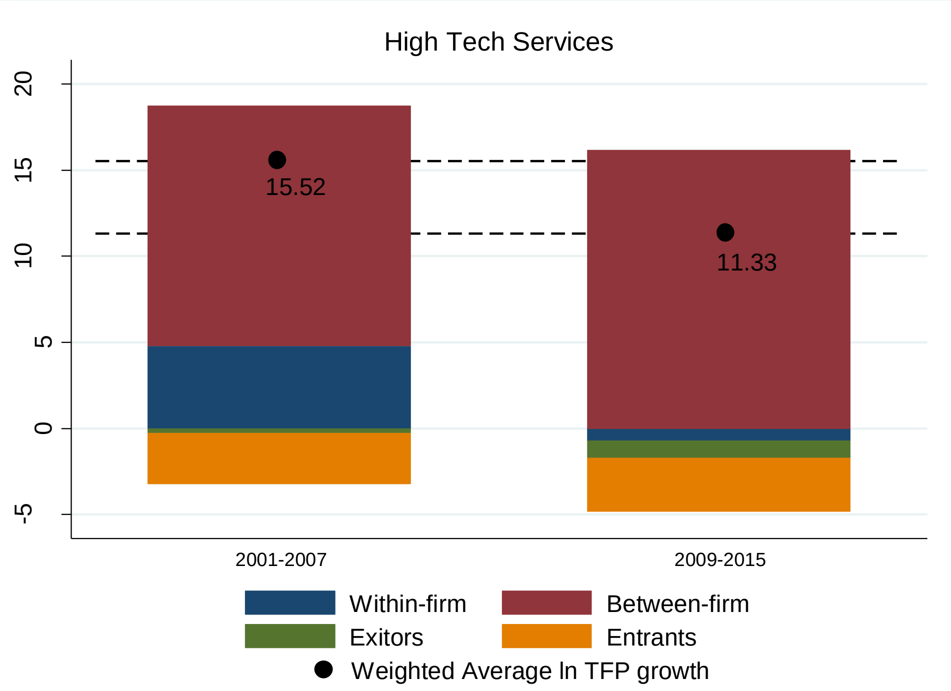
Sources: French administrative firm datasets (FICUS-FARE) from the INSEE for 2001-2015.

Figure 4.7: Sector aggregate ln TFP growth decomposition (DOPD)



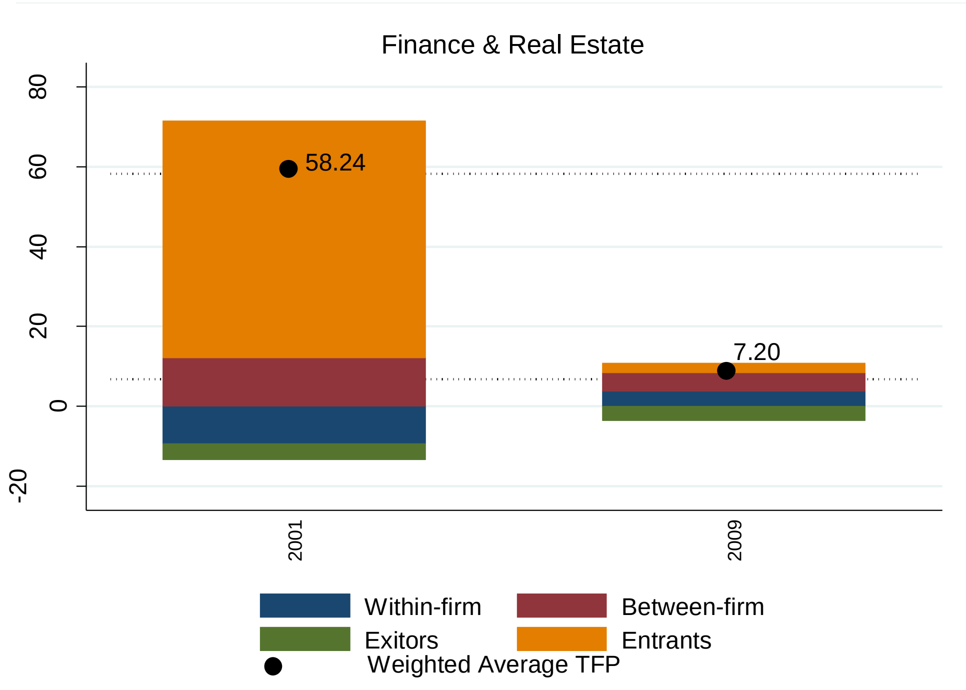
Sources: French administrative firm datasets (FICUS-FARE) from the INSEE for 2001-2015.

Figure 4.8: Sector aggregate ln TFP growth decomposition (DOPD)



Sources: French administrative firm datasets (FICUS-FARE) from the INSEE for 2001-2015.

Figure 4.9: Sector aggregate ln TFP growth decomposition (DOPD)



Sources: French administrative firm datasets (FICUS-FARE) from the INSEE for 2001-2015.

CHAPTER 5

Firm-Level Productivity Distributions and Job Creation

Margarita Lopez Forero, OFCE SciencesPo
Lionel Nesta, OFCE SciencesPo, University Nice Sophia-Antipolis, France

5.1 Introduction

As mentioned in the previous chapter, this analysis contributes to the (now well-established) literature on firm heterogeneity, which emphasises that policy interventions under highly skewed distributions (say, in terms of productivity or firm performance) may need to be targeted given that very different outcomes are likely to arise depending on the tail of the distribution that is affected by the policy. Thus, any policy intervention that takes the existence of firm heterogeneity into account should be better able to attain its objectives. In this sense, this analysis aims to consider more information regarding the relevant aspects of the heterogeneity of French firms.

In particular, a strand of the literature stresses the need to reallocate resources from low- to high-productivity firms to restore growth. This view may involve a trade-off between growth and employment and social inclusion depending on the relationship between productivity distribution and employment growth on the one hand and productivity distribution and market power on the other. More specifically, the relevance of the link between employment growth and productivity distribution becomes more evident after a recent paper by Autor et al. (2017) that argues that the rise in the importance of super-productive firms – the so-called superstar firms – explains the decline in the labour share in the economy given that these firms tend to have a lower share of labour in sales and value added. Using US and European data, they find that this fact is true across sectors and is exacerbated in highly concentrated sectors. In this context, if the most productive firms employ relatively fewer resources to reward labour, then policies and institutional changes that advantage the most productive firms may also disadvantage workers.

Indeed, lower labour shares can be explained either by lower wage bills or by a lower number of workers at a constant value added. Whatever the source of the changes in the labour share, a decline translates into increased inequality between factors of production: workers and capital. This is particularly true if firms with a low labour share progressively increase their market share and end up driving the aggregate labour share trend, which is at the heart of current policy and academic debates. Our results echo the findings of Autor et al. (2017) that the most productive firms have substantially lower labour shares and increasingly important market shares. Interestingly, their labour shares do not follow a declining trend, as in the case of the U.S., as shown by Autor et al. (2017). However, the top productive firms' labour shares remain significantly lower than those in the other quartiles despite the positive trend. This means that there are two competing forces driving inequality between workers and shareholders, as market shares go to low labour share firms (upper productivity quartile) and these firms are simultaneously increasing their labour shares.

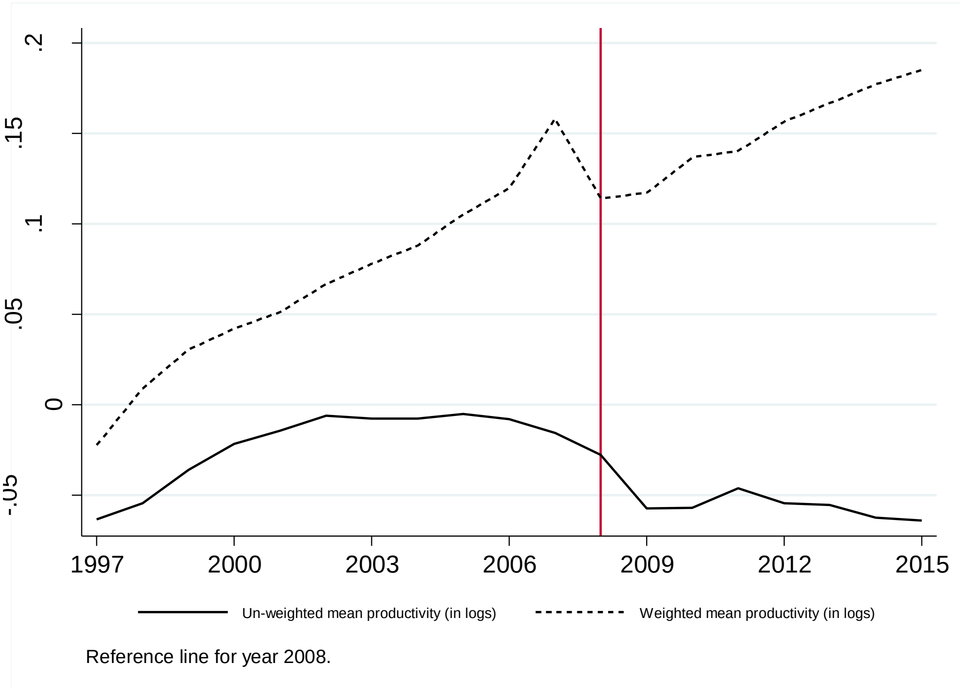
At the same time, this is accompanied by a growing wage gap among top and bottom productivity firms. Therefore, we observe that increased wage inequality among workers is strongly influenced by differences between firms at the top and bottom of the productivity distribution. This increased between-firm inequality in terms of wages together with a more concentrated market is in line with the findings of Criscuolo et al. (2017). This may in turn explain part of the aggregate productivity growth slowdown observed after the crisis, which is discussed in the previous chapter. Indeed, based on firm-level data for 16 OECD countries, Autor et al. (2017) find evidence of a stronger productivity slowdown in sectors in which concentration and more divergent trends of wages and productivity between the top and bottom firms appear.

Overall, this boils down to a study of the relationship between productivity, productivity growth and job creation. This analysis aims to link firm-level productivity distribution with different labour market outcomes in a strongly descriptive fashion. We create quartiles of productivity levels and analyse how they relate to labour shares (of value added), job creation, wage inequality and shares of skilled labour (out of total labour). We measure firm productive efficiency by means of total factor productivity, and some robustness results using labour productivity are included in the appendix.[29]

5.2 Trends in Aggregate Productivity

A first glance at the evolution of average productivity in the market economy allows us to understand the importance of firm heterogeneity. Figure 5.1 plots both the levels of unweighted average productivity and (value added) weighted average productivity in the whole market economy (excluding sectors 12, 19 and 65) over 1997 and 2015, as measured by TFP (Figure 5.1 in the appendix plots ALP).

Figure 5.1: Evolution average ln TFP market economy



Sources: French administrative firm datasets (FICUS-FARE) from the INSEE for 1997-2015.

The first message emerging from this figure is that the weighted average productivity is above the simple average, meaning that larger firms – in terms of market share – are indeed the most productive. Additionally, while this gap is relatively small in 1997, it becomes substantially larger over time, with an initial difference of 4.1% and a final gap of 24% in 2015. This increasing gap is the result of a clear positive trend of the weighted average TFP and a negative trend of the unweighted average TFP, where all firms are given the same weight. In particular, this divergence seems to be driven by changes in

[29] See Section 4.2 for a detailed presentation of the productivity measures and the variables used in their computation.

the market structure during the financial crisis in 2007-2008. Even though the weighted mean displays an abrupt – and stronger – slowdown, it soon recovers its positive trend, while the productivity level of the simple average, despite suffering a less abrupt shock during the crisis, continues to slow over time with no sign of recovery by the end of 2015. This means that on average, the TFP shock after the crisis is transitory for larger firms but seems to translate into a permanent negative shock for the average firm.

To evaluate whether these trends are representative of the whole market economy or are merely the result of the behaviour of specific sectors that are very sizeable in the economy, we now focus on the different trends within 6 broad sectors. These broad sectors are defined as the "sections", or A21 levels, of the NAF revision 2 (2008): manufacturing (C); construction (F); high-tech services (information and communication, J; professional, scientific and technical activities, M); low-middle-tech services (transportation and storage, H; administrative and support activities, N); finance and real estate (K; L); other services (trade and repair, G; accommodation and food service, I). In this sense, Figure 5.2 displays the mean evolution of the weighted and unweighted TFP for each broad sector.

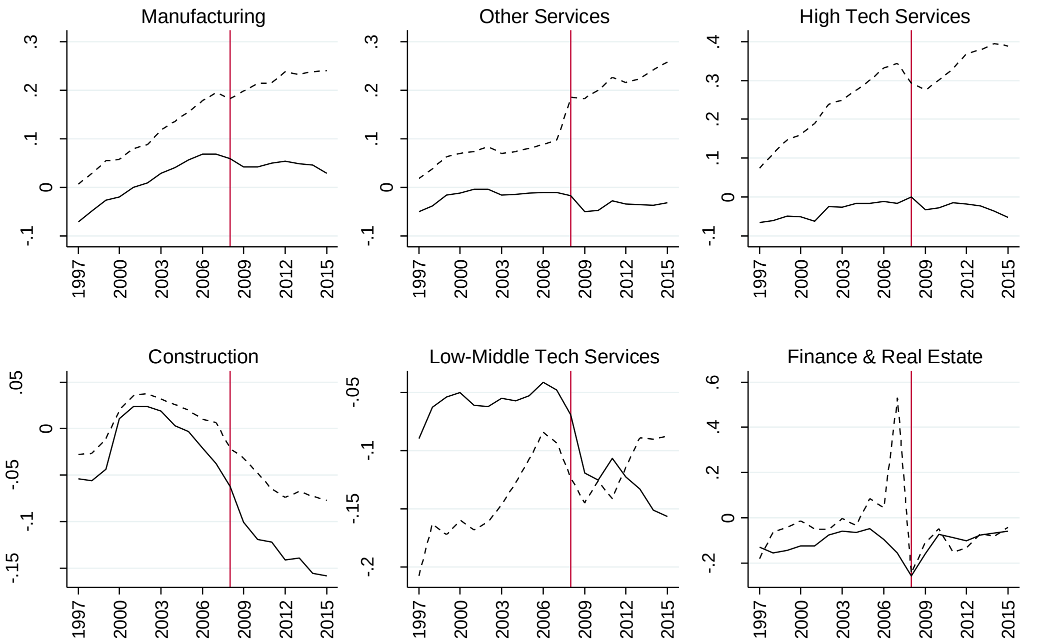
We find the same pattern as that in the aggregate market economy in manufacturing, high-tech services and other services, where the weighted average productivity is initially above the simple average and where the divergence between the two means increases after the financial crisis. This means that these three broad sectors represent a large segment of the whole economy both in terms of market share (as indicated by the weighted average trends) and in terms of the number of firms (as indicated the evolution of the simple mean where all firms are given the same weight).

However, the rest of the sectors display remarkably different behaviours and evolutions with respect to the whole market economy and with respect to each other. Even if construction and low-middle-tech services display an initial difference between the weighted and unweighted mean productivity, where the first is higher than the latter, the crisis translates into very different effects between them. In the construction sector, both trends follow the same pattern with an initially marked increase in productivity and a strong negative shock after the crisis – and neither shows any sign of recovery by the end of the period (i.e., 2015). Hence, even large firms retain stronger market shares over the whole period, and no divergence between the two averages is found after the crisis, as is the case for the whole market economy.

In contrast, low-middle-tech services start with a strong difference in favour of the weighted average productivity, with an important negative shock for both in 2008 but a clear upsurge in average productivity and a strong slowdown in the weighted average around 2012. These shocks within the sector translate into a divergence between the two average productivities by the end of the period, but in this case, it is because more productive firms have increasingly less market share.

Finally, the average means, both in terms of level and relative importance, in the finance and real estate sector seem to undergo no drastic change between 1997 and 2015 despite strong movements within the period. The two productivity means are comparable at the beginning and end of the period, meaning that productivity is rather homogeneous among large and small firms. Nonetheless, the evolutions in between are strongly illustrative of the fact that nature of the 2008 crisis is financial. During the years preceding the financial crisis, the simple average productivity begins evolving faster than the weighted average, attaining its peak in 2007. A clear misallocation of market share is observed between 2006 and 2007, when the productivity of firms with important market shares slows, while the simple average productivity increases.

Figure 5.2: Evolution average ln TFP broad sectors



Reference line for year 2008. Solid line is Un-weighted mean productivity (in logs) and dashed line is Weighted mean productivity (in logs)

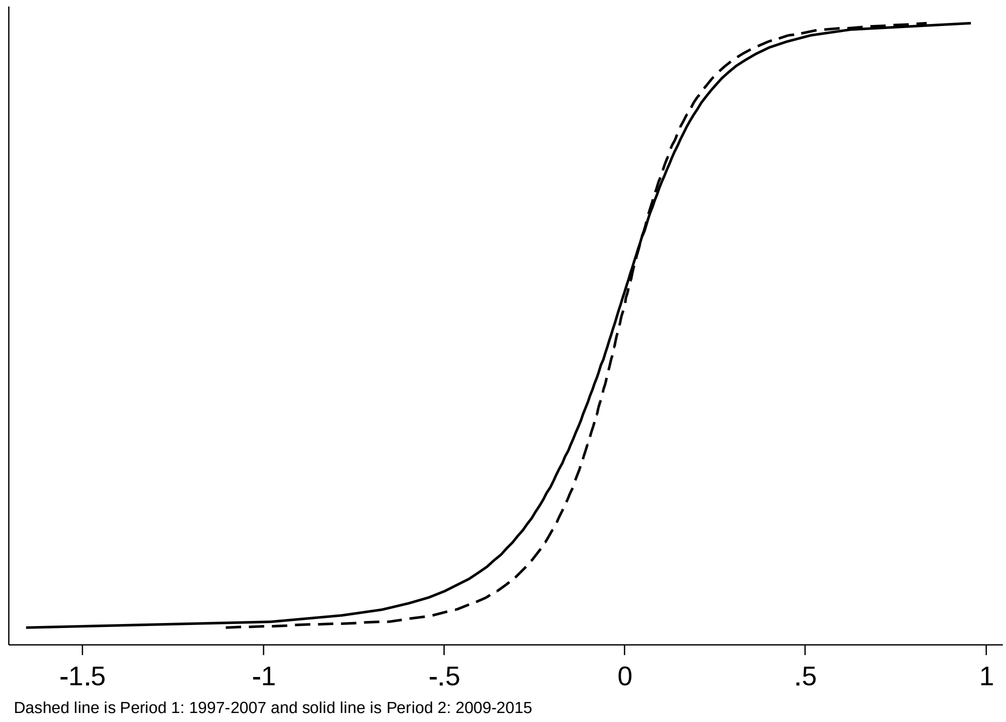
Sources: French administrative firm datasets (FICUS-FARE) from the INSEE for 1997-2015.

5.3 Distributions of Aggregate Productivity

Average trends are indeed informative and help set useful orders of magnitude; however, it is important to bear in mind that they may hide strong compositional effects. To properly account for firm heterogeneity, we also compare the entire productivity distribution of firms before and after the crisis. This allows us to assess whether the average productivity improvement from one period to another is explained by a few super-productive firms, by many less productive firms or by both. This is shown in Figure 5.3 for TFP (Figure 5.3 in the appendix for ALP), in which we compare the cumulative distribution function (CDF) of productivity levels before and after the crisis (dashed and solid line, respectively).

The main message of the two figures is that the crisis translates into a significant dispersion of productivity among firms at the level of the market economy. At the upper part of the CDF, productivity in the second period lies at the right of that of the first period, while at the bottom part of the distribution, the opposite is true. This means that less productive firms are less productive after the crisis than before, while the most productive firms are more productive after the crisis than before. One possible explanation may be that the financial crisis implies the exit of firms under financial stress that are not necessarily the least productive firms, allowing a reallocation of market shares to incumbents and new firms. On the one hand, the market shares left by exitors may translate into a growing efficient scale of operation for highly productive incumbents, allowing them to achieve optimal firm size. On the other hand, less productive entrants may benefit from market shares left by more productive but financially constrained exitors. Indeed, the productivity decomposition results, in which the contributions of exits and entries are properly analysed, support these hypotheses (see chapter 4).

Figure 5.3: CDF ln TFP Market Economy before and after the crisis



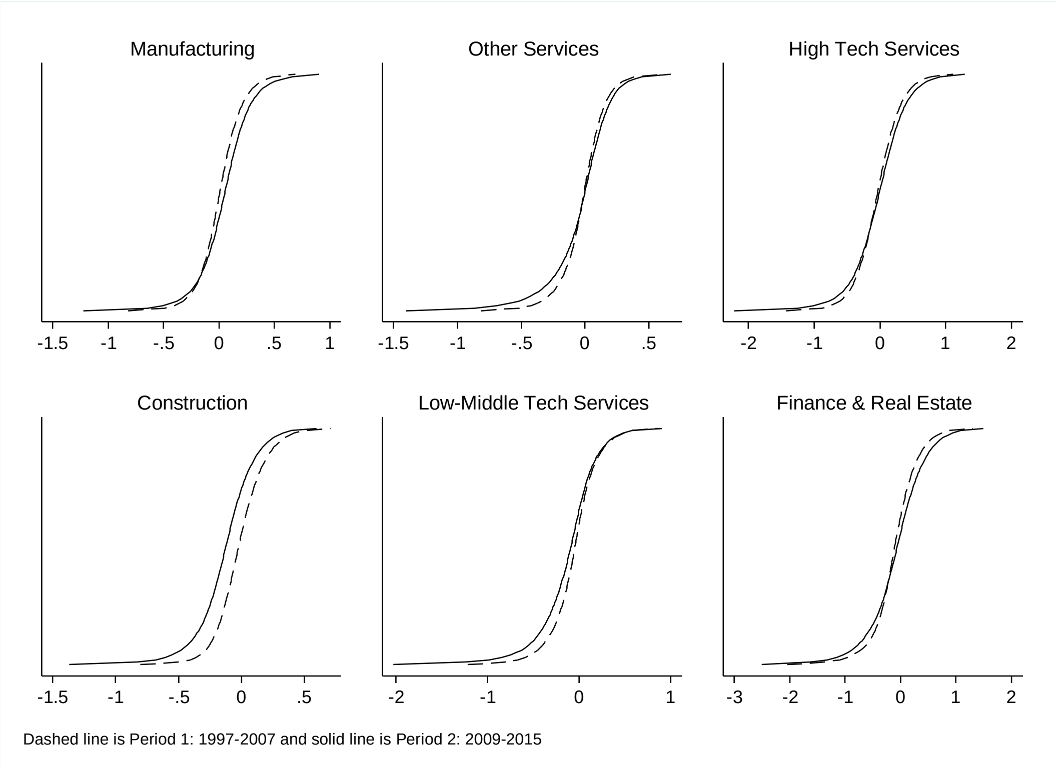
Sources: French administrative firm datasets (FICUS-FARE) from the INSEE for 1997-2015.

As before, we evaluate each broad sector separately. Figure 5.4 displays the CDF of productivity, as measured by TFP, before and after the crisis. A clear message of the CDFs of the different sectors is that none of them display similar behaviours. The only common pattern observed across sectors is that firms are more heterogeneous after 2008. This is mostly driven by the fact that in all cases, firms at the lower tail of the productivity distribution are those in the period after the financial crisis. This is particularly true for construction, other services and low-middle-tech services. In contrast, the heterogeneity between periods in the upper tail of the distribution is less marked and is sizeable only for some sectors: manufacturing and high-tech services.

In the manufacturing sector, we find that even if firms at the lowest end of the distribution are more productive before the crisis, those at the low-middle, middle and top of the distribution are clearly more productive after 2008. A similar pattern is found for high-tech services, finance and real estate and other services, although it is true only for firms at the middle and top of the distribution, while firms with a low-middle level of productivity are more productive before the financial turmoil. In the case of low-middle-tech services, we find that firms with low-middle levels of productivity appear to be considerably more productive and less heterogeneous before the crisis than after it. Finally, construction is the only sector for which we observe that one productivity CDF is clearly to the right of the other one: the CDF of the first period lies to the right of that in the second period. This can also be interpreted in terms of first-order stochastic dominance, meaning that productivity levels before the crisis dominate the productivity levels after 2008 in the construction sector.

Overall, we conclude that firms are much more heterogeneous in terms of productivity level after the 2008 crisis than before it. In light of the current economic and social challenges faced by France, the following pertinent question arises: How does productivity heterogeneity relate to the labour market in terms of job creation and inequality (wage and labour share – capital vs workers)? The next section addresses this issue.

Figure 5.4: CDF ln TFP broad sectors before and after the crisis



Sources: French administrative firm datasets (FICUS-FARE) from the INSEE for 1997-2015.

5.3 Productivity Distribution and Job Creation

The analysis in this sub-section divides the variables of interest pertaining to the labour market by quartiles of productivity and into three periods. We will exclude the years of crisis in France, that is, 2001-2002 and 2008 (this particular year has strong problems in our data), and we define the first period as 1997-2000, the second as 2003-2007 and the third as 2009-2015. In this sense, we regard the first two periods as those during which the economy expands and the last as a recession period in which the private sector crisis is followed by the public sector crisis. We start by describing the aggregate market economy and then disentangle the analysis by broad sectors.

First, it is worth noting that firms belonging to each quartile are not necessarily the same from one period to another, as firms may move between productivity quartiles from one period to another. Additionally, it should be kept in mind that firms in each quartile also change over time due to exits and entries in the market. Table 5.1 displays the transition matrix for the productivity quartiles between 2001 and 2007 and Table 5.2 for the productivity quartiles between 2009 and 2015. These tables indicate the productivity persistence of firms over time, before and after the crisis.

The first table shows that productivity persistence over the 7 years preceding the crisis fluctuates around 45.5% and 62.7%, with the firms displaying the strongest persistence at the extremes of the distribution: top and bottom quartiles, respectively (62.7% and 53.6%). This means that two-thirds of the firms that are in the upper quartile of the distribution in 2001 are also in the upper quartile in 2007. Of the other third, most of them are in the third quartile (24% of firms in the third quartile in 2007 are initially in the top quartile), while a number of them end up at the bottom of the distribution of productivity (5% of firms in the first quartile in 2007 are in the upper productivity quartile in 2001).

At the other extreme, approximately half of the firms that are initially in the first quartile of the distribution display productivity persistence, as they remain in the same quartile in 2007. Approximately one-fifth of the firms in the second productivity quartile in 2007 are initially the least productive firms of the distribution, while only 3.6% of the top productive firms by the end of the period are in the first quartile in 2001. On the other hand, we observe stronger mobility for middle productive firms; approximately 41.7% of firms that are initially in the second productivity quartile remain in the same quartile, while a similar number is found for firms in the third quartile. The strongest mobility for these middle productive firms occurs through productivity downgrading: approximately 29% of firms in the lowest quartile in 2007 happen to be in the second quartile in 2001, and these firms represent 25% of the firms in the third quartile by 2007; in the same sense, 26% of the firms in the second quartile are initially in the third, while they represent 25% of the firms in the upper quartile by the end of the period. The latter show the strongest upward mobility in our sample in the years preceding the financial crisis.

Table 5.1: Transition matrix, first period

2001 TFP quartile	2007 TFP quartile				
	1	2	3	4	Total
1	36,995	19,397	7,888	2,926	67,206
	53.60	22.74	9.00	3.57	20.75
2	19,869	35,553	22,393	7,377	85,192
	28.79	41.68	25.55	9.00	26.30
3	8,622	22,493	36,332	20,278	87,725
	12.49	26.37	41.45	24.75	27.08
4	3,531	7,860	21,034	51,350	83,775
	5.12	9.21	24.00	62.67	25.86
Total	69,017	85,303	87,647	81,931	323,898
	100	100	100	100	100

Sources: French administrative firm datasets (FICUS-FARE and DADS) from the INSEE for 1997-2007.

Table 5.2 shows the same figures for the 7 years following the financial crisis. The most salient fact emerging from the transition matrix after the crisis is that persistence decreases at the bottom of the distribution from 53.6% in the first period to 51% in the second. However, productivity persistence slightly increases for the middle and top productive firms in the years before the crisis, rising from approximately 41% to 43% for firms in the middle quartiles and from 62.7% to 64.4% for firms at the top of the distribution. As before, mobility for the middle-productive firms occurs more through a downgrading than through an upgrading of productivity, with a slightly greater magnitude than in the years preceding the crisis.

Table 5.2: Transition matrix, second period

2009 TFP quartile	2015 TFP quartile 1	2	3	4	Total
1	38,470	22,480	8,964	3,672	73,586
	51.10	20.87	7.76	3.17	17.77
2	22,361	47,000	29,333	9,324	108,018
	29.70	43.64	25.40	8.06	26.08
3	9,915	28,254	50,410	28,192	116,771
	13.17	26.23	43.65	24.37	28.20
4	4,532	9,968	26,780	74,491	115,771
	6.02	9.26	23.19	64.39	27.95
Total	75,278	107,702	115,487	115,679	414,146
	100	100	100	100	100

Sources: French administrative firm datasets (FICUS-FARE and DADS) from the INSEE for 2009-2015.

Now, we begin the analysis relating productivity quartiles to labour market outcomes over time. Table 5.3 displays the following yearly variables for each productivity quartile averaged for each of the three periods: average value added of firms (in thousand real euros) in column 3; average employment, defined as the number of full-time equivalent employees per year, in column 4; average real wages per year in column 5; average labour shares, defined as firm wages and social charges over firm value added, in column 6; average share of skilled employment, defined as total number of top managers, professionals, technical managers and engineers over total number of employees, in column 7; *total* job net creation of all firms at the quartile level, defined as the sum of the difference in total employment from one year to another, in column 8; *total* skilled job net creation, defined as the sum of the difference in total skilled employment from one year to another, in column 9; and *total* number of firms per year in each quartile in column 10.

The first fact emerging from Table 5.3 is that as firms become more productive, an almost perfect ordering of magnitudes (either ascending or descending) appears for many statistics and holds true in all three time periods. This is the case for total value added (ascending ordering), average labour share (negative), average share of skilled workers (positive), employment net creation (positive), skilled employment net creation (positive), and average real wage (positive).

In this sense, we find a perfect ascending ordering of average value added as firms pass from a lower to a higher productivity quartile that holds true in all three periods. Nonetheless, the average market shares of firms in the lower quartile of productivity decrease over time, while those of firms in the upper quartile increase over time. The market shares of firms in the middle quartiles evolve from the first to the second period but decrease during the crisis. These trends translate into a market that becomes more concentrated over time. For instance, the ratio of the average value added of firms in the upper quartile to that of firms in the lower quartile is 2 in the first period, 2.7 in the second period and 3.3 in the third period. This is in line with the analysis of the evolution of productivity means, in which we found that for the whole economy, the (value added) weighted productivity evolves positively, while the unweighted distribution evolves negatively after the financial crisis (see Figure 5.1).

Interestingly, although firms in the upper quartile of the distribution (in terms of TFP level) are those with the most important average market shares in all periods, these firms are not the largest if we consider their average employment. In fact, firms with the highest average number of employees are in the middle quartiles of productivity, the third and second in order of importance. Additionally, the average number of employees of firms in the middle productivity quartiles evolves from the first to the second period, which is particularly true for firms in the third quartile. However, the negative shock of the crisis translates into an average reduction in employment for firms in the middle quartiles – either through a within-firm change or through a change led by entries and exits. This means that the average employment in middle productivity firms appears to be pro-cyclical in our sample.

Interestingly, the crisis does not seem to alter the mean number of workers in firms in the upper and lower quartiles of productivity, although the overall trends are very different for these two types of firms. Those with the highest productivity levels manage to maintain a constant average number of employees over the whole period. In contrast, the least productive firms slightly decrease their average number of workers during expansion times (i.e., from the first to the second period) but do not additionally reduce employment after the financial crisis. A possible explanation might be that on average, the least productive firms experience more "labour hoarding" than their more productive counterparts in crisis times. On the one hand, bargaining power should be much weaker for firms at the bottom of the distribution than for more productive firms. On the other hand, the crisis seems to translate into a negative demand shock for the least productive but not for the most productive firms – as inferred from the average value added in the second and third periods.

It is worth noting that these are only averages within each quartile over each period, but they give us an idea of what happens at the mean. Additionally, these changes from one period to another are also highly affected by firm exits and entries (both within the quartile and within the economy).[30] Hence, these averages do not necessarily reflect within-firm changes from one period to another.

[30] For instance, Tables 2-3 give us an idea of the exits and entries that affect each productivity quartile by presenting the productivity persistence of firms.

Table 5.3: Market Economy

Period	Productivity Quartile	Average VA	Average Employment	Average Wage	Average Labour Share	Average Share Skilled	Net Job Creation	Net Skilled Job Creation	Total number of firms
1997-2000	1	482	11	2,084	72.65	4.35	-2.42	0.49	139,702
	2	696	16	2,711	71.64	4.61	2.25	0.49	139,675
	3	892	16	3,271	67.03	6.17	4.23	1.02	139,687
	4	955	11	4,219	57.80	7.85	6.67	1.86	139,659
2003-2007	1	432	10	2,060	74.48	4.95	-2.30	0.00	145,324
	2	777	17	2,708	73.17	5.95	0.25	0.06	145,296
	3	1,144	19	3,326	68.19	8.33	1.10	0.28	145,310
	4	1,160	11	4,404	59.21	10.87	3.40	0.63	145,282
2009-2015	1	358	10	1,709	70.68	6.23	-1.16	0.06	170,581
	2	733	16	2,532	74.51	6.60	0.28	0.11	170,552
	3	1,031	17	3,272	72.07	8.62	1.77	0.36	170,567
	4	1,164	11	4,712	65.48	10.78	3.34	0.45	170,540

Sources: French administrative firm datasets (FICUS-FARE and DADS) from the INSEE for 1997-2015.

In the same sense, when firms are in the upper quartiles of the productivity distribution, their net job creation becomes stronger, with a net destruction observed only for firms in the bottom quartile, and these patterns hold true over the whole sample period. Nonetheless, net job creation evolves differently from one period to another depending on the productivity quartile. For instance, middle-productive firms sharply decrease their job creation from the first to the second period – hence, during the economic expansion years – while they manage to slightly increase net job creation over the recession years. Interestingly, net job *destruction* for the least productive firms becomes less important over time, while the opposite is true for the very productive firms, for which the net job *creation* diminishes over time. Firms in the bottom TFP quartile display -2.4% net job creation in 1997-2000, and this number falls to -1.2% in 2009-2015, while the top productive firms create a net of 6.7% more jobs during the first period versus 3.3% by the end of the sample period. In other words, over the past two decades, the gap in job creation between firms in the upper and lower productivity quartiles tends to narrow over time.

At this point, it is convenient to clarify a result that may appear *a priori* contradictory if one links the findings regarding the average number of employees from one period to another (column 4) with those regarding net job creation (column 8) of firms in different productivity quartiles. Indeed, we find strong net job creation from one period to another for the top productive firms, while their average number of employees remains stable over the whole sample period. At the same time, we find net job destruction for firms at the bottom of the productivity distribution, while their average number of employees remains relatively stable over time. The reason for this apparent inconsistency is that net creation/destruction occurs essentially though the extensive margin of firms: some firms enter the market, while new firms are created.

Different hypotheses that have been studied in the now growing literature on aggregate labour shares of GDP may explain the narrowing net job creation gap between firms at the top and bottom of the productivity distribution. This literature describes two possible phenomena that may occur as markets become more concentrated that are difficult to disentangle in practice: rising market power and an increasingly efficient scale of production (see Gutierrez, 2017 and Gutrierrez and Philippon, 2017). On the one hand, an increased concentration of market shares among more productive firms can be linked to an increase in the efficiency of the scale of operation, upon which "the winner takes all" argument is based. In this sense, network effects, new technologies and globalisation i) increase consumers' elasticity of substitution and ii) increase the scale of operation of highly productive firms (see Autor et al., 2017). In this case, higher concentration can be expected to translate into higher job creation for the top productive firms as their market shares grow.

On the other hand, an increased concentration of market shares among highly productive firms can be linked to an increase in market power as competition decreases and markups rise for very productive firms (see De Loecker and Eeckhout, 2017). In this context, it is reasonable to assume that concentration and aggregate productivity growth do not necessarily translate into more job creation. This is the argument proposed by Caballero et al. (2017) in their study of labour shares in the case of the U.S.; they suggest that a higher concentration is linked to an increasing efficiency of scale before 2000 but not necessarily afterwards. Based on EUKLEM data, Gutierrez (2017) argues that concentration is not yet an issue in Europe, as it is in the U.S., and that Europe has yet to 'catch up' with the US US in terms of technological change; thus, concentration can be linked to rising markups instead of an increasing scale of operation. Nonetheless, although this is not the object of our current study (for instance, we do not evaluate firm markups), we find that over the past 18 years in France, i) concentration increases and ii) the gap in job creation between the top and bottom productive firms closes over time.

We believe that these results indicate an "efficient scale argument" that becomes less important over time and a "market power argument" that increasingly becomes part of the story.

In relation to this literature, we study the evolution of firm labour shares – although here, we display only average numbers and we do not investigate aggregate evolutions as most authors do – to account for firm heterogeneity in terms of productivity. The first fact emerging from these numbers is that the top productive firms are characterised by having the lowest average labour shares in the market economy.[31] This is true for the whole period and is in line with Autor el al. (2017), who find that the declining trend of the aggregate labour share in the US US is explained by the fact that very productive firms in the economy – characterised by having low and declining labour shares –become increasingly important in the economy (in terms of market share). Additionally, we observe an almost perfect descending ordering of labour shares as firms fall into higher productivity quartiles. The only exception to this pattern is the case of the bottom productive firms during the crisis period. For the rest of the firms and periods, we find not only a perfect negative correlation between labour share and productivity but also an increasing trend. In other words, average labour shares follow a positive trend between 1997 and 2015 except that the least productive firms experience, on average, a 2.6% decline in labour after 2007, ending up with a lower share than their initial one (70.7% vs 72.7%). Less productive firms may display a falling trend in their labour share after the financial crisis because their wages undergo a sharp drop in this period (see supra in this section, where we analyse the trend of wages by productivity quartile), while their productivity does not decline in the same proportion.

Nonetheless, even if we focus here only on unweighted averages, we can link these findings to those of section 4.3, where we find an increased allocative efficiency after the financial crisis – defined as increasing market shares directed towards more productive firms. This may explain why aggregate labour shares follow an increasing trend after 2000 in France, as found by other analyses (see CEPII and Banque de France blogs) for France, which is confirmed by our aggregate figures based on EUKLEMS data (see Figure 5.6 in the appendix). In the case of aggregate figures, firms that account for a larger market share have a higher weight; therefore, the trends that these firms experience have a greater weight in the economy aggregates. Indeed, in section 4.3, we find that market shares are increasingly directed towards top productive firms after the 2008 crisis, and the results presented in this section indicate that these firms display an increasing trend in average labour share after 2000. A plot of these figures shows that this is also the case for firms in the second and third productivity quartiles, but with a lower slope than that of firms in the first quartile, while firms in the bottom productivity quartile experience a declining trend in labour share after the year 2000.[32]

As for wages, as mentioned earlier, we find a perfect ascending ordering of average real wages as firms become more productive over the complete time span. Low and low-middle productivity firms tend to have lower average wages, while high-middle productivity firms experience a slight increase during the expansion years (that is, in period 2 compared to period 1), but they decrease their average wages during the recession (period 3), with the same average real wage in 1997-2000 and at the end of the period (2009-2015). In contrast, only the most productive firms have stronger wages during the crisis period than in the previous periods. Hence, firms in the top quartile of the productivity distribution are the only ones that manage to increase their average

[31] For the sake of illustration, these labour share numbers are plotted in Figure 5 in the appendix.

[32] Figure 5 in the appendix.

wages from one period to another, which means that the gap in real wages between the top and bottom productivity firms widens increasingly over time. At the beginning of our sample period, the top productive firms pay wages that are on average twice as much as those paid by less productive firms, while at the end of the sample period, they pay wages that are almost three times higher than those paid by less productive firms.

Although we do not evaluate wage inequality among workers within firms, we conclude that the differences among firms progressively contribute to wage inequality among workers. This is in line with Song et al. (2017), who find that most wage inequality in the US US over the past 30 years is driven by differences among firms and not differences within firms.

Additionally, we observe that the demand for skilled employment becomes more important over the past two decades for most firms in the market economy. In absolute terms, as firms become more productive, they employ, on average, a higher share of skilled workers, which can explain to some extent why they also pay higher mean wages. Indeed, over the entire time span, the ratio of the share of skilled workers of firms in the upper quartile to that of firms in the bottom quartile fluctuates around 1.7 to 2. This means that more productive firms have a share of skilled workers that is on average almost twice as that of the least productive firms.

Nonetheless, only for firms in the upper TFP quartile does the average number of skilled workers relative to the total number of employees remain stable (and even slightly decrease) during the crisis, while the remaining firms increase their average skilled employment. This is particularly true for firms in the lower productivity quartiles. This reflects the fact that the least productive firms may be relatively more affected by the crisis; as they face the financial shock, the employment adjustment concerns mostly low-skilled workers. It is also interesting to compare the signs of net job creation for total employment and for skilled workers of firms in different productivity quartiles. In fact, only firms at the bottom of the distribution experience negative net job creation and positive net skilled job creation, while both figures are positive for the remaining firms in the market economy. This means that for the latter, high-skilled jobs and low-skilled jobs appear to be complementary, while the different job levels compete at low-productivity firms and appear to substitute for one another over the three periods.

Now, we further disentangle the links between firm productivity distribution and labour market outcomes by evaluating the broad sectors of the market economy one at a time. This allows us to determine whether the market economy exhibits strong composition effects, with some specific sectors of the economy strongly affecting the aggregate outcomes. Tables 4-9 display the results. We begin by evaluating the manufacturing sector, which follows the same trends as the market economy: an almost perfect ordering (positive or negative) of the magnitudes of the different variables appears as firms become more productive.

First, firms with substantially higher productivity than their peers have stronger market shares. Nonetheless, the market concentration in the manufacturing sector is significantly higher than that of the aggregate market economy for the whole sample period, and, as was the case for the whole economy, becomes increasingly stronger. The ratio of value added between firms in the upper quartile and firms in the lower quartile starts at 2.7 in the first period, increases to 5.5 in the second and reaches 7.5 in the third. The latter is substantially higher than the ratio of 3.2 for the whole market economy. The reason for the difference is that in the manufacturing sector, the increasing gap is uniquely driven by the strong progression of value added in the top productive firms, while value added for firms at the bottom remains relatively constant over time (whereas it follows a negative trend for the aggregate market). In contrast, middle productivity firms experience a strong increase in value added from the first to the second period and then a decline after the financial crisis.

If we consider firm size in terms of employment, we again find that high-middle productive firms are on average the largest in terms of number of employees with a relatively constant number of employees over the whole period (fluctuating around 36 with pro-cyclical behaviour). However, it is no longer the case that the top productive firms are smaller than their low-middle productivity peers because they are the only ones that manage to increase their average number of employees over the whole period. Whereas low-middle firms indeed have a higher average number of employees at the beginning of the period, they remain unchanged during the expansion times (second period) and decrease their employment during the crisis (third period). Additionally, it is no longer the case that the top productive firms have employment numbers comparable to those of their least productive peers; firms at the bottom not only are significantly smaller than firms at the top in the first period (18 versus 25 employees) but also follow opposite trends over time, as employment contracts from one period to another in the least productive firms. Finally, it is worth mentioning that regardless of the chosen measure – value added or employment – firms in the manufacturing sector are substantially larger than the average firm size in the whole market economy.

Wages also tend to be higher as firms upgrade their productivity levels. As before, the real wage gap between the top and bottom productive firms increases over time, with an initial ratio of top to bottom of 1.8, increasing to 1.9 in the second period and reaching 2.2 in the third period. The reason again is that firms at the bottom follow a negative trend in their mean wages, and firms at the top follow a positive trend over the whole sample period. Less productive firms experience a negative trend from one period to another, and low-middle and high-middle productive firms also display a decline in wages over the three periods. Average labour share also experiences an almost perfect descending ordering with respect to productivity level, and the average numbers are very similar in magnitude to those for the whole market economy. Additionally, almost all quartiles of the productivity distribution have increasing average labour shares over time, again with the exception of firms at the bottom of the distribution, for which labour shares decline by 1.6% after the financial crisis. This reflects the fact that average real wages decline more rapidly than mean productivity for less productive firms after 2008.

When we focus on the type of job, we find that as for the market economy, when firms are more productive, they also tend to have higher shares of skilled labour. However, some differences from the aggregate appear. First, the average shares of skilled workers in manufacturing tend to be significantly lower than that in the market economy. Additionally, the shares appear to be pro-cyclical for the manufacturing sector – they expand in the second period and contract in the third period for firms in the whole productivity distribution, while they increase over time in the aggregate market economy.

In addition, we again find a perfect ascending ordering of net job creation as we ascend in the productivity distribution, but net job *destruction* now appears for firms at the middle of the distribution as well. In fact, only the bottom productivity firms destroy jobs on net by the beginning of the sample period, but interestingly, in expansion times, firms in the second and third productivity quartiles experience net job *destruction.* In the recession period, only low and middle-low productive firms continue to destroy jobs on net.

Interestingly, net job creation in the manufacturing sector appears to be counter-cyclical for all productivity quartiles, as all firms create fewer jobs or destroy more jobs than in the first period, depending on the quartile, but in the third period, net creation increases and net destruction declines. This seems to be driven to some extent by the extensive margin of firms, with the average number of firms per year in each quartile dropping from 23,000 to 21,100 from the first to the second period and then increasing slightly to 21,200 after the crisis . Furthermore, the net job creation gap between the top and bottom productivity firms again narrows over the entire sample period. Indeed, this gap narrows more rapidly than that for the whole market economy, which, together with the significantly stronger concentration of the manufacturing sector, indicates that productivity growth and concentration relate less to an increasing scale of operation over time.

Table 5.11: Manufacturing (C)

Period	Productivity Quartile	Average VA	Average Employment	Average Wage	Average Labour Share	Average Share Skilled	Net Job Creation	Net Skilled Job Creation	Total number of firms
1997-2000	1	542	18	2,223	75.01	3.52	-2.00	0.36	23,031
	2	1,130	30	2,799	73.43	3.77	0.67	0.38	23,020
	3	1,746	35	3,263	68.42	4.42	1.96	0.68	23,024
	4	1,945	25	4,062	59.35	5.15	3.16	1.46	23,014
2003-2007	1	532	17	2,176	76.86	4.10	-3.61	-0.20	21,127
	2	1,357	30	2,745	74.92	5.08	-0.92	-0.08	21,115
	3	2,413	38	3,246	69.89	6.45	-0.22	0.21	21,121
	4	2,916	29	4,144	60.97	8.29	1.08	0.44	21,110
2009-2015	1	445	13	1,958	75.20	3.50	-1.83	-0.05	21,226
	2	1,194	24	2,632	76.66	4.21	-0.69	0.02	21,215
	3	2,389	36	3,193	73.40	5.46	0.49	0.26	21,221
	4	3,320	31	4,339	66.13	6.55	1.78	0.46	21,211

Sources: French administrative firm datasets (FICUS-FARE and DADS) from the INSEE for 1997-2015.

Finally, we also find a perfect ascending ordering of net skilled job creation as firms become more productive. Nonetheless, we find that firms in the first and second quartiles of productivity also experience net job *destruction* for skilled workers during the expansion period, which continues to be the case for the least productive firms after the financial crisis – although to a much lower extent than that of total net job *destruction*. In contrast, the whole market economy shows positive net skilled job creation for all quartiles of the distribution over the whole period.

Focusing on the rest of the sectors in Tables 5-9, we find that in general, construction, other services (which includes trade) and high-tech services display the same almost perfect ordering of magnitude (positive or negative) for the same variables as the market economy because firms in these sectors are in the upper quartiles of productivity. Average value added, average real wages, average share of skilled workers, net job creation and net skilled job creation increase when firms become more productive in these three broad sectors. The effect occurs for average labour shares, with labour shares being lower for more productive firms and tending to increase as firms downgrade their productivity level. As noted before for the market economy and the manufacturing sector, the only exception in the three sectors is the case of the least productive firms in the third period. Again, this points to a faster decrease in wages than in productivity during the recession period for the least productive firms.

Concentration also increases over time for these three sectors, with the high-tech services sector experiencing a sharp progression in the ratio of value added of firms at the top to firms at the bottom of the distribution from 1.8 in 1997-2001 to 7.4 in 2009-2015. The same ratio for the other services sector starts at 3.3 and ends at 4.5, which is still stronger than the concentration in the construction sector (starting at 2.1 and ending at 3.3). Interestingly, the ratio of the average real wages between top and bottom productivity firms never attains the level of heterogeneity between high and low productive firms that we observe for average value added. Nonetheless, we observe that for top to bottom firms, wage heterogeneity increases over time. In these three sectors, the ratio starts at approximately 2, which means that firms at the top pay twice as much as firms at the bottom. By the end of the sample period, the top productive firms pay wages that are, on average, three times higher than wages in the bottom productivity firms. In addition, as in the case of the market economy and the manufacturing sector, for these sectors, firms at the bottom *destroy* jobs on net, while firms at the top always appear to create jobs on net. Even more interestingly, as before, this gap in net job creation between the top and bottom productive firms narrows over time for all three sectors.

Unsurprisingly, the average share of skilled workers in the high-tech services sector is substantially higher than that in the other sectors in the overall economy (approximately 10 times higher than in construction, for instance), and this sector has the highest net creation of skilled jobs. Naturally, these numbers highly influence the aggregate economy averages. In addition to finance and real estate, which are discussed later, this sector behaves very differently from the rest of the economy because employment does not contract in any part of the productivity distribution during the recession period.

Finally, for the low-middle-tech services and the finance and the real estate sectors, particularly the latter, we observe patterns that differ from those of the aggregate economy and the other broad sectors. Although we find some similarities between low-middle-tech services and the aggregate economy, such as the perfect ascending ordering of average wages, average share of skilled workers, net job creation and net skilled job creation as firms upgrade in productivity, we find very different patterns for average real value added and, to a lesser extent, for average labour shares. Indeed, average value added in this sector is negatively correlated with productivity; we actually find a perfect descending ordering of magnitude as firms become more productive in the first sample period. Nonetheless, this does not come as a complete surprise if we recall the conclusions obtained from Figure 5.2, where we analysed the evolution of value added-weighted versus the unweighted productivity. The main conclusion from the comparison of the two means is that less productive firms have stronger market shares in the sector, particularly in the years preceding the financial crisis. This points to a misallocation of resources (or negative allocative efficiency), which, as we saw from the decomposition of the variation of aggregate productivity in chapter 4, is largely explained by the contribution of exits of firms before the financial crisis and of both entries and exits after the financial crisis.

For the finance and real estate sector, the only patterns that coincide with the aggregate market economy are the almost perfect ascending ordering of average skilled labour and the perfect ascending ordering of average real wages for firms in the upper productivity quartiles. As for low-middle-tech services in the first period, we find that in the third period (recession), less productive firms in finance and real estate have the highest average value added and that it decreases with firm productivity. These findings again indicate a negative allocative efficiency. However, recalling the decomposition results from chapter 4, we conclude that this is largely due to firm flows (especially the contribution of exitors).Aside from wages and skilled workers, there are no other clear patterns across periods connecting productivity and the other labour market variables of interest for this sector.

5.4 Conclusion

We find that after the crisis, allocative efficiency (in the sense of Olley and Pakes, 1996) seems to increase as more productive firms progressively increase their market shares. However, it is notable that this measure may also indicate higher market concentration. Additionally, we observe an aggregate productivity growth slowdown after the crisis, with a decrease from 10% in the 7 years preceding the crisis to 6% in the 7 subsequent years. Simultaneously, we observe increased heterogeneity in TFP distribution after 2008, particularly at the bottom of the distribution.

Furthermore, firms at the upper end of the TFP distribution appear to create more jobs (on net) than firms in the other quartiles, while firms at the bottom appear to destroy jobs (on net). Firms in the top quartile also create more skilled jobs and have relatively higher skilled labour shares. In addition, they pay higher wages on average yet have a lower labour share in value added. The latter fact, together with improved allocative efficiency, is in line with the "superstar firm" theory of Autor et al. (2017), who show that declining aggregate labour shares are driven by market reallocations to top productive firms. However, we observe that even though low labour share firms have increasing market shares, firms at the top of the TFP distribution increase their average labour shares after the crisis. Hence, two competing forces drive changes in aggregate labour shares after 2008 (and therefore inequality between workers and shareholders). Nonetheless, despite the positive trend for the top productive firms, their average labour shares remain largely below those observed for the other firms.

At the same time, wage gaps between the top and bottom firms progressively increased. Hence, even if we do not evaluate within-firm differences in wages, we find that inequality between workers is influenced by increasing differences between firms. This fact, together with increased TFP dispersion and increasing market concentration, is in line with the findings of Criscuolo et al. (2017) and may help explain the productivity growth slowdown after 2008. Based on firm data from various OECD countries, the authors show that the sectors with more dispersion of both wages and productivity are those in which competition reforms are the least important and where the aggregate productivity slowdown is the strongest.

In summary, our results echo several recent findings in the literature that relate market concentration to the aggregate productivity slowdown and inequality, both between workers and between factors of production (labour versus capital). Therefore, although a thorough understanding of the underlying causes of each of these trends requires further academic research, a clear policy implication of our findings and those of the recent literature is the need to address market concentration that prevents competition.

Table 5.12: Construction (F)

Period	Productivity Quartile	Average VA	Average Employment	Average Wage	Average Labour Share	Average Share Skilled	Net Job Creation	Net Skilled Job Creation	Total number of firms
1997-2000	1	240	6	2,109	76.50	1.77	-5.69	0.10	26,760
	2	497	10	2,671	74.92	1.60	1.21	0.18	26,758
	3	677	10	3,148	70.46	1.90	4.11	0.34	26,759
	4	494	6	3,924	60.01	1.93	9.59	0.75	26,758
2003-2007	1	247	7	2,161	76.66	1.58	-1.85	0.01	31,007
	2	510	10	2,806	75.51	1.97	1.81	0.15	31,006
	3	671	10	3,365	70.34	2.63	4.06	0.33	31,006
	4	472	5	4,348	60.21	2.90	7.38	0.49	31,005
2009-2015	1	135	5	1,815	73.16	1.64	-2.45	0.03	36,353
	2	358	9	2,715	77.72	1.80	-0.62	0.10	36,351
	3	559	11	3,410	75.31	2.41	1.11	0.19	36,352
	4	439	6	4,817	68.22	2.58	4.62	0.32	36,350

Sources: French administrative firm datasets (FICUS-FARE and DADS) from the INSEE for 1997-2015.

Table 5.13: Other Services (G,I)

Period	Productivity Quartile	Average VA	Average Employment	Average Wage	Average Labour Share	Average Share Skilled	Net Job Creation	Net Skilled Job Creation	Total number of firms
1997-2000	1	172	6	1,916	71.10	3.21	-2.60	0.38	58,542
	2	476	12	2,521	69.78	3.68	2.00	0.36	58,540
	3	570	11	3,057	64.70	5.76	5.27	0.68	58,541
	4	575	6	3,986	55.31	7.47	7.59	0.99	58,538
2003-2007	1	172	6	1,817	73.43	3.60	-2.73	0.00	60,134
	2	579	14	2,393	71.23	4.32	0.02	0.00	60,131
	3	665	13	2,978	65.97	7.05	-0.01	-0.07	60,132
	4	668	7	4,034	57.41	10.08	4.16	0.35	60,130
2009-2015	1	143	6	1,430	69.14	5.70	-1.39	0.03	72,546
	2	580	15	2,157	72.13	5.45	-0.01	0.03	72,543
	3	628	12	2,857	69.46	7.37	1.67	0.09	72,544
	4	638	7	4,263	63.26	10.13	4.15	0.12	72,542

Sources: French administrative firm datasets (FICUS-FARE and DADS) from the INSEE for 1997-2015.

Table 5.14: Low-Middle-Tech Services (H,N)

Period	Productivity Quartile	Average VA	Average Employment	Average Wage	Average Labour Share	Average Share Skilled	Net Job Creation	Net Skilled Job Creation	Total number of firms
1997-2000	1	1,726	32	2,110	72.73	4.14	0.25	0.24	9,084
	2	1,427	36	2,742	75.37	4.32	6.96	0.37	9,079
	3	1,248	25	3,279	72.40	5.48	9.44	0.52	9,081
	4	923	12	4,228	63.20	7.51	11.39	0.79	9,076
2003-2007	1	2,073	32	2,027	74.50	4.40	-0.92	0.13	9,788
	2	1,615	37	2,675	77.27	4.71	1.19	0.03	9,782
	3	2,161	47	3,258	74.09	6.31	3.04	0.22	9,785
	4	1,147	15	4,299	64.89	9.09	5.21	0.27	9,780
2009-2015	1	1,243	37	1,539	71.12	2.94	-1.11	-0.01	13,935
	2	1,869	38	2,363	76.65	3.13	2.04	0.00	13,929
	3	1,465	31	3,047	75.40	4.73	4.61	0.16	13,932
	4	1,172	15	4,339	68.29	7.17	3.77	0.18	13,927

Sources: French administrative firm datasets (FICUS-FARE and DADS) from the INSEE for 1997-2015.

Table 5.15: High-Tech Services (J,M)

Period	Productivity Quartile	Average VA	Average Employment	Average Wage	Average Labour Share	Average Share Skilled	Net Job Creation	Net Skilled Job Creation	Total number of firms
1997-2000	1	892	17	2,491	73.51	14.24	-3.95	1.20	14,714
	2	630	11	3,406	70.85	15.55	1.47	1.52	14,707
	3	1,184	16	4,288	66.71	19.00	5.08	4.36	14,710
	4	1,599	15	5,675	57.71	23.52	10.15	5.94	14,704
2003-2007	1	274	8	2,512	74.81	16.14	-1.62	0.02	17,403
	2	666	11	3,458	71.96	19.81	0.85	0.57	17,397
	3	1,560	19	4,383	67.21	25.44	1.07	1.18	17,400
	4	1,946	16	5,838	58.45	30.49	4.15	1.69	17,393
2009-2015	1	287	8	2,280	74.78	18.74	0.14	0.46	19,822
	2	583	11	3,416	75.57	21.28	1.04	0.94	19,815
	3	1,634	19	4,531	72.22	27.56	1.86	1.74	19,819
	4	2,222	17	6,449	65.75	31.95	3.74	1.23	19,812

Sources: French administrative firm datasets (FICUS-FARE and DADS) from the INSEE for 1997-2015.

Table 5.16: Finance and Real Estate (K,L)

Period	Productivity Quartile	Average VA	Average Employment	Average Wage	Average Labour Share	Average Share Skilled	Net Job Creation	Net Skilled Job Creation	Total number of firms
1997-2000	1	1,266	10	2,057	61.15	6.11	-2.17	0.56	7,572
	2	1,031	15	2,664	65.85	4.57	3.17	1.44	7,571
	3	558	8	3,403	62.85	5.96	1.36	1.40	7,572
	4	1,301	10	4,694	58.11	9.10	6.48	1.32	7,570
2003-2007	1	1,443	11	2,312	62.34	9.76	-2.32	0.43	5,866
	2	1,071	14	3,109	70.58	10.34	0.13	0.35	5,865
	3	1,063	11	3,957	66.52	12.74	2.55	0.29	5,865
	4	1,256	9	5,365	58.79	15.96	4.31	0.49	5,864
2009-2015	1	2,003	14	2,036	46.84	14.64	1.84	0.40	6,700
	2	1,051	12	3,027	68.42	16.24	0.53	0.41	6,698
	3	967	10	4,008	71.38	17.48	2.91	0.31	6,699
	4	818	6	5,836	66.12	20.19	6.34	0.91	6,698

Sources: French administrative firm datasets (FICUS-FARE and DADS) from the INSEE for 1997-2015.

APPENDIX

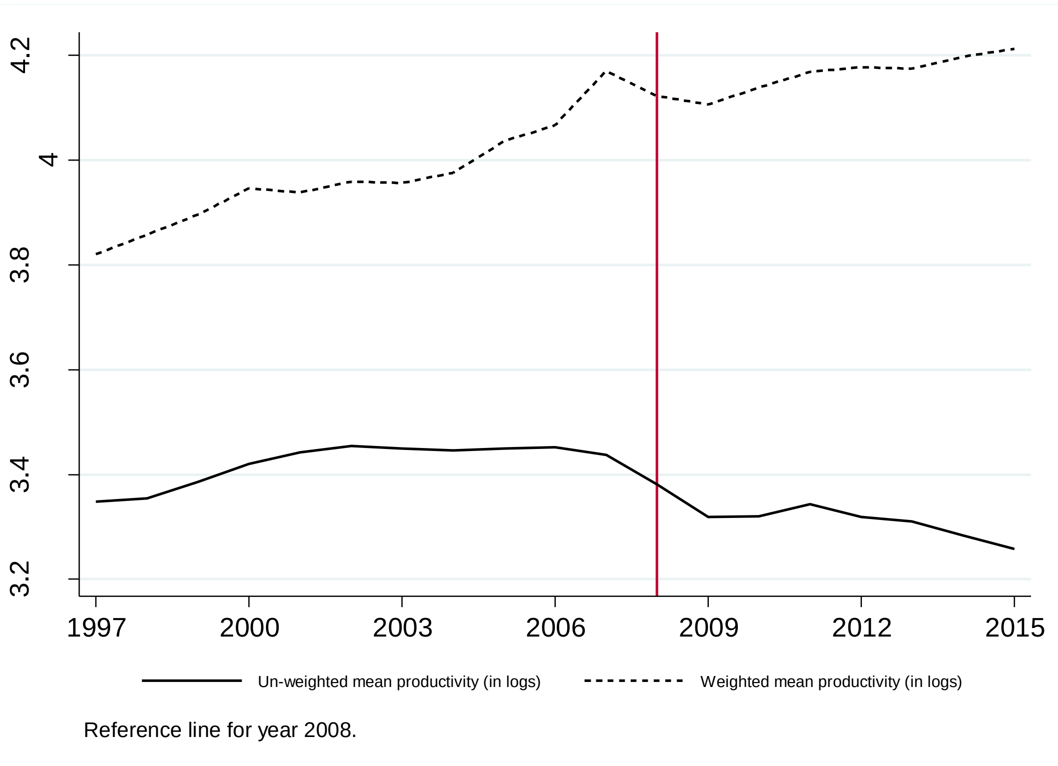
Apparent Labour Productivity and Industry Turbulence

Table A1: Aggregate ln ALP growth decomposition Market Economy

ALP		Δ Aggregate Productivity	Technical Efficiency	Allocative Efficiency	Exitors	Entrants
2001-2007	Construction	-7.27	-13.82	6.62	1.39	-1.46
	Finance & Real Estate	147.70	-2.60	9.67	5.12	135.50
	High-Tech Services	21.35	4.96	19.77	0.81	-4.19
	Low-Middle-Tech Services	7.91	2.03	11.02	1.64	-6.79
	Manufacturing	30.70	15.31	14.01	2.39	-1.00
	Other Services	2.96	-3.49	7.10	7.76	-8.42
	MARKET ECONOMY	23.19	-1.02	16.22	2.74	5.26
2009-2015	Construction	-10.49	-15.79	3.49	3.59	-2.23
	Finance & Real Estate	-31.47	-4.57	2.42	-16.95	-12.37
	High-Tech Services	14.74	-3.60	27.96	-6.86	-2.76
	Low-Middle-Tech Services	1.37	-6.44	9.73	2.14	-4.06
	Manufacturing	15.01	-4.65	21.06	0.59	-1.99
	Other Services	16.26	-1.42	18.18	10.88	-11.38
	MARKET ECONOMY	10.57	-5.59	19.79	1.49	-5.13

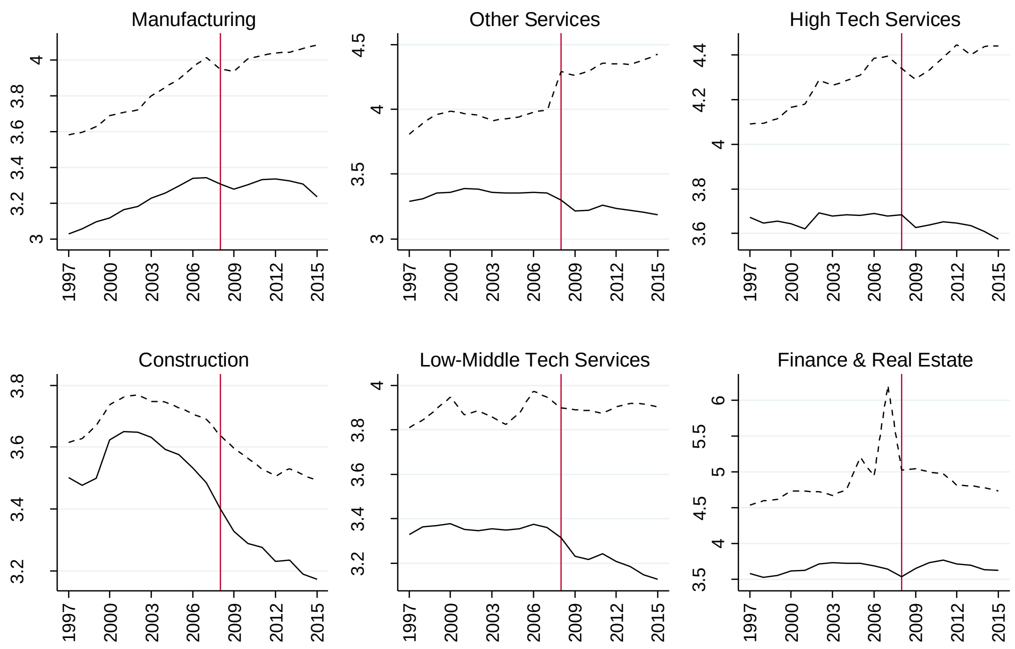
Sources: French administrative firm datasets (FICUS-FARE) from the INSEE for 2001-2015.

Figure A1: Evolution average ln ALP Market Economy



Sources: French administrative firm datasets (FICUS-FARE) from the INSEE for 1997-2015.

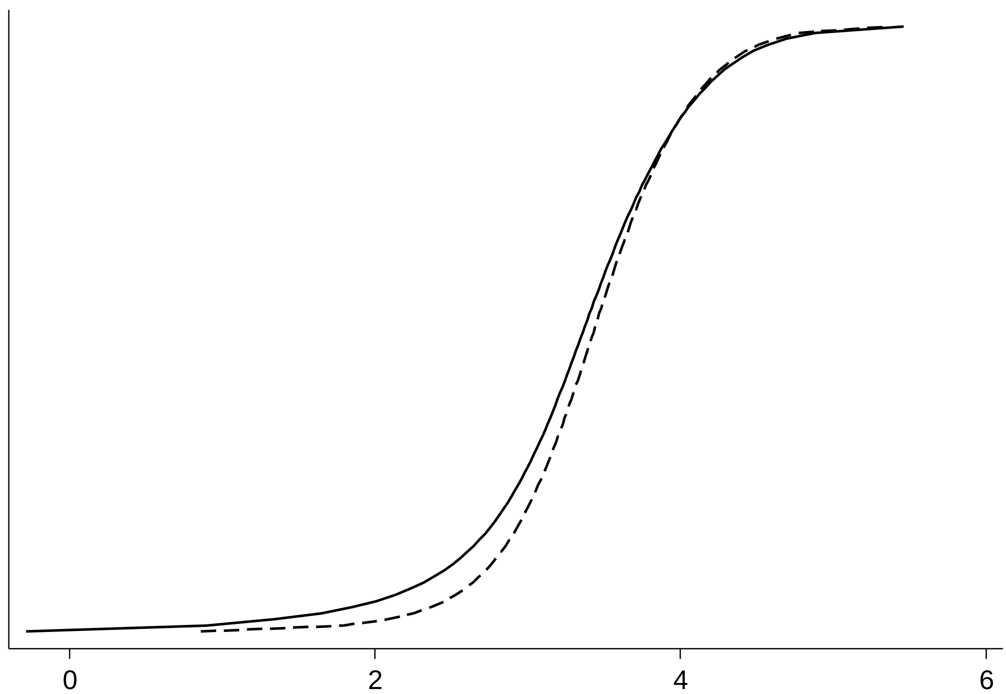
Figure A2: Evolution average ln ALP broad sectors



Reference line for year 2008. Solid line is Un-weighted mean productivity (in logs) and dashed line is Weighted mean productivity (in logs)

Sources: French administrative firm datasets (FICUS-FARE) from the INSEE for 1997-2015.

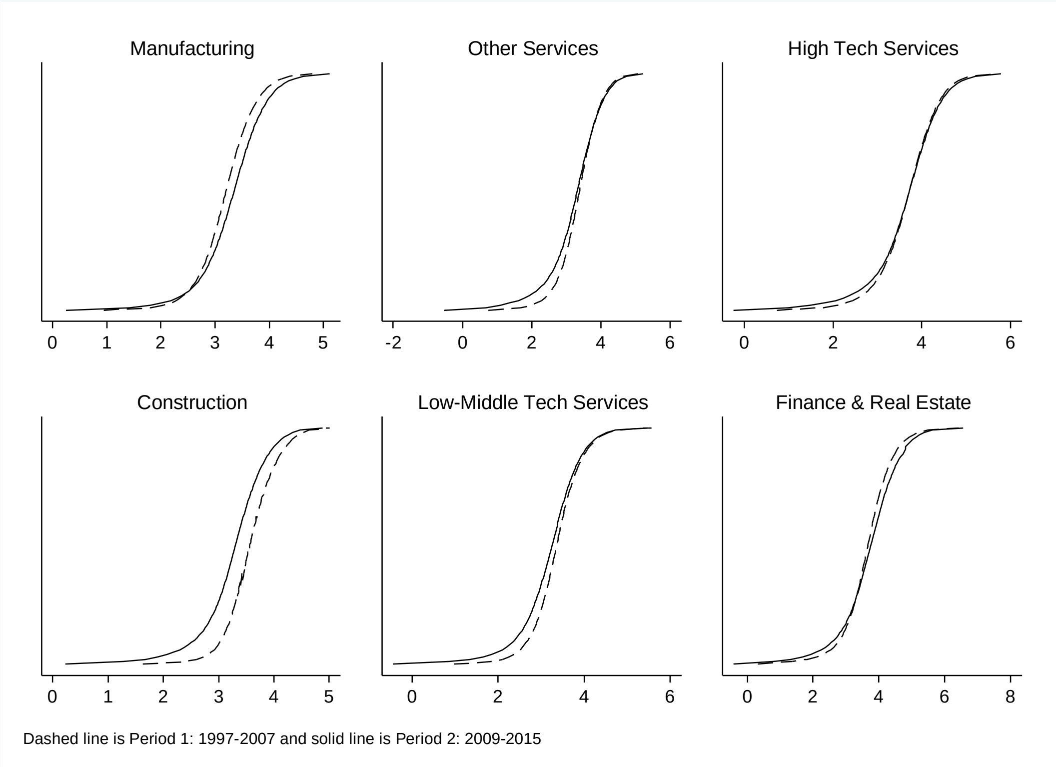
Figure A3: CDF ln ALP Market Economy before and after the crisis



Dashed line is Period 1: 1997-2007 and solid line is Period 2: 2009-2015

Sources: French administrative firm datasets (FICUS-FARE) from the INSEE for 1997-2015.

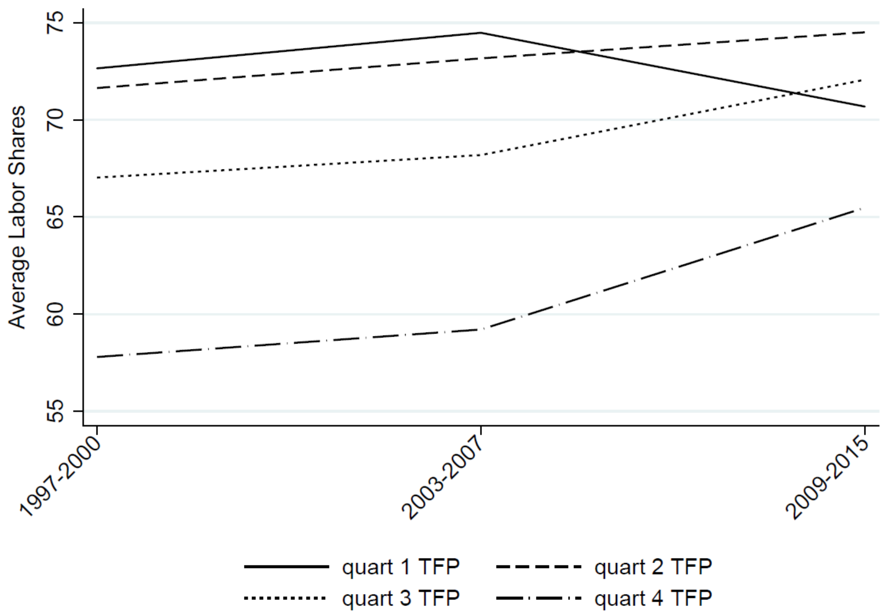
Figure A4: CDF ln ALP broad sectors before and after the crisis



Sources: French administrative firm datasets (FICUS-FARE) from the INSEE for 1997-2015.

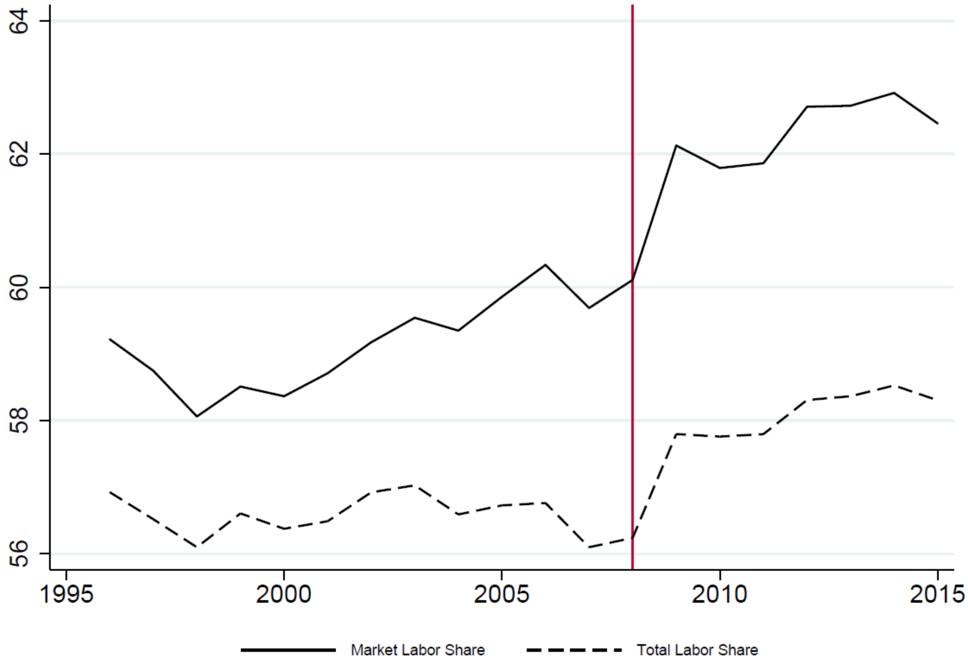
- Additional Figures

Figure A5: Average firm labour shares Market Economy



Sources: French administrative firm datasets (FICUS-FARE and DADS) from the INSEE for 1997-2015.

Figure A6: Aggregate Labour Share Market Economy (%)



Sources: EUKLEMS data from 1995-2015.

CHAPTER 6

Firm Survival and Growth under Foreign Competition: the role of human capital

Margarita Lopez Forero, OFCE SciencesPo
Lionel Nesta, OFCE SciencesPo, University Nice Sophia-Antipolis, France

6.1 Introduction

Previous works have shown that the French productive system suffers from the presence of barriers to growth more than from barriers to entry. Several research strategies can be used to assess barriers to firm growth. For example, one could imagine using threshold models to evaluate the presence of obstacles preventing increases in size. In the case of France, we have in mind the famous fifty-employee threshold; beyond this threshold, the administrative burden – and costs – increases substantially, motivating firms to grow by adding establishments rather than increasing in size.[33] However, the threshold model is not currently applied, and it is not clear how the number of employees should be used in such models.

Another, admittedly simpler, way to address the issue of size in firm growth is to use survival models to investigate the drivers of firm exit. Hence, we evaluate firm exit and survival, distinguishing the different ways in which firms survive in terms of size as measured by employment growth. We therefore analyse firms that either i) survive and contract, ii) survive and maintain their size or iii) survive and expand. We condition firm exit and survival mode on a series of attributes, such as firm size, productivity growth, profitability, share of skilled workers, sector concentration and degree of foreign competition.

We are particularly interested in the way in which foreign competition affects firm survival and how this relation depends on firms' human capital. As is well known from the international trade literature, imports from high-income countries tend to have very different effects, in terms of competition, than imports from low-income countries. Usually, imports from high-income countries are thought to compete with domestic production through the differentiation of goods, which translates into an increase in the variety of goods available in the market. In monopolistically competitive markets, this type of competition is thought to be "less fierce" in the sense that consumers are characterised by a "love of variety", and there will be a demand for each type of goods as long as they are differentiated. In contrast, low-income countries are characterised by strong wage differentials and different market regulations – for instance, less stringent environmental rules – which tend to translate into significant differences in production cost, making it more difficult for domestic firms to compete with such imports, which are subject to significant price differences. As is currently common wisdom, this is particularly the case of China. Hence, in our regression analysis, we distinguish between import competition from OECD countries, from low-wage countries (excluding China) and from China.

This means, as argued by De Loecker et al. (2014), that international integration is the same process that, on the one hand, imposes stronger competition on domestic firms and, on the other hand, allows them to increase their efficiency and quality through the "supply channel" (e.g., cheaper and new varieties of inputs and technology spillovers). The ability to benefit from the supply channel and compete in the international market is very likely to depend on human capital. Higher shares of skilled labour may affect how a

[33] Garicano et al. (2016).

firm is able to adjust its cost of production and product quality in the presence of foreign competition. While quality should unambiguously be positively related to higher shares of skilled employment, the relationship between cost of production and skilled employment is less evident, as efficiency gains may be offset by a higher wage bill for the firm. Hence, as firms employ more skilled workers and pay higher wages, it may become more difficult for them to face strong competition from relatively lower-wage countries. In this sense, our analysis focuses on the relationship between skilled employment and firm survival conditional on different types of foreign competition.

We focus on the manufacturing sector given that the effects of foreign competition are better understood for the tradable sector, and we use firm-level census data (FICUS-FARE) and employer-employee matched data (DADS) between 1997 and 2015 (as described in section 4.2 of chapter 4).

6.2 Econometric model

We estimate a maximum likelihood model in which we evaluate the exit and survival modes of firms. Given that we observe several outcomes, we apply a multinomial logit model in which the log odds of the outcomes are modelled as a linear combination of the explanatory variables. In this sense, the dependent variable is a categorical variable, j, with four different outcomes: 0) *survive at a constant size*, 1) *exit*, 2) *survive and contract* and 3) *survive and expand*.

Furthermore, we define expansion and contraction in different ways for different firms sizes given that the same increase in employment is not the same for large and small firms. Hence, we first classify firms into different size classes as follows: *Large firms* are firms with more than 499 employees above, *medium firms* are firms with between 50 and 499 employees and *small firms* are firms with more than 10 and less than 50 employees. Then, we define contraction/expansion as an employment percentage change (negative for contraction and positive for expansion) of 1% for *large firms,* 5% for *medium firms* and 10% for *small firms.* All values between the intervals of these numbers for each size class are considered to indicate *survive at a constant size.*

Suppose firms $\mathrm{i} = \{1, \dots, \mathrm{N}\}$ enter the industry at time $\mathrm{t} = 0$, where the probability that a firm exits or survives by either of the three alternative modes, $\mathrm{j} = \{0, 1, 2, 3\}$ at interval $\mathrm{t} - 1$ is given by the conditional probability of each mode j divided by the sum of all conditional probabilities (which add up to unity):

$$p_{ijt}(X_{it}) = p_{it}(y_{it} = j \mid X_{it}) = \frac{\exp\{Z_{ijt}\}}{\sum_{k=0}^{m=3} \exp\{Z_{ikt}\}} = \frac{\exp\{X'_{it}\beta_j\}}{\sum_{k=0}^{m=3} \exp\{X'_{it}\beta_k\}}$$

where Z_{ijt} is the log of the relative risk ratio allowing predicted outcomes that lie within the valid range (i.e., relative probabilities between 0 and 1) and X_{it} is a series of time-varying covariates summarising the observed differences between firms, which are further discussed below. For m outcomes of j, the model requires one set of coefficients to be normalised to zero; thus, $m - 1$ sets of coefficients are estimated. For the sake of interpretation, we set *survive at a constant size* as the base outcome. In this sense, the coefficients of exit and the other survival alternatives are interpreted in reference to *survive at a constant size*, where the idea is to compare any changes to the situation in which there is no change. Finally, we condition Z_{ijt} on the following variables of interest (for simplicity, we obviate firm indexes, bearing in mind that the share of skilled workers is firm-level specific, while import penetration is a sectoral variable):

$$Z_{ijt} = X'_{it}\beta_{jt}$$

$$+ \beta_{skill}\, Share\ of\ skilled + \beta_{sq_{skill}}\, (Share\ of\ skilled * Share\ of\ skilled)$$

$$+ \beta_{oecd}\, Imp.\ pen.OECD + \beta_{oecd_{sk}}\, (Imp.\ pen.OECD * Share\ of\ skilled)$$

$$+ \beta_{lwc}\, Imp.\ pen.LWC + \beta_{lwc_{sk}}\, (Imp.\ pen.LWC * Share\ of\ skilled)$$

$$+ \beta_{chn}\, Imp.\ pen.CHN + \beta_{chn_{sk}}\, (Imp.\ pen.CHN * Share\ of\ skilled)$$

$$+ \beta_{lwc}\, Imp.\ pen.LWC + \beta_{lwc_{sk}}\, (Imp.\ pen.LWC * Share\ of\ skilled) + \gamma_{industry} + \zeta_t$$

The firm-specific time-varying control variables, X_{it}, are time duration, change in TFP, profitability, and firm size (as measured by stock of capital or tangible assets). Our variables of interest are firm-specific share of skilled workers and its squared term; import penetration from OECD countries, low-wage countries (LWC) and China (CHN); the interaction term between each type of import penetration; and the share of skilled employment. Additionally, we include 4-digit sectoral variables reflecting the degree of market concentration measured by the standard Herfindahl index. The latter is defined as the sum of the squares of the market shares of firms within the sector; it ranges from 0 to 1, with increases in the index reflecting lower competition and stronger market power. All variables are introduced in logarithms except for the ratios and the concentration measure. In addition, we include year dummies to account for time effects (ζ_t) and 4-digit sectoral dummies to capture time-invariant unobserved heterogeneity at the sector level ($\gamma_{industry}$).

6.3 Descriptive Statistics

Before presenting our results, note that these numbers are subject to data cleaning (described above in chapter 4) through which, in addition to excluding outliers, we retain only firms for which we have no gaps, given that we might create false entries and exits if for any reason a firm is not in the sample for one or more years. However, we believe that this cleaning does not alter the results for different outcomes (exit and each survival mode). Additionally, for the survival analysis, we concentrate on firms that have an average of 10 or more employees from 1997 to 2015. The reason is twofold: this focus better captures real entries and exits, as firms with fewer than 10 employees display relatively more gaps, and it allows our econometric model to converge, as it significantly reduces the sample, given that firms with fewer than 10 employees represent the majority of the universe of French firms. Maximum likelihood models are highly computationally demanding, particularly with firm fixed effects, which are included in the final report.

Table 6.1 allows us to assess the frequency at which firms in each size class exit the market and survive under the three different modes (first row of each size class) as well as the share of each of these events in each size class (second row) and in the whole sample (third row) in each size class. Of the total number of observations (number of firms times number of years they are observed), 2.6% are large firms, 22% are medium and 75% are small. Of this total, we observe 3% of exits, 19% of survival under employment contraction, 55% of survival at a constant size and 25% of survival under expansion. Furthermore, of the total number of exits, 79% are small firms, 19% are medium firms and only 1.6% are large firms. Naturally, the fact that most of the sample is composed of small firms translates into most activity – exits and different survivals – taking place among small firms. Indeed, similar relative proportions are found for each type of survival. Hence, it might be more interesting to focus on the proportion of each outcome within each firm size class. Interestingly, large firms have the lowest exit rates (1.84%) and almost no survival at constant size (0.5%); survival is almost equally distributed between expansion (43%) and contraction (45%). As firms become medium and smaller, their exit rates increase compared to those of large firms (2.6% and 3.2%, respectively), as does the frequency at which they survive at a constant size (49% and 58%, respectively. In contrast, compared to large firms, the survival rates under contraction and expansion of medium and small firms are less frequent; 21% of medium-type firms contract, and 27% expand, while 17% of small firms survive under contraction and 21% under expansion. The next section formally analyses the determinants of the conditional probabilities of exiting and of the different survival modes.

Table 6.1: Frequencies of exits and survival modes

Size Class	Exitors	Survivor Contraction	Survivor Constant	Survivor Expansion	Total
Large	181 1.84 1.56	4,397 44.70 6.00	996 10.13 0.47	4,262 43.33 4.77	9,836 100 2.55
Medium	2,228 2.61 19.23	18,323 21.45 24.91	42,112 49.30 19.91	22,757 26.64 25.48	85,420 100 22.14
Small	9,177 3.16 79.21	50,623 17.43 69.02	168,426 57.98 79.62	62,282 21.44 69.74	290,508 100 75.31
Total	11,586 3.00 100	73,343 19.01 100	211,534 54.84 100	89,301 23.15 100	385,764 100 100

Sources: French administrative firm datasets (FICUS-FARE and DADS) from the INSEE for 1997-2015.

6.4 Baseline Econometric Results

Tables 2-3 separately present the regression results for two different samples: firms with 10 or more employees (average of the whole sample period) and firms with 20 or more employees (average of the whole sample period). The reason to do so is to separate firms that are differently affected by the French labour market regulatory system.[34] Indeed, most of these regulations become binding only when a firm attains a specific threshold in terms of employment size. For instance, some laws become binding as firms reach the ten-employee threshold. Nonetheless, the bulk of regulation is directed towards the fifty-employee threshold, after which it is common knowledge that costs significantly increase, as shown by Garicano et al. (2016). Hence, even if we do not intend to capture the effect of any threshold, as has already been done by these authors, we perform regressions over the whole sample and additional regressions for larger firms (with more than 20 employees) for the sake of robustness. This allows us to better control for the possible differential effects of the determinants of firm survival, conditional on firm size class.

Column 2 in each table shows the coefficients of the *exit* outcome, column 3 shows the coefficients of the *survive and contract* outcome, and column 4 shows the coefficients of the *survive and expand* outcome. As mentioned earlier, the chosen base outcome is the

[34] For details on French labour market regulation, see Abowd and Kramarz (2003), Cahuc and Kramarz (2005) and Garicano et al. (2016).

survive at a constant size mode. Hence, the coefficient interpretation is performed with respect to the coefficient *survive at a constant size* (where $\beta_{j=survive\ constant} = 0$). Given that we present our output in terms of regression coefficients rather than marginal effects (which vary with the different values of each variable), this analysis discusses only the sign and significance of each variable's relationship to each firm exit/survival outcome (where standard errors are displayed in parentheses). This allows us to assess how the explanatory variables relate to the probability of observing each survival outcome in terms of the probability of exiting.

Table 6.17: Multinomial Logit Regressions: Survival and Growth with foreign competition, firms with 10 or more employees

	Exit	Survive and Contract	Survive and Expand
Duration	0.106***	-0.229***	-0.634***
	(0.035)	(0.015)	(0.013)
Δ ln TFP	-1.137***	-2.059***	1.251***
	(0.103)	(0.051)	(0.048)
Share skilled labour	-0.941***	-0.292**	0.045
	(0.223)	(0.116)	(0.107)
Squared share skilled labour	4.147***	1.643***	0.912***
	(0.318)	(0.208)	(0.196)
Profitability	-2.481***	-1.287***	0.434***
	(0.025)	(0.018)	(0.022)
ln Capital	-0.095***	0.129***	0.054***
	(0.007)	(0.003)	(0.003)
Sector Concentration	0.217*	0.270***	0.042
	(0.129)	(0.061)	(0.058)
Imp. pen. OECD	0.074	-0.144***	-0.386***
	(0.091)	(0.042)	(0.041)
Imp. pen. LWC (excl. China)	-2.147***	-0.279	-0.982**
	(0.694)	(0.371)	(0.394)
Imp. pen. China	0.461	0.771***	0.133
	(0.321)	(0.159)	(0.160)
Imp. pen. OECD x skilled labour	-0.866**	-0.343	0.377*
	(0.437)	(0.233)	(0.218)
Imp. pen. LWC (excl. China) x skilled labour	6.165	3.034	5.577**
	(4.965)	(2.736)	(2.773)
Imp. pen. China x skilled labour	-3.475**	-2.474***	-0.068
	(1.645)	(0.858)	(0.811)
N		334,211	
Log likelihood		-346,042.38	
Pseudo R^2		0.05	

* p<0.1; ** p<0.05; *** p<0.01. Robust standard errors in parentheses.

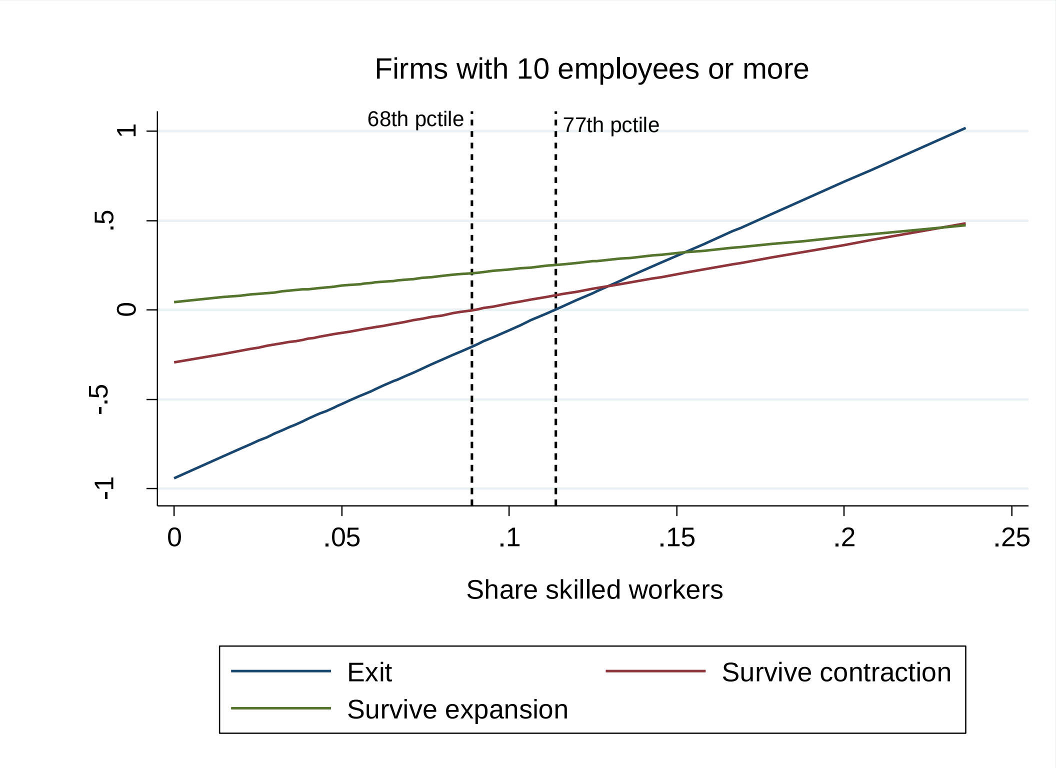
Sources: French administrative firm datasets (FICUS-FARE and DADS) from the INSEE for 1997-2015.

We begin by analysing our results for all firms with more than 10 employees in Table 6.2, starting with the control variables and ending with our variables of interest: skilled employment and foreign competition. The first conclusion emerging from this table is that firm productivity changes and firm profitability increase the probability of firm survival with expansion and decrease the probability of exiting and survival with contraction with respect to surviving at constant size. Indeed, all these coefficients are statistically significant at the highest levels for the three outcomes. In contrast, time duration displays a negative and statistically significant coefficient (at the one-percent level) for surviving and growing, while it is positive for firm exit and surviving with contraction. This means that the longer we observe a firm in the sample, the higher the probability of a negative outcome is – either exiting the market or surviving with contraction.

Firm size (as measured by tangible assets) also appears to be highly significant (at the one-percent level) and increases the probability of surviving, with the highest coefficient for surviving with contraction, while decreasing the probability of exiting. Hence, the larger the firm, the lower its probability of exiting the market and the higher its probability of adjusting its employment size are, either positive or negative, conditional on the effect of the rest of the covariates. The coefficient of sector concentration appears to be statistically significant only for negative outcomes; the stronger the value of the Herfindahl index, the higher the probability of exiting and the higher the probability of surviving with employment downsizing are. However, sector concentration does not seem to have a different effect between surviving and expansion and surviving at a constant size. This suggests that concentration generates competitive pressure on firms, either by pushing them out of the market or by pushing them to contract their employment level.

Turning to our variables of interest, we evaluate how skilled labour and foreign competition relate to firm exit and survival. Starting with the hypothetical case of a firm that does not face foreign competition (i.e., the values of import penetration are set to be equal to zero), we graphically illustrate the relationship between the share of skilled employment and each of the regression outcomes in Figure 6.1. The figure plots the derivative of the Z_{jt} for each outcome with respect to the share of skilled labour (y-axis) against the different values of share of skilled labour observed in our sample (x-axis). The dashed vertical lines correspond to the values of skilled share employment that set the first order condition of the quadratic function (imposed on the relationship between firm survival and skilled labour) to be equal to zero.

Figure 6.1: Firm Exit/Survival Mode and Skilled Labour



Sources: French administrative firm datasets (FICUS-FARE, Customs and DADS) from the INSEE for 1997-2015.

We find that an increased share of skilled employment decreases the probability of exiting as well as the probability of survival under contraction, but there seems to be an optimal amount of skilled employment, as the coefficient of the squared term appears to be positive and highly significant. More precisely, we find that for some firms, increasing their skilled labour share beyond 11.4% and 8.9% translates into a higher probability of exiting and of surviving with employment contraction, respectively (dashed lines in Figure 6.1). This positive second-order effect of skilled labour is observed for 23% of firms in our sample in the case of exiting, where the optimal ratio of skilled to unskilled workers is 1 to 9. In addition, for 32% of firms in our sample, we find a positive second-order effect of skilled employment, where more than 1 manager or technician (skilled labour) per 11 unskilled workers appears to increase the probability of firm contraction.[35] Interestingly, this is not the case for surviving under expansion, where only the coefficient of squared skilled employment appears to be significant (at the highest level), but it is also positive. This suggests that for firms under expansion, any increase in the share of skilled labour increases their survival probability. A possible explanation may be the higher costs of production. The fact that skilled workers demand higher wages and

[35] The reason is that the value of the share of skilled labour that sets the first-order condition of the quadratic function (imposed on the relationship between firm survival and skilled labour) to be equal to zero is given by the following expression:

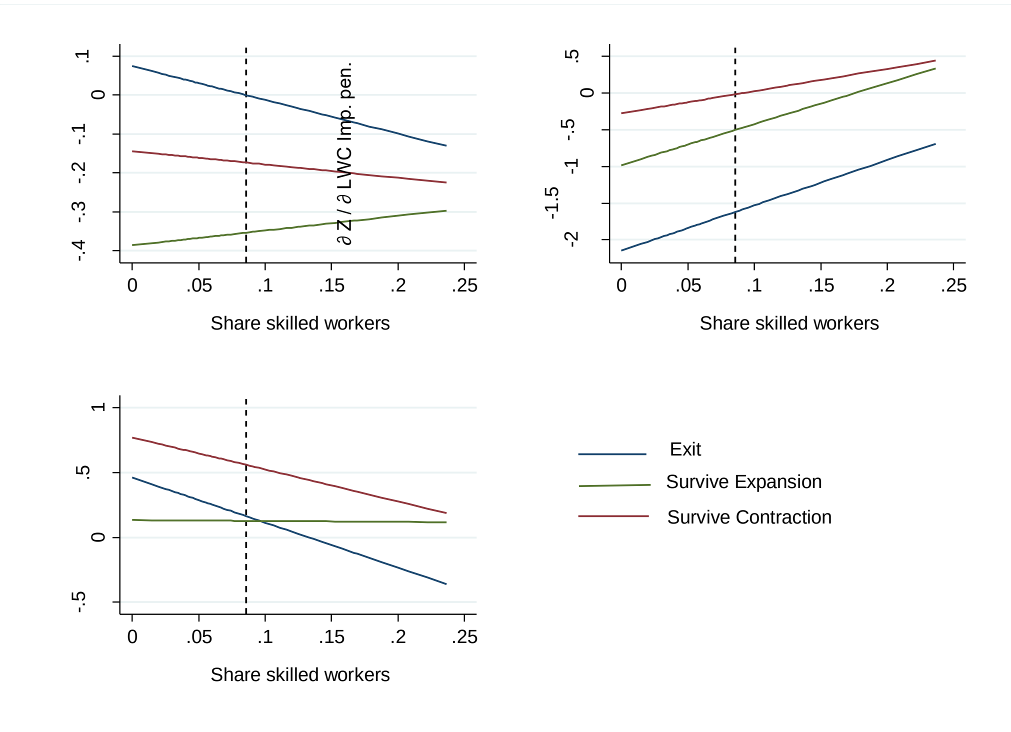
$$\frac{\partial\, z_{jt}}{\partial\, Share\ skilled} = 0 = \beta_{share\ skilled,jt} + 2\,\beta_{share\ skilled,jt} * share\ skilled$$

For instance, for the case of firm exit, we obtain $share\ skilled$ = 0.941 + 2 (4.147) = 0.114, where this value is observed at the 77th percentile of the distribution of the variable. Hence, a negative second-order effect of skilled labour is found for 23% of the firms in our sample.

have stronger bargaining power than unskilled workers may translate into a higher cost burden for the firm unless it finds itself in an expansion phase. This finding can also be linked to the theory of firm growth by Penrose (1959), which states that a firm's ability to expand is constrained by its human capital and, more fundamentally, by the availability of slack managerial resources.

Going further in the analysis of the relationship between human capital and firm survival, we now turn to the effect of foreign competition on firm survival, conditional on the firm's share of skilled employment. The main and the conditional (on skilled employment) coefficients of sector import penetration suggest that foreign competition relates differently to firm survival depending on the type of country from which the imports come. Figure 6.2 plots the main effects of each type of import penetration (at the y-axis intercept of each sub-graph) and its effects conditional on the values taken by the share of skilled employment (on the x-axis) for each firm outcome (i.e., *exit*, *survival with contraction* and *survival with expansion*). The dashed lines represent the mean of the share of skilled labour.

Figure 6.2: Firm Entry/Survival Mode and Skilled Labour under Foreign Competition



Sources: French administrative firm datasets (FICUS-FARE, Customs and DADS) from the INSEE for 1997-2015.

Although some coefficients are not statistically significant (see Table 6.2), they appear to be the most likely outcomes; thus, they are used to construct Figure 6.2, which will help us evaluate the magnitude of the total effect as skilled labour shares take the values observed in our sample. The significance of each coefficient will be further discussed below. A general conclusion from this figure is that increases in the share of skilled labour translate into a firm's ability to better cope with foreign competition. This happens through a decline in the probability of exiting or of survival under contraction and an increase in the probability of survival under expansion. The cases in which we do not observe these attenuations of competitive pressure are cases of competition from low-wage countries for exit and survival under contraction outcomes. Hence, we find that higher shares of skilled employment are not an impediment to foreign competition from China or OECD countries (e.g., through more expensive labour costs).

Interestingly, the unconditional effect of OECD import penetration for two outcomes is either not statistically significant (for exiting) or negative (for survival under contraction). Therefore, on average, the negative effects of foreign competition may be attenuated by an intra-industry type of trade that complements domestic production. This is particularly true for survival under contraction, for which the main effect is negative and significant (while the interaction term, despite being negative, is not significant). This points to imports of intermediate inputs within the same industry that are necessary for the production of a final good. For instance, a firm within the automobile sector (NAV rev. 2 division 29) may import a particular motor from Germany to produce cars as a final good; in both cases, the sector codes coincide evenly at the 4-digit level (29.10Z). If we evaluate the total effect of foreign competition at the mean value of skilled employment (i.e., at 8.6%), we find that import penetration from OECD countries translates into a total negative probability for exiting (where skilled labour has a negative and significant second-order effect) and for survival under contraction (where skilled labour does not have a second-order effect).

For survival under expansion, we find a strong and negative unconditional effect of OECD import penetration, indicating strong competitive pressure for growth and a positive conditional effect of skilled employment. Nonetheless, the positive contribution of human capital to firm expansion does not offset the strong negative effect of the main effect of import penetration from OECD countries (and would require a value of skilled labour share greater than one).

Concerning import penetration from low-wage countries, no statistically significant effect (of foreign competition) is found for firm survival under contraction; neither do we find a significant conditional effect on firm exit. Specifically, imports from low-wage countries translate, on average, to a relatively strong decrease in the probability of exiting the market regardless of the share of skilled employment. Indeed, the main effect is negative and significant. Although the interaction is positive (but nonsignificant), which means that higher shares of skilled labour increase the probability of exiting for some firms, the total effect is equal to zero at the average value of skilled labour shares. In contrast, this type of import penetration translations into strong competition pressure for firm expansion, but the effect is mitigated if the firm employs a relatively more skilled labour force. In this case, both coefficients are statistically significant. Nonetheless, the level of skilled labour shares required to completely offset the competitive pressure of low-wage countries on firm expansion (17.6%) is observed for only 11% of the firms in our sample (which corresponds to the 89th percentile).

Finally, import penetration from China has no statistically significant effect on firm expansion, regardless of the level of skilled labour. The average main effect on the probability of firm exit is zero but strictly positive, and skilled labour shares a decrease in the likelihood of exiting; this is the case for 70% of the firms in our sample (i.e., the 30th percentile corresponds to the first positive share of skilled labour, which is equal to 1.5%)[36]. Whereas import penetration from China strongly translates into a higher probability of firm contraction through the main effect, it is attenuated, although not completely offset, by higher shares of skilled labour. In this case, the competitive pressure of the main effect is completely offset at skilled employment shares above 31%, bearing in mind that the median share of skilled labour is 5.8% (this is the case for only 4 firms in our sample).

Overall, import penetration may translate into stronger competition forces precluding firm survival and firm expansion by pushing firms to either downsize employment to survive or, in the worst case, exit the market. These competitive pressures may come in

[36] We remind the reader that top managers are not included in this measure.

the form of competition at lower prices (e.g., from low-wage countries) or at better quality (e.g., from OECD countries). At the same time, import penetration may allow a firm to increase its productive efficiency through a number of channels, such as stronger incentives for specialisation, access to new varieties of inputs and inputs at lower prices, and transfers of new technology, thus translating into increased probabilities of firm survival and expansion. Hence, survival in the presence of foreign competition depends on two different competition effects on firm performance: cost of production and product quality, as argued by De Loecker et al. (2004). Given that both quality and cost of production are likely to depend on a firm's intensity of human capital, we condition the effects of skilled labour shares to better identify the competition forces on firm survival exerted by international competition. We find that increases in the share of skilled labour translate into a lower probability of exiting and survival under contraction and a higher probability of survival under expansion. We do not find negative effects of skilled labour conditional on foreign competition on the probability of firm survival. Therefore, human capital increases a firm's ability to face foreign competition.

Now, we to turn the results shown in Table 6.3, where we focus on firms with 20 or more employees. These new regression results are relatively unaltered (in terms of signs and significance) for all covariate variables included in the model, while some minor changes appear for our variables of interest: foreign competition and share of skilled labour.

The main changes come from firm survival under both contraction and expansion, where we observe that the negative main effect of skilled labour on contraction becomes nonsignificant, translating into increases in the probability of exit. For firms in the expansion phase, the direct positive effect becomes stronger and statistically significant, but the second-order effect becomes less important (becoming closer to a linear relationship).

For foreign competition and its effects conditional on skilled labour, we now observe clear effects for import competition from Chinese and low-wage countries on firm contraction, but the effects are attenuated by a higher share of skilled labour. In contrast, except for OECD import penetration, no significant negative relation appears between foreign competition and firm expansion. However, a significant and positive effect conditional on skilled labour appears for China, suggesting the integration of large firms in global value chains.

Table 6.3: Multinomial Logit Regressions: Survival and Growth with foreign competition, firms with 20 or more employees

	Exit	Survive and Contract	Survive and Expand
Duration	0.121**	-0.163***	-0.528***
	(0.050)	(0.022)	(0.020)
Δ ln TFP	-1.339***	-1.811***	0.929***
	(0.148)	(0.075)	(0.071)
Share skilled labour	-0.889***	-0.049	0.530***
	(0.317)	(0.164)	(0.151)
Squared share skilled labour	4.576***	1.617***	0.454*
	(0.432)	(0.282)	(0.268)
Profitability	-2.523***	-1.464***	0.358***
	(0.032)	(0.023)	(0.028)
ln Capital	-0.038***	0.253***	0.137***
	(0.010)	(0.004)	(0.004)
Sector Concentration	0.244	0.219***	-0.061
	(0.158)	(0.075)	(0.071)
Imp. pen. OECD	0.160	-0.099*	-0.463***
	(0.113)	(0.054)	(0.053)
Imp. pen. LWC (excl. China)	-0.939	1.110**	-0.740
	(0.867)	(0.475)	(0.515)
Imp. pen. China	0.791*	0.900***	-0.275
	(0.420)	(0.210)	(0.216)
Imp. pen. OECD x skilled labour	-1.530***	-0.706**	0.375
	(0.572)	(0.305)	(0.286)
Imp. pen. LWC (excl. China) x skilled labour	-4.974	-6.006*	2.786
	(6.762)	(3.575)	(3.543)
Imp. pen. China x skilled labour	-3.380	-1.891*	1.968**
	(2.106)	(1.079)	(1.002)
N		197,307	
Log likelihood		-200,232.11	
Pseudo R^2		0.07	

* p<0.1; ** p<0.05; *** p<0.01. Robust standard errors in parentheses.

Sources: French administrative firm datasets (FICUS-FARE and DADS) from the INSEE for 1997-2015.

6.4 Conclusion

Firm survival in the presence of foreign competition depends on two different competition effects on firm performance: cost of production and product quality.[37] If a firm is able to take advantage of international competition through the supply channel (cheaper inputs, better technology) to increase its quality and decrease its cost of production, it will be better able to face the price shocks imposed by increased international competition

[37] See, for instance, De Loecker et al. (2014).

(demand channel). Both quality and cost of production are likely to be functions of a firm's human capital. While the first should unambiguously be positively related to higher shares of skilled employment, the relationship between cost of production and higher shares of skilled employment is less obvious. Beyond translating into efficiency gains, it may also translate into higher relative wages for the firm, making it harder to face strong competition from abroad.

Therefore, in this chapter, we evaluate how skilled labour is linked to firm survival, and we condition its effect on different types of foreign competition. Our results suggest that skilled labour is positively related to firm survival and growth (it decreases the probabilities of contraction and of exiting). Nonetheless, an optimal level of share of skilled labour seems to exist beyond which additional increases in the share are related to higher probabilities of exiting and of contraction. However, conditional on survival and growth, increasing the share of skilled workers is always related to a higher probability of expanding.

In addition, we find competing effects of import penetration on the probabilities of firm exit and of survival. These competing effects stem from stronger competition pressure (pushing firms out of the market, forcing them to downsize employment or preventing them from expanding) as well as from the "supply channel" (decreasing the probabilities of exiting and of contraction and increasing the probability of expansion). With the sole exception of Chinese imports, whose competitive pressure effects are clear only from firm contraction and exit, no clear identifiable channel is found for particular origins of imports. However, a clear pattern arises for the conditional effect of import penetration and shares of skilled labour, where human capital increases a firm's ability to face foreign competition (decreasing the probabilities of firm exit and contraction and increasing the probability of expansion). This is particularly true for import competition from OECD countries and from China. Although the effect is not significant, higher shares of skilled labour may translate into higher probabilities of exit and of contraction for some firms in facing competition from low-wage countries.

A policy conclusion from this chapter's results may support human capital creation because it allows firms to better cope with international competition and integrate into global value chains, which seems to be an auto-reinforcing action. Nonetheless, attention is required for firms under exit threat given other firm specificities, such as increases in the wage bill burden or excessive management of unskilled workers, that may push a firm out of the market.

PART III

International Trade

CHAPTER 7

Workforce Composition, Trade Costs and Margins of Trade: Firm-Level Evidence from France

Raphaël Chiappini, LAREFI, University of Bordeaux

7.1 Introduction

Over the past two decades, the direction and composition of world trade have drastically changed. The emergence of new global actors, especially the BRICS, has eroded the leading position of industrialised economies in world trade. As depicted in Figures A.1 and A.2, there has indeed been a major redistribution of export market shares between emerging and developed economies.

The decline in market shares is a phenomenon that affects all industrialised economies, but it appears particularly important in France, where it is one of the most marked among OECD countries (Boulhol and Sicari, 2014; Bas et al., 2015; Bellone and Chiappini, 2016). Furthermore, this downward trend is still significant after the 2007/2008 financial crisis. Indeed, between 2000 and 2007, the French market share in goods decreases from 5.1% to 4% and decreases further to 3% in 2017. A striking fact is that Germany has succeeded in maintaining a relatively stable market share since 2000. In this respect, it represents one of the most notable exceptions among developed economies.

Since 2000, the French current balance (including especially goods and services) has been in deficit every year, with imports structurally higher than exports. In 2016, the French current deficit was 24 billion euros (1.1% of GDP), the highest value recorded since 2012, with an increase in the merchandise trade deficit (-48.1 billion euros).

These weak trade performances are coupled with a more pronounced deindustrialisation phenomenon in France than in other European economies, as depicted in Figure 7A.3. If the deindustrialisation process seems common to all developed economies and closely related to technological change (Guillou and Nesta, 2011), the decline in the share of value added in the French manufacturing industry appears to be greater than that in other developed economies. Indeed, the share of the manufacturing industry in the total French value added fell by an average of 1.8% per year between 2000 and 2017 compared with only -0.6% for the European Union. In contrast, we note the atypical pattern of Germany, which has maintained the share of the manufacturing industry at approximately 23% (twice the French share in 2017).

These two important facts raise questions about the ability of French firms to face international competition and to adapt their production to the changing international environment. The comparison with the impressive German performance on the global market, characterised by an important market share (8.2% in 2017 for goods) and the highest trade surplus in the world in 2016 (253 billion euros), further highlights the competitiveness problem of French firms on the global market.

While the decrease in the French export market share is not the result of poor geographical or sector specialisation (Cheptea et al., 2014; Marc and Patier, 2016), a growing number of studies have highlighted the role of cost competitiveness in the evolution of French export market shares (see Gallois, 2012). Indeed, unit labour costs in the whole economy increased more rapidly in France (+17%) than in Germany (-3%) between 2000 and 2007 (Piton, 2018). This problem could lead to a vicious circle in which French firms lose price competitiveness on the global market or reduce their margins and invest less in innovation or the quality of products. This, in turn, could harm their non-price competitiveness. However, Bussière et al. (2014) argue that France’s decline in cost competitiveness is only a partial explanation of the evolution of the French trade pattern. For example, Sautard et al. (2014) indicate that French products have an intermediary position regarding their sensitivity to prices, while German and Japanese products are less sensitive to prices. Similarly, Bas et al. (2015) show that France is ranked only seventh in terms of non-price competitiveness, which clearly contrasts with the leading position of Germany in terms of the quality of its products.

These macroeconomic factors are important in understanding the export performance of France. However, microeconomic factors can also be at stake. Indeed, as depicted in Figure 7A.4, France is characterised by a strong fall in the number of exporting firms between 2000 and 2011 (-35%) and slow growth since then. In 2015, some 120,000 French firms exported goods. Furthermore, as displayed in Table 7A.1, French firms exhibit low values of export participation and export intensity by firm, which is more pronounced for small and medium enterprises (SMEs) than for large firms, even in the manufacturing industry. Indeed, French SMEs tend to be small, especially compared to German SMEs (Cancé, 2009). Moreover, the French export setup is also characterised by a strong concentration of exports (Figure 7A.5), as a small number of firms account for the bulk of exports (the top ten exporters represent approximately 95% of total exports); by a small number of products exported by firm (a median of 2 in 2015; see Table 7A.2); and by a small number of destinations (a median of 2 in 2015; see Table 7A.2). This is confirmed in Figure 7A.6, where we observe a stagnation of the volume of goods exported by France since 2009, with the exception of 2002, while during the same period, the number of exporting firms has drastically fallen, implying an increase in the concentration of exports.

The main purpose of the present study is to investigate the determinants of the export behaviour of French firms. Although standard trade barriers, such as tariffs, applicable standards, transportation costs or even technical barriers to trade (Fontagné and Orefice, 2018) between countries, are well identified in the trade literature, other hidden trade frictions, such as cultural distance, linguistic proximity or bilateral trust, are less well investigated in the empirical literature. However, these factors are of great importance, notably because they persist over time (Head and Mayer, 2013), while standard trade determinants record a sharp decline with the liberalisation process and the increase in countries’ openness since the 1990s. Head and Mayer (2013) argue that these hidden trade frictions account for 50%-85% of the negative effect of geographical distance on trade flows. As a consequence, the export performances of French firms could be altered by these trade frictions. In particular, cultural and linguistic distances can strongly affect both the intensive and extensive margins of trade of French firms.

To explore the relationship between cultural and linguistic distances and the export behaviour of French firms, we estimate a structural gravity model of trade at the firm level. We rely on two different measures of cultural proximity between countries: the first is derived from the World Value Survey (WVS) and proposed by Spolaore and Wacziarg (2016), while the second is linked to an extended definition of linguistic proximity proposed by Melitz and Toubal (2014).

This study is related to previous studies on cultural differences and trade (Guiso et al., 2009; Felbermayr and Toubal, 2010; Gokmen, 2017; Bargain et al., 2018). However, in contrast to previous studies, this paper is the only one, to our knowledge, to combine a novel measure of cultural distance based on the previous work of Spolaore and Wacziarg (2016) with firm-level characteristics of French firms, especially workforce composition. Indeed, as shown by Matsuyama (2007), international trade requires more intensive use of skilled labour with expertise in international business and in languages. As a consequence, we can test, controlling for productivity, whether firms that hire more engineers or executives are less sensitive to cultural and linguistic distances.

Three main results are highlighted in this study. First, as with physical distance, we find that greater cultural differences between countries affect not only the level of exports (i.e., the intensive margin) but also the likelihood of exporting (i.e., the extensive margin). Second, our results indicate that workforce composition also influences both the firm-level intensive and extensive margins of trade. Indeed, firms with a higher share of executives have a higher probability of exporting to a given country and recording a higher level of exports, while the share of blue-collar workers negatively affects the extensive margin of French firms. Finally, our results also provide evidence that workforce composition allows firms to avoid the trade costs linked to cultural differences. Indeed, the effect of cultural distance on the intensive margin of trade is non-linear and depends on the share of executives and intellectual professionals in total employment.

The rest of this chapter is organized as follows. The first section reviews the literature on the impact of cultural distance on trade. The second section presents the data, the measures of cultural distance and the empirical model. The third section presents the empirical results, while the fourth section concludes and suggests some economic policy recommendations.

7.2 Literature Review

Trade costs are important factors that harm trade around the world. In the standard trade literature, the effect of trade frictions, such as transportation costs, on trade flows is evaluated based on the elasticity of physical distance in a structural gravity model of trade. However, despite the reduction of transportation costs due to innovation in transportation and a decrease in tariffs and non-tariff measures, the distance elasticity estimated in gravity models is still very high at over 1 (Disdier and Head, 2008). Head and Mayer (2013) argue that other hidden sources of trade frictions drive this observation. In particular, they argue that three main costs harm trade flows: informational impediments to trade (i.e., trust), localised historically determined tastes and distribution networks. These hidden sources of trade frictions are linked to cultural differences (Gokmen, 2017).

A few recent studies have used different measures to investigate the relationship between cultural differences and trade flows. Guiso et al. (2009) build a measure of bilateral trust based on the Eurobarometer survey for 15 countries and control for transportation costs to show that a higher level of bilateral trust results in cross-country trade than structural gravity models of trade can explain. Their results also indicate that bilateral trust is strongly linked to cultural components, such as genetic and somatic distances between countries, commonality of religion and history of wars. Moreover, they also provide evidence that bilateral trust impedes other economic variables, such as FDI and portfolio investments.

Felbermayr and Toubal (2010) use a different measure of cultural differences based on scores from the Eurovision Song Contest. The main advantage of this measure is that it varies over time and within country pairs. Relying on a structural gravity model of trade, Felbermayr and Toubal (2010) measure cultural proximity and show that it can increase trade between countries even after controlling for both transportation costs and other standard measures of cultural proximity, such as common language or adjacency. In a similar vein, Melitz and Toubal (2014) build an indicator of linguistic proximity for 195 countries and show that linguistic proximity increases trade flows, not only because it reflects cultural proximity between countries but also because it reduces communication costs. In another strand of the literature, (2017) evaluates the impact of cultural differences on trade over time. He measures cultural differences using differences in civilization, religion, language and ethnicity and shows that the negative effect of cultural differences on trade has evolved over time and that it was more prominent in the post-cold war period.

More recently, Bargain et al. (2018) examine the hypothesis of localised historically determined tastes in the French wine trade. They suggest that genetic variation can be a proxy for biological taste/preference heterogeneity across countries. They show that genetic distance reduces trade flows and that only high-end wines can escape the negative effect of both physical and genetic distances.

7.3 Empirical Model and Data

7.3.1 A gravity model at the firm level

To empirically analyse the impact of cultural distance on trade flows, we rely on a theory-consistent estimation of the gravity model of trade. In its first general formulation, this model states that bilateral trade flows depend positively on countries' gross domestic product (GDP) and negatively on distance (representing trade costs). The standard model that is widely used in the empirical literature to evaluate the effect of policy or trade cost variables (see Head and Mayer, 2014) is based on the theoretical model of Krugman (1980), which allows a conclusion only for the intensive margin of trade (i.e., trade volume). However, Helpman et al. (2008) reveal that there is a large proportion of zeroes in the trade matrix, even at the aggregate level, suggesting that the extensive margin is of great importance.

Chaney (2008) derives a structural gravity model equation from an international trade model with a continuum of firm heterogeneity in productivity (Melitz, 2003), monopolistic competition across firms and countries and iceberg trade costs. He shows that both the intensive and extensive margins of trade can be modelled by a gravity equation. Crozet and Koenig (2010) empirically confirm that both margins of trade at the firm level are affected by trade costs.

Relying on the theoretical framework of Chaney (2008), we estimate the following baseline equation:

$$y_{i,j,t} = \alpha + \beta_1 \ln(TFP)_{i,t-1} + \beta_2 \ln(Emp)_{i,t-1} + \beta_3 \ln(Age)_{i,t-1} + \beta_4 \ln(Workforce)_{i,t-1} + \sum_n \eta_n Z_j + \sum_n \gamma_n G_{j,t} + \phi_i + \lambda_t + \epsilon_{i,j,t} \quad (1)$$

where the subscripts i, j and t denote firm, destination country and year, respectively.

The dependent variables ($y_{i,j,t}$) are

- The value of exports (in logs) at the destination (j) level;
- The number of products (in HS4) exported by a firm at the destination (j) level; and
- A dummy variable for positive trade flows into a certain destination market.

TFP is the firm-level total factor productivity estimated using the methodology proposed by Wooldridge (2009), relying on a translog production function; Emp is the level of employment of firm *i*; Age is the age of firm *i*; and $Workforce$ represents the workforce composition of firm *i,* namely, the share of executives and intellectual professionals (cs3), the share of employees (cs5) or the share of blue-collar workers (cs6). All firm-level characteristics are lagged one period to avoid endogeneity problems.

Z_j is a vector of variables capturing time-invariant gravity determinants, such as the geographical distance between Paris and the capital of the destination country (in logs), a dummy variable for the existence of a common language (Comlang), a dummy variable for the existence of colonial links (Colony), a dummy variable capturing the presence of a common border (Contiguity), and a dummy variable capturing whether the destination country is a member of the European Union (EU). We also include, alternatively, two measures of cultural distance/proximity: the first is provided by Spolaore and Wacziarg (2016), while the second, based on linguistic proximity, is derived from Melitz and Toubal (2014).

$G_{j,t}$ is a set of time-varying gravity variables such as the gross domestic product (GDP) of the destination country and the total population of the destination country (Pop). ϕ_i represents firm-level fixed effects, while λ_t is time fixed effects. $\epsilon_{i,j,t}$ is an error term that is assumed to be statistically independent of the regressors. In some specifications, the non-linearity of the effect of cultural distance is studied using an interaction between this variable and the workforce composition of firms.

Note that in some specifications, country-time fixed effects are included to account for the multilateral resistance term (see Anderson and Van Wincoop, 2003; Baldwin and Taglioni, 2006). In this case, all time-varying and time-invariant variables at the destination level are captured by these fixed effects. Similar to previous studies (Fontagné et al., 2015; Martin and Mayneris, 2015), we estimate Eq. (1) using ordinary least squares (OLS) for the period 2000-2015, even if one dependent variable is dichotomous[38].

7.3.2 Measuring cultural differences

Measuring cultural differences is a challenge because it involves non-metric variables, such as values or habits. As a consequence, there is no consensus in the literature regarding this concept. Nevertheless, the choice of a measure can affect the accuracy of the empirical results. Therefore, we rely on two measures of cultural difference/proximity to test the robustness of our results.

The first and main metric of cultural differences used in this study is from Spolaore and Wacziarg (2016). As in some previous studies (Guiso et al., 2009; Ahern et al., 2015), the main idea is to rely on questions asked in a survey about individual values. However,

[38] We use a simple linear probability model in this case.

in contrast to studies that focus on specific questions relying on bilateral trust (Guiso et al., 2009) or on hierarchy and individualism (Ahern et al., 2015), we choose to focus on all the value-related questions from the World Value Survey 1981-2010 Integrated Questionnaire to avoid arbitrary choices. The final dataset contains 98 questions for 74 countries to compute the measure of cultural distance between countries.

To obtain a distance in values between countries, we compute a simple Euclidian distance between the shares of respondents in the two countries who give a specific answer to a particular question. If s_{ij}^{d} is the share of respondents in country *d (d={France, Germany})* who give answer *j* to question *i*, then for binary questions, the cultural distance between France and Germany (CD_i^{F-G}) is calculated as follows:

$$CD_i^{F-G} = \left| s_{i1}^{F} - s_{i1}^{G} \right|$$

For non-binary questions (meaning that the question allows more than two answers), the cultural distance is calculated as follows:

$$CD_i^{F-G} = \sqrt{\sum_{j=1}^{J} \left(s_{i1}^{F} - s_{i1}^{G} \right)^2}$$

To obtain a reliable measure of cultural distance, a standardisation procedure is used so that the distances computed for each specific question have a mean of zero and a standard deviation of one. Then, all the indexes are summed across all 98 questions, and we obtain a measure of cultural distance between countries.

We use this measure to obtain the cultural distance between France and 72 other countries[39]. According to the measure, Belgium and Luxembourg are the closest countries to France in terms of culture, while Jordan and Egypt are the most distant countries from France.

We also rely on a different measure of cultural differences based on an index of linguistic proximity (lp2) provided by Melitz and Toubal (2014). The index is based on the ethnologue classification of language between trees, branches and sub-branches. The author allows for four possibilities: 0 for two languages from two separate trees, 0.25 for two languages from different branches of the same family tree (French and English, for example), 0.5 for two languages from the same branch of the same tree (German and English, for example) and 0.75 for two languages from the same sub-branch of the same branch of the same tree (Dutch and German, for example). They mix these data with a score of similarity between 200 words. Finally, they normalise the index, which results in an index that ranges from 0 (complete dissimilarity) to more than one.

7.3.3 Data sources

For the purposes of this study, we combine six different databases.

First, we rely on French customs data that provide individual information on the exports of French firms for the period 2000-2015. This dataset includes export records at the

[39] See list in Table A.3.

firm, product and market level for all exporting firms located in France. All product-level transactions are classified at the 8-digit level of the Combined Nomenclature (CN). Therefore, the potential number of observations could be very large. To obtain a relevant dataset, we sum all exports by destination market over all firms. We restrict our sample to 72 destination countries for which we have information on cultural distance in relation to France. We also restrict our analysis to firms that have a median size (total employment) over the period 1995-2015, of at least 10.

Second, we use the FICUS and FARE databases provided by the French National Institute of Statistics (INSEE), which gathers accounting and performance variables at the firm level and covers all French firms, with the exception of firms with no employees or in the agricultural and financing sectors. Specifically, the database contains information about firm value added, nominal gross output, number of employees, intermediate inputs, tangible and intangible capital, investment goods and date of creation. These variables are used to compute the total factor productivity (TFP), size and age of French firms. Third, we use employer-employee data from the Declarations of Social Data (DADS) to compute the share of executives and intellectual professionals, the share of employees and the share of blue-collar workers in total employment for each firm.

Fourth, we rely on the World Development Indicators (WDIs) provided by the World Bank to obtain information on country population and GDP. Fifth, all time-invariant gravity variables, such as geographical distance and dummy variables for colonial links, common border, common language and European Union membership, are obtained from the CEPII[40] GeoDist and Gravity databases.

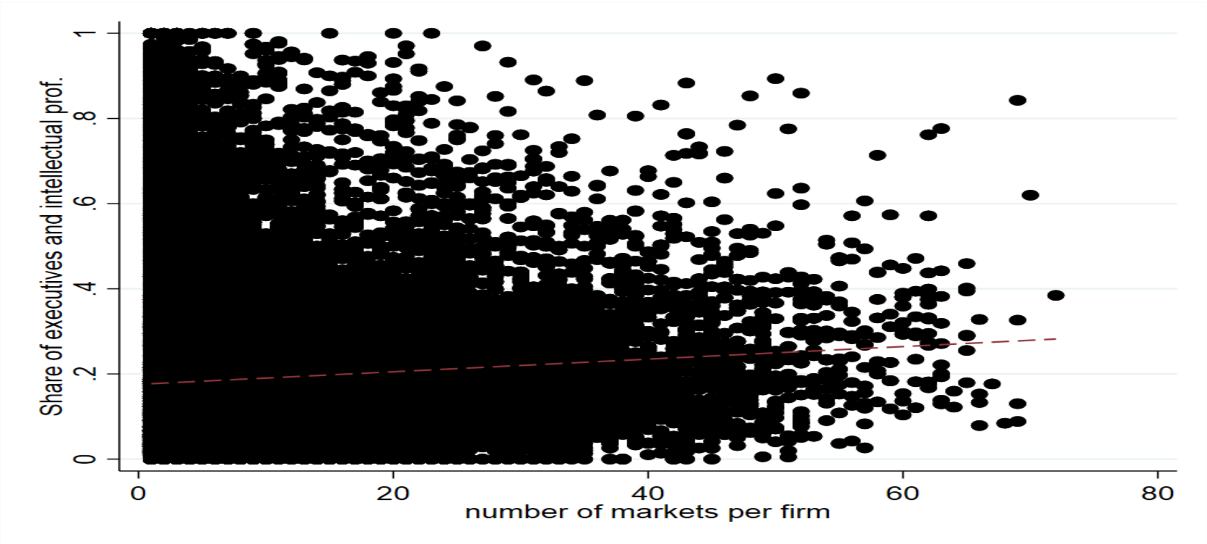
Finally, for the aforementioned measure of cultural distance, based on the World Values Survey, we rely on the database provided by Spolaore and Wacziarg (2016) and use data from Melitz and Toubal (2014) for the linguistic proximity index. We obtain unbalanced panel data for the intensive margin of more than 50 000 firms and 72 destination markets during the period 2000-2015.

7.3.4 An intuition of the results

Before discussing the estimation results, we provide graphical illustration of the correlation between workforce composition and exports (Figures 7.1, 7.2 and 7.3), on the one hand and between cultural distance and both margins of trade on the other (Figures 7.4 and 7.5).

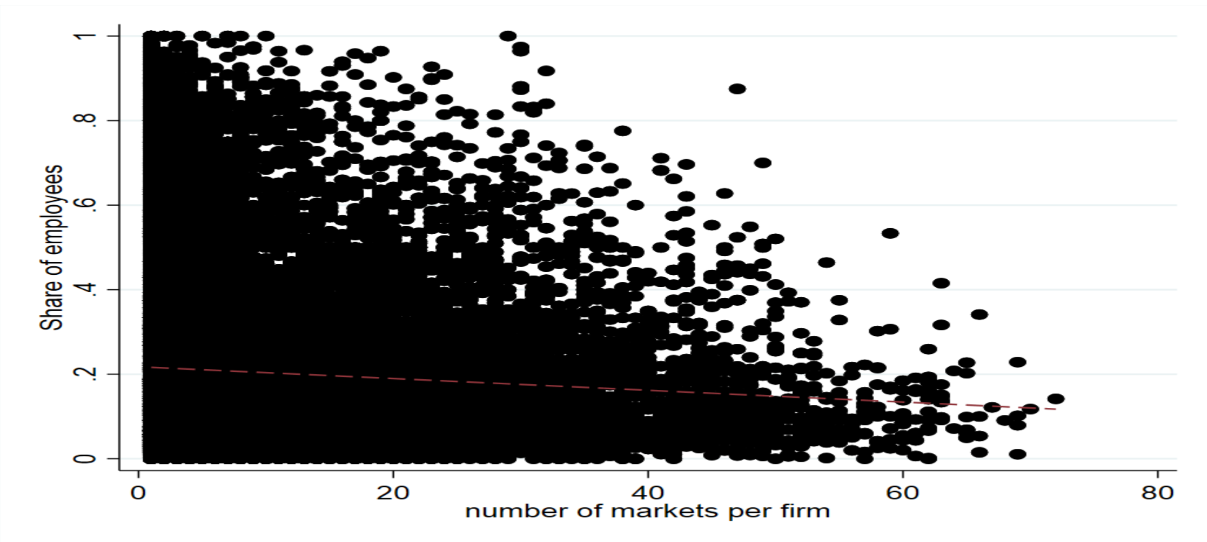
[40] Centre d'Etudes Prospectives et d'Informations Internationales.

Figure 7.1: Share of executives and intellectual professionals and number of markets



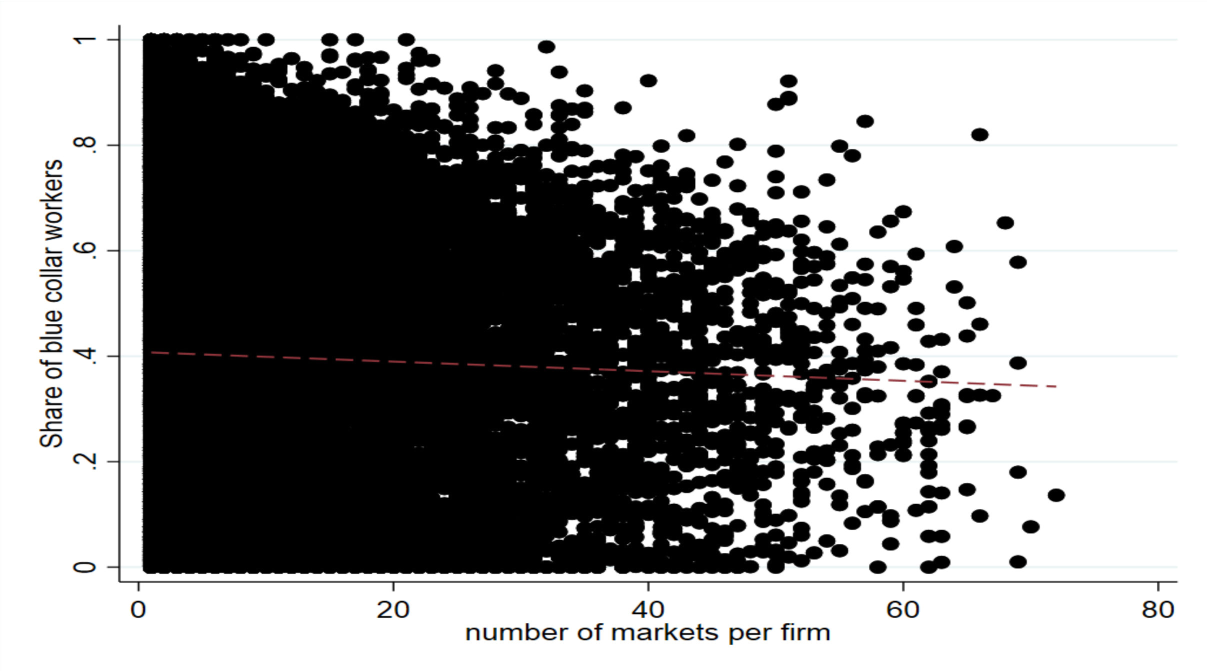
Source: Customs data, FARE, DADS and authors' calculations

Figure 7.2: Share of employees and number of markets



Source: Customs data, FARE, DADS and authors' calculations

Figure 7.3: Share of blue-collar workers and number of markets

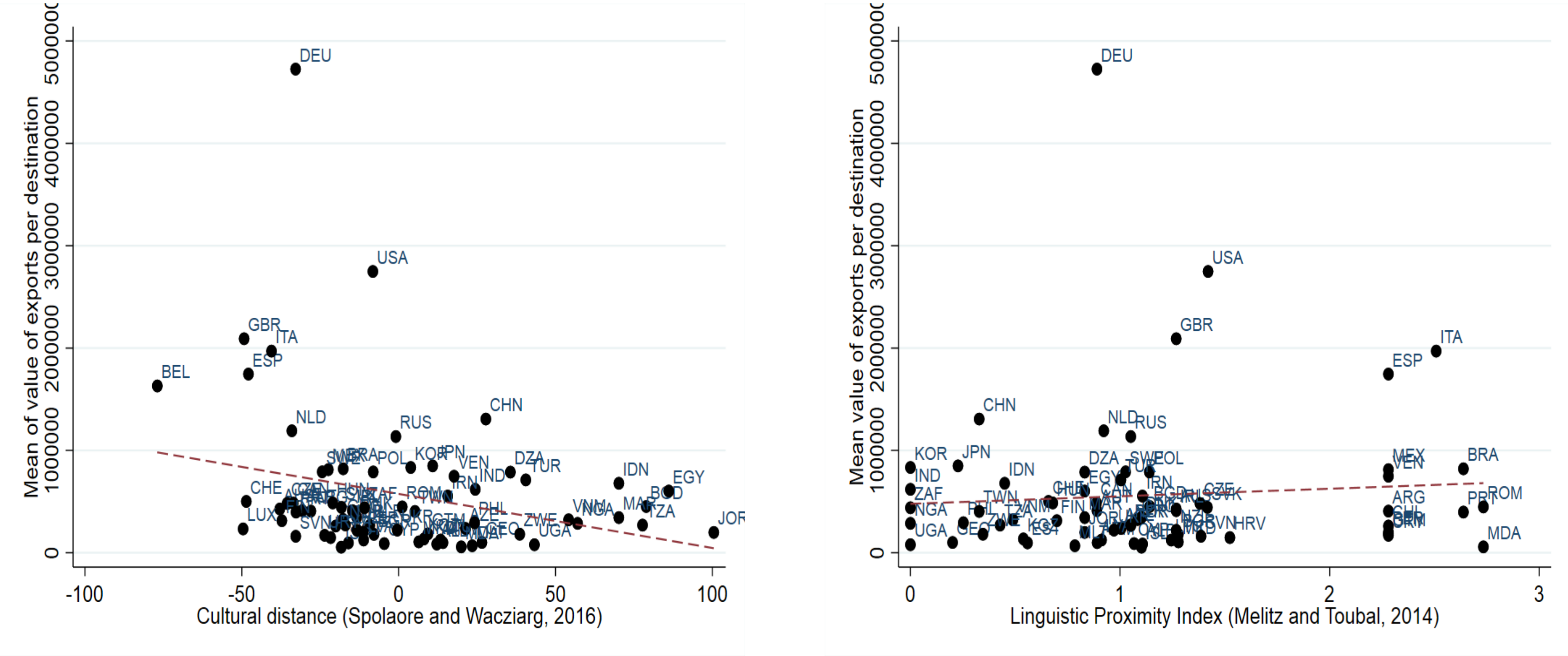


Source: Customs data, FARE, DADS and authors' calculations

As shown in Figure 7.1, a positive correlation seems to exist between the share of executives and intellectual professionals in total employment and the number of markets covered by French exporting firms (i.e., a measure of the extensive margin of trade). In contrast, Figures 2 and 3 appear to illustrate a negative relationship between the extensive margin of trade and the share of employees and blue-collar workers.

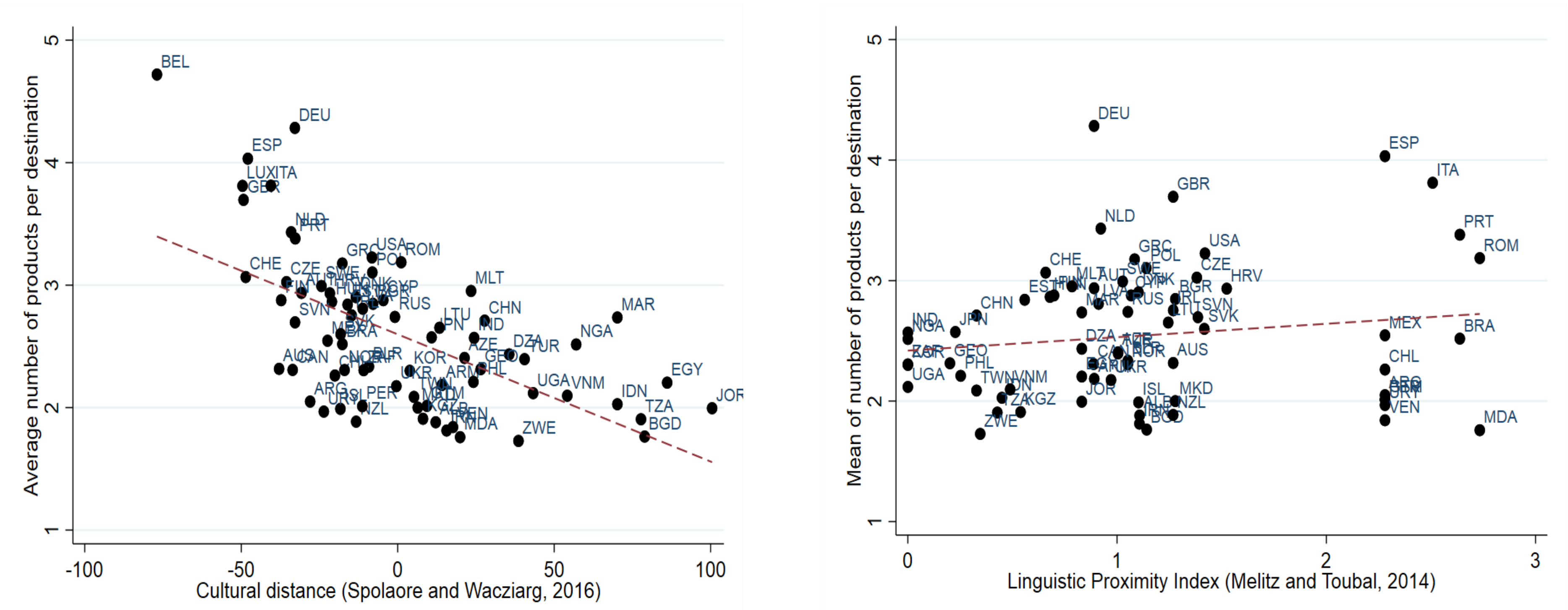
If we focus on the relationship between cultural differences, linguistic proximity and the level of exports per firm and by destination (Figure 7.4), we observe a negative relationship between cultural distance and exports, while we observe a slightly positive relationship between linguistic proximity and exports. A similar pattern can be observed for the extensive margin. Indeed, the relationship between the average number of products exported by a firm to a certain market and cultural distance (linguistic proximity) seems to be negative (positive).

Figure 7.4: Cultural distance, linguistic proximity and the intensive margin



Source: Customs data, FARE and authors' calculations

Figure 7.5: Cultural distance, linguistic proximity and the extensive margin



Source: Customs data, FARE and authors' calculations

7.4 Results

7.4.1 Baseline results

We first present our main results, namely, the estimation of model (1) for the exports of our unbalanced panel data of 59,506 firms to 72 destinations over the period 2000-2015, representing 2,970,581 observations. We also address the robustness of our results through a battery of checks using alternative measures of cultural differences and alternative specifications.

Workforce composition. Table 7.1 summarises the results of the estimation of Eq. (1), including country-by-year fixed effects to control for multilateral resistance. In this case, all time-varying variables at the destination level are removed from the equation. Columns 1 to 5 report the OLS estimates for the logarithm of exports (i.e., the intensive margin) as the dependent variable, while columns 6 to 10 show the results for the number of products exported at the firm-destination level (i.e., the extensive margin). First, we notice that coefficient estimations are stable and robust to the inclusion of other firm-level determinants of trade. Second, we find that total factor productivity (TFP) positively affects both the level of exports and the number of products exported at the firm-destination level. Our results also reveal that the size of a firm positively influences both margins of trade. This is consistent with previous studies at the firm level (Lawless, 2013) and with the prediction of the theoretical model of Melitz (2003). More interestingly, we find that the share of executives and intellectual professionals in total firm employment has a positive and significant impact on the level of exports and the number of products exported. An increase of one percentage point in the share of executives and intellectual professionals leads to an increase in French firms' exports of 5 to 7%. In contrast, our results highlight that the share of employees has a negative impact on the intensive margin of trade, while the share of blue-collar workers negatively influences the extensive margin of trade. These results extend those of Brambilla et al. (2016) on Chilean firms. Furthermore, they provide evidence that workforce composition is an important factor in explaining firms' export behaviour. Indeed, exporting activities involve expertise in terms of international business, language skills or the legal environment of destination markets and therefore require more skilled workers.

Cultural distance. To evaluate the effect of cultural distance on both margins of trade, we re-estimate Eq. (1) without country-by-year fixed effects. Table 7.2 displays the results. Notably, the estimated coefficients of firm-level determinants are similar to those estimated in Table 7.1. Moreover, as expected, we find that market size, measured by GDP, has a positive impact on French firms' level of exports and on the number of products exported by French firms. The same applies to the population level. Furthermore, standard gravity variables, representing trade costs, have the expected sign for both margins of trade. Indeed, we find that adjacency to France, speaking French, being a former colony of France and being a member of the European Union (EU) strongly increase the French firms' level of export and the number of products that they export. The negative effect of transportation costs on the intensive and the extensive margins of trade of French firms, reflected by the estimated coefficient of distance, are also highlighted in Table 7.2. Finally, we find that the cultural distance index introduced in the gravity model of trade has a negative and significant impact on the level of exports of French firms. This confirms that cultural distance between France and its trading partners impedes exports by French firms. At first glance, it could be argued that the estimated coefficient is rather small, especially compared to the coefficient associated with physical distance. However, the estimated coefficient is semi-elastic, and the values of the cultural distance index range between -100 and +100. To obtain a better sense of the actual effect of cultural distance on the intensive margin of French firms, we can increase the index from zero to its standard deviation value. In this case, when the cultural distance index increases from one standard deviation of 35, it decreases French firms' exports to approximately 4.2% (35*-0.0012*100). Note that cultural distance does not seem to affect the number of products exported by French firms. This counter-intuitive result for the extensive margin of trade could be related to the level of aggregation that we consider for the number of products (HS4).

In the last two columns of Table 7.2, we introduce a measure of cost competitiveness by constructing a bilateral real exchange rate using data on the unit labour costs (ULC) of the whole economy provided by the OECD. This measure restricts our sample to 2,119,923 observations, as we have data for this variable only for 31 countries. Our results for cultural distance and workforce composition are robust to the inclusion of a measure of competitiveness. Furthermore, we find that cost competitiveness negatively affects both the intensive and the extensive margins of French firms. Surprisingly, when our sample is restricted to 31 OECD trading partners of France, we find that cultural distance also has a negative and significant impact on the extensive margin of trade. As a consequence, our results not only confirm previous studies on aggregate data, such as Guiso et al. (2009), Felbermayr and Toubal (2010) and Bargain et al. (2018), but also enrich the literature by using a novel measure of cultural distance and exploring its negative impact on firms' export behaviour.

Robustness check 1: Alternative measure of culture. To ensure the accuracy of our results for cultural differences, we estimate Eq. (1) using an alternative measure of cultural proximity, the linguistic proximity index developed by Melitz and Toubal (2014). Using this linguistic proximity index involves excluding two countries: Belgium and Luxembourg. Therefore, our estimations focus on only 69 countries. The regression results are reported in Table 7.3. The results are very stable and robust to an alternative measure of cultural differences. Indeed, we find that linguistic proximity has a positive and significant impact on the intensive margin of trade for the whole sample and a positive and significant impact on the extensive margin of trade for the restricted sample (29 countries).

Robustness check 2: Another measure of the extensive margin. To obtain a better idea of the cross-country heterogeneity of the impact of cultural differences and linguistic proximity on the extensive margin of trade, we adopt a different vision of the latter. We define it as the probability that a firm exports to a given country in 2015. We therefore construct a balanced panel of firms' export behaviour to 70 countries for 2015 (19 960)[41]. Hence, we obtain 1,367,200 observations, and we compute a dummy variable reflecting the export status of firm *i* to destination market *j* in 2015. We then estimate Eq. (1) using a linear probability model. The results are summarised in Table 7.4. Our previous results for workforce composition and the extensive margin of trade of French firms are all confirmed. Indeed, the share of executives and intellectual professionals increases the likelihood that a firm will export to a certain market, while the share of blue-collar workers has a negative impact on this likelihood. Nevertheless, in contrast to our previous findings regarding the number of products exported by a firm to a given country, we show that cultural distance affects the probability that a firm will export to a

[41] We do not have information on the GDP of Venezuela and Iran in 2015.

certain market. Therefore, both the intensive and extensive margins of trade of French firms are affected by cultural distance.

Table 7.1: Workforce composition and margins of trade

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
			Exports (log)					# Products (log)		
$Ln(TFP)_{t-1}$	0.266***	0.265***	0.265***	0.266***	0.264***	0.0246***	0.0236***	0.0257***	0.0244***	0.0245***
	(0.0211)	(0.0210)	(0.0209)	(0.0211)	(0.0208)	(0.00682)	(0.00683)	(0.00666)	(0.00682)	(0.00667)
$Ln(Empl)_{t-1}$	0.259***	0.262***	0.260***	0.260***	0.263***	0.0786***	0.0806***	0.0783***	0.0827***	0.0827***
	(0.0086)	(0.0086)	(0.0085)	(0.0085)	(0.0082)	(0.0025)	(0.0025)	(0.0024)	(0.0026)	(0.0024)
$Ln(Age)_{t-1}$	0.00623	0.00626	0.00666	0.00625	0.00670	-0.00365	-0.00362	-0.00389*	-0.00357	-0.00377
	(0.0081)	(0.0081)	(0.0081)	(0.0080)	(0.0080)	(0.0023)	(0.0023)	(0.0023)	(0.0023)	(0.0023)
Share $cs3_{t-1}$		0.0687***			0.0504*		0.0687***			0.0580***
		(0.0224)			(0.0262)		(0.00724)			(0.00915)
Share $cs5_{t-1}$			-0.072**		-0.073**			0.042***		0.034**
			(0.0291)		(0.0358)			(0.0140)		(0.0167)
Share $cs6_{t-1}$				-0.00895	-0.0184				-0.066***	-0.042***
				(0.0177)	(0.0243)				(0.00639)	(0.00856)
Observations	2,970,581	2,970,581	2,970,581	2,970,581	2,970,581	2,970,581	2,970,581	2,970,581	2,970,581	2,970,581
R^2	0.393	0.393	0.393	0.393	0.393	0.447	0.447	0.447	0.447	0.447
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Destination-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

This table presents the regressions of the log of exported values at the firm-destination level (col. 1-5) and of the log of the number of products exported to each country (col. 6-10). Cs3 corresponds to the category “Executives and intellectual professionals”, cs4 corresponds to the category “Employees” and cs6 corresponds to the category “Blue-collar workers”. The data are for the period 2000-2015. Clustered standard errors by destination-year in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 7.2: Cultural distance and margins of trade

	(1)	(2)	(3)	(4)
	Exports (log)	# Products (log)	Exports (log)	# Products (log)
$Ln(TFP)_{t-1}$	0.251*** (0.0210)	0.0233*** (0.00680)	0.294*** (0.0262)	0.0293*** (0.00802)
$Ln(Empl)_{t-1}$	0.258*** (0.0086)	0.0824*** (0.00263)	0.297*** (0.0107)	0.0885*** (0.00292)
$Ln(Age)_{t-1}$	0.0086 (0.0080)	-0.00301 (0.00225)	0.0120 (0.00936)	0.00131 (0.00255)
Share $cs3_{t-1}$	0.0460* (0.0242)	0.0449*** (0.00716)	0.0613** (0.0282)	0.0361*** (0.00845)
Share $cs5_{t-1}$	-0.0723** (0.0300)		-0.00706 (0.0345)	
Share $cs6_{t-1}$		-0.0532*** (0.00620)		-0.0607*** (0.0074)
$Ln(GDP)_t$	0.230*** (0.0144)	0.0735*** (0.00275)	0.137*** (0.0154)	0.0256*** (0.0044)
$Ln(Pop)_t$	0.221*** (0.0184)	0.0097*** (0.00279)	0.433*** (0.0154)	0.0603*** (0.0048)
Ln(Dist)	-0.331*** (0.0155)	-0.0593*** (0.00432)	-0.238*** (0.0142)	-0.0741*** (0.0048)
Cultural distance	-0.0012** (0.0005)	0.00019 (0.0001)	-0.0071*** (0.0004)	-0.0005*** (0.0001)
Comlang	0.201*** (0.0530)	0.125*** (0.0128)	0.340*** (0.0409)	0.07916*** (0.0163)
Contiguity	0.575*** (0.0337)	0.123*** (0.00784)	0.451*** (0.0311)	0.1417*** (0.00915)
Colony	0.437*** (0.0512)	0.0900*** (0.0137)	-0.304*** (0.0448)	0.0628*** (0.02273)
EU	0.227*** (0.0320)	0.167*** (0.0093)	0.105*** (0.0391)	0.0785**** (0.0119)
$Ln(TDCR)_t$			-0.0191*** (0.0053)	-0.0066*** (0.0014)
Observations	2,970,581	2,970,581	2,119,923	2,111,923
R^2	0.382	0.440	0.428	0.524
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Destination-year FE	No	No	No	No

This table presents the regressions of the log of exported values at the firm-destination level (col. 1 and 3) and of the log of the number of product exported to each country (col. 2 and 4). Cs3 corresponds to the category "Executives and intellectual professionals", cs4 corresponds to the category "Employees" and cs6 corresponds to the category "Blue-collar workers". The data are for the period 2000-2015. Clustered standard errors by destination-year in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 7.3: Linguistic proximity and margins of trade

	(1)	(2)	(3)	(4)
	Exports (log)	# Products (log)	Exports (log)	# Products (log)
$Ln(TFP)_{t-1}$	0.243*** (0.0199)	0.0238*** (0.00679)	0.280*** (0.0251)	0,0301*** (0.0082)
$Ln(Empl)_{t-1}$	0.254*** (0.00867)	0.0812*** (0.00264)	0.298*** (0.0109)	0,883*** (0.0029)
$Ln(Age)_{t-1}$	0.00585 (0.00749)	-0.00449** (0.00216)	0.00975 (0.00870)	-0.0001 (0.0024)
Share $cs3_{t-1}$	0.0353 (0.0256)	0.0460*** (0.00754)	0.0468 (0.0303)	0.0362*** (0.0091)
Share $cs5_{t-1}$	-0.0844*** (0.0315)		-0.0121 (0.0354)	
Share $cs6_{t-1}$		-0.0527*** (0.0065)		-0.0604*** (0.0079)
$Ln(GDP)_t$	0.257*** (0.0127)	0.0669*** (0.00277)	0.243*** (0.0195)	0.0376*** (0.0052)
$Ln(Pop)_t$	0.160*** (0.0140)	0.00379 (0.00301)	0.300*** (0.0222)	0.0429*** (0.0067)
Ln(Dist)	-0.358*** (0.0137)	-0.0771*** (0.00341)	-0.300*** (0.0106)	-0.0830*** (0.0052)
Linguistic Proximity	0.0569*** (0.0136)	0.00260 (0.0044)	0.0703*** (0.0219)	0.0150** (0.0075)
Contiguity	0.638*** (0.0313)	0.157*** (0.00766)	0.543*** (0.0279)	0.1500*** (0.0117)
Colony	0.535*** (0.0438)	0.162*** (0.0123)	-0.181*** (0.0395)	0.0833*** (0.0183)
EU	0.123*** (0.0256)	0.114*** (0.00874)	0.0473* (0.0282)	0.0547*** (0.0166)
$Ln(TDCR)_t$			-0.0238*** (0.00584)	-0.0063*** (0.0014)
Observations	2,715,634	2,715,634	1,864,929	1,864,929
R^2	0.387	0.428	0.437	0.517
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Firm-year FE	No	No	No	No

This table presents the regressions of the log of exported values at the firm-destination level (col. 1 and 3) and of the log of the number of products exported to each country (col. 2 and 4). Cs3 corresponds to the category "Executives and intellectual professionals", cs4 corresponds to the category "Employees" and cs6 corresponds to the category "Blue-collar workers". The data are for the period 2000-2015. Clustered standard errors by destination-year in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 7.4: Workforce composition, cultural distance and probability of exports

	(1)	(2)	(3)	(4)	(5)
	Exp. status	Exp. status	Exp. status	Exp. status	Exp. status
$Ln(TFP)_{t-1}$	0.0034***	0.0048***	0.0037***	0.0037***	0.0048***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0010)
$Ln(Empl)_{t-1}$	0.0468***	0.0474***	0.0469***	0.0469***	0.0656***
	(0.0002)	(0.0002)	(0.000253)	(0.0002)	(0.0040)
$Ln(Age)_{t-1}$	0.0205***	0.0203***	0.0207***	0.0207***	0.0299***
	(0.0004)	(0.0004)	(0.000439)	(0.0004)	(0.0016)
Share $cs3_{t-1}$	0.0843***		0.0670***	0.0670***	0.0789***
	(0.0015)		(0.00197)	(0.0020)	(0.0134)
Share $cs6_{t-1}$		-0.0438***	-0.0179***	-0.0179***	-0.0102
		(0.0009)	(0.00118)	(0.0012)	(0.0104)
$Ln(GDP)_{t}$				0.0413***	-0.00239
				(0.0003)	(0.0137)
$Ln(Pop)_{t}$				-0.00130***	0.0588***
				(0.0003)	(0.0165)
Ln(Dist)				-0.0438***	-0.0614***
				(0.0004)	(0.0165)
Cultural distance				-0.0002***	-0.00134**
				(1.06e-05)	(0.0005)
Comlang				0.0268***	0.0129
				(0.0020)	(0.0469)
Contiguity				0.156***	0.114***
				(0.0019)	(0.0252)
Colony				0.0560***	-0.0186
				(0.0017)	(0.0477)
EU				0.0167***	-0.0743
				(0.0009)	(0.0558)
$Ln(TDCR)_{t-1}$					-0.00682**
					(0.0031)
Observations	1,397,200	1,397,200	1,397,200	1,397,200	618,760
R^2	0.171	0.170	0.171	0.153	0.134
Firm FE	No	No	No	No	No
Destination FE	Yes	Yes	Yes	No	No

This table presents the LPM of a dummy equal to one if there is a positive export flow to a country and zero otherwise at the firm level. Cs3 corresponds to the category "Executives and intellectual professionals", cs4 corresponds to the category "Employees" and cs6 corresponds to the category "Blue-collar workers". The data are for the period 2000-2015. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

7.4.2 Workforce composition and non-linear effect of trade costs

While we stressed the important role played by trade costs, such as cultural distance, in the previous section, their impact on both margins of trade of French firms could be non-linear and depend on the share of executives and intellectual professionals in each firm. To test this hypothesis, we interact the variable capturing cultural distance (or linguistic proximity) with the variable measuring the share of executives and intellectual professionals in total employment at the firm level. In doing so, our aim is to test whether the relationship between cultural distance and exports of French firms is non-linear and conditional on the workforce composition. Table 7.5 summarises the results for the intensive margin of trade. Columns (1) and (2) present the results for the cultural distance index, while columns (3) and (4) show the outcomes for the linguistic proximity index. Note that in columns (2) and (4), we control for multilateral resistance using destination fixed effects. In this case, destination-level variables are dropped from the estimation. The non-linear impact of cultural distance on the level of exports is confirmed in the first two columns of Table 7.5. Indeed, we find that the interaction between the share of executives and intellectual professionals in total employment and the cultural distance index is significant and positive. The results reveal that the positive impact of the share of executives and intellectual professionals on the intensive margin of trade increases with the level of the cultural distance index. In other words, when a destination country is far from France in terms of culture, the benefits of hiring executives to export increase. The reverse is also true: when the share of executives in total employment is high, it decreases the negative impact of cultural distance on the intensive margin. This result is highly important because it appears that hiring more skilled workers is a way to escape hidden sources of trade frictions. The results concerning linguistic proximity are in the same vein because the interaction term has the expected sign (negative).

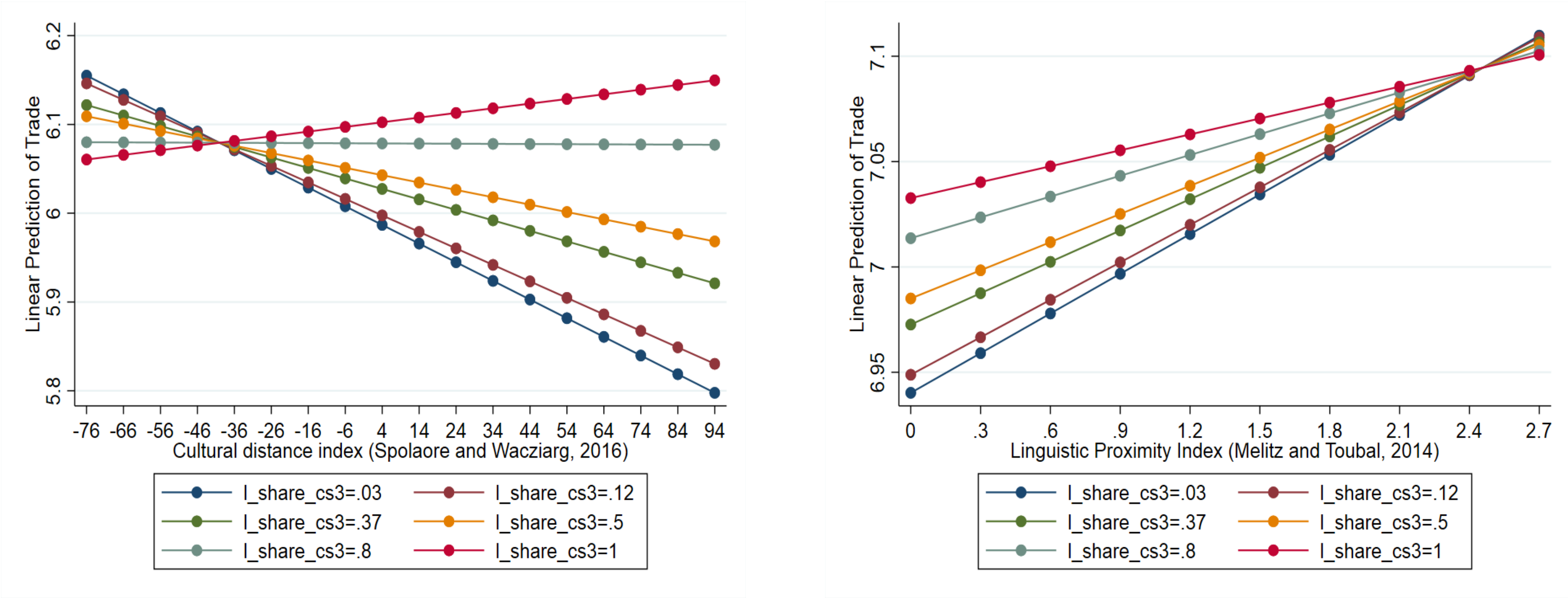
To obtain a clearer idea of the non-linear impact of both cultural differences and linguistic proximity on the intensive margin of trade, in Figure 7.6, we plot the response of the intensive margin to the cultural distance index (or linguistic proximity index) for different values of the share of executives in total employment. The results for the cultural distance index are displayed on the left side of Figure 7.6, while those for the linguistic proximity index are shown on the right side of Figure 7.6. We can clearly observe the non-linear effect of both measures of cultural differences/proximity on trade. Indeed, we remark that for low values of the share of executives in total employment, the depressive effect of cultural distance on the intensive margin is important. In contrast, for values equal to at least 80% of executives in total employment, the negative effect of cultural distance on trade disappears. For the linguistic proximity index, the non-linear effect is confirmed but is not as important as that of cultural distance.

Table 7.5: Non-linear effect of cultural distance and linguistic proximity on intensive margin

	(1)	(2)	(3)	(4)
	Cultural distance	Cultural distance	Ling. prox.	Ling. prox.
$Ln(TFP)_{t-1}$	0.252*** (0.0210)	0.265*** (0.0210)	0.245*** (0.0200)	0.256*** (0.0200)
$Ln(Empl)_{t-1}$	0.257*** (0.0086)	0.261*** (0.0086)	0.253*** (0.0087)	0.259*** (0.00865)
$Ln(Age)_{t-1}$	0.0081 (0.0079)	0.00607 (0.0080)	0.0053 (0.0075)	0.00365 (0.00743)
Share $cs3_{t-1}$	0.103*** (0.0268)	0.132*** (0.0243)	0.0953** (0.0461)	0.105** (0.0407)
Share $cs3_{t-1}$* Cult. Dist.	0.0025*** (0.0005)	0.0033*** (0.0004)		
$Ln(GDP)_t$	0.231*** (0.0143)		0.257*** (0.0127)	
$Ln(Pop)_t$	0.221*** (0.0183)		0.160*** (0.0140)	
Cultural distance	-0.0016*** (0.0005)		0.0640*** (0.0159)	
Ln(Dist)	-0.331*** (0.0137)		-0.358*** (0.0137)	
Contiguity	0.574*** (0.0337)		0.638*** (0.0313)	
Comlang	0.200*** (0.0531)			
Colony	0.438*** (0.0514)		0.535*** (0.0438)	
EU	0.226*** (0.0319)		0.122*** (0.0256)	
Share $cs3_{t-1}$* Ling. Prox.			-0.0388 (0.0313)	-0.0380 (0.0272)
Observations	2,970,581	2,970,581	2,715,634	2,715,634
R^2	0.382	0.393	0.387	0.397
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	No	Yes	No
Destination-year FE	No	Yes	No	Yes

This table presents the regressions of the log of exported values at the firm-destination level. Cs3 corresponds to the category "Executives and intellectual professionals". Share cs3t-1* Cult. Dist. is the interaction variable between the share of cs3 in total employment and the cultural distance index. Share cs3t-1* Ling. Prox. is the interaction variable between the share of cs3 in total employment and the linguistic proximity index. The data are for the period 2000-2015. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Figure 7.6: Predictive margins of cultural distance and linguistic proximity indexes on the intensive margin



Note: This figure presents the response of the logarithm of exports at the firm-destination level to the cultural distance index (left side) and linguistic proximity index (right side) for different values of the share of executives and intellectual professionals in total employment (l_share_cs3): 3%, 12%, 37%, 50%, 80% and 100%. Predicted margins are estimated using columns 1 and 3 from Table 7.5.

7.5 Conclusion and Policy Implications

The purpose of this study is to investigate the relationship between workforce composition, cultural distance and the intensive and extensive margins of French firms. To explore this relationship, we conducted a firm-destination-level analysis using data on French firms' exports to 72 trading partners during the 2000-2015 period.

First, we found that workforce composition, reflecting labour skills, has a significant impact on the intensive and extensive margins of the trade of French firms. Indeed, exporting activities involve certain skills, such as understanding foreign languages, understanding foreign markets, and understanding international business, which can be synthesised through the concept of "export culture". Therefore, firms with a higher share of skilled workers have a higher probability of exporting, exporting more products to more destinations and recording higher values of exports. Second, we confirm that hidden sources of trade frictions, such as cultural differences between countries, negatively affect both the probability that a firm will export to a certain destination and the level of its exports. It is important to consider that these trade frictions persist over time because, in contrast to transportation costs, they decrease only slowly over time because they involve differences in tastes or bilateral trust. Third, our results highlight that the share of skilled workers allows firms to escape these hidden trade frictions. Indeed, the negative impact of cultural differences on trade can be reduced by a labour force that engages in a "culture" of international business, reflected by better language skills and better expertise in the international environment.

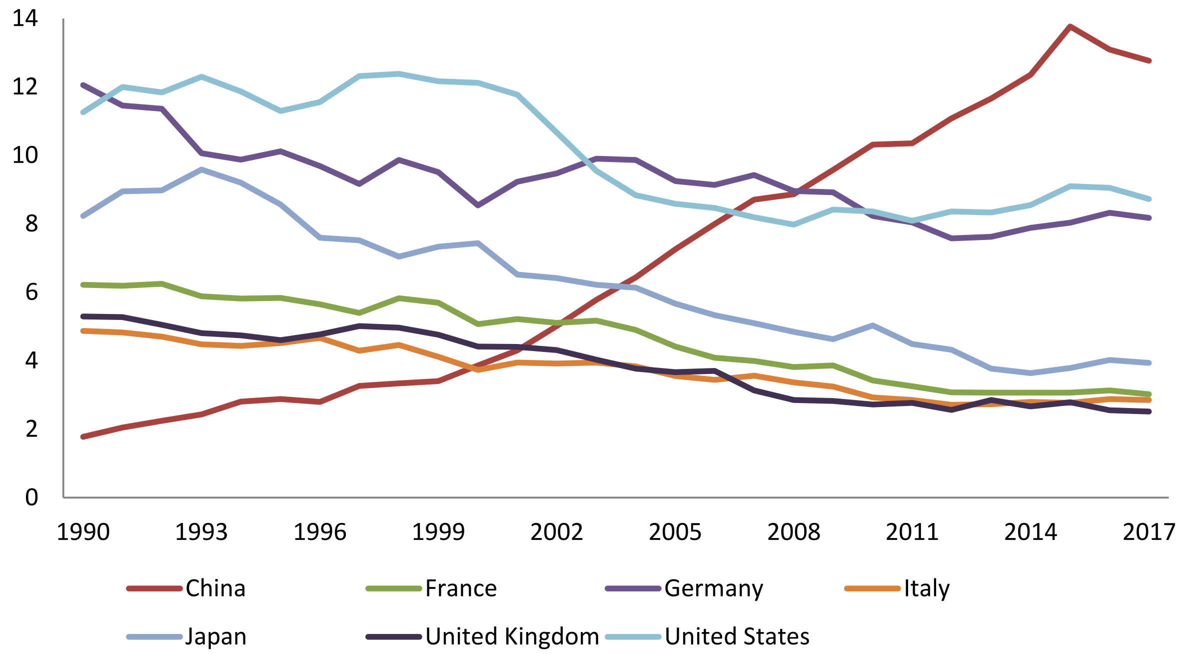
Our results indicate that the poor French export performance is related not only to increasing labour costs, as highlighted in previous studies, or to low price competitiveness, as for Italy, but also to non-price competitiveness, which is an important factor in explaining French exports. As noted in this chapter, non-price competitiveness, especially the skills of the French labour force, is an important factor affecting both margins of trade. As a consequence, France suffers from several disadvantages: increased labour costs, especially during the period 2000-2008, an intermediary position in terms of quality of products, a relatively low involvement in global value chains and a lack of human capital reflected by the relatively low skill level of the labour force.

This work has two main policy implications. First, it highlights the development of the "Francophonie", i.e., the French-speaking world, and the learning of foreign languages. If a destination country shares the same language as France (French), it increases both margins of trade for French firms. Following this reasoning, the promotion of the "Francophonie" in Africa, which is supported by French president Emmanuel Macron, will certainly deepen bilateral trade with French-speaking partners. However, it is not certain that it will increase trade with all African countries (Melitz and Toubal, 2014). Indeed, an increase in the Francophonie will certainly boost French exports to French-speaking countries. Nevertheless, this increase could be at the expense of French export flows with the rest of the world if there is a simple reallocation of resources between industries that benefit from the Francophonie and others that do not. In this case, the impact on total French exports will be mixed. Conversely, the reduction of all frictions related to differences in languages will have a positive effect on the trade of the whole country, as suggested by our results. Therefore, as suggested in Melitz and Toubal (2014), learning more than one foreign language, especially the languages of trading partners (English, German, Italian, Spanish or Chinese), could lower the frictions related to language and ease communications between French firms and their trading partners. In that sense, the proposition made by the French president in September 2017 that French students should speak two other European languages by 2024 is a movement in the right direction.

Second, as our results suggest, the development of a "culture" of international business that eases exporting activities requires more skilled workers. As a consequence, the development of programmes such as Erasmus to promote the internationalisation of students in Europe and the proposition that half of an age class spend at least six months in another European country before they are 25 are good ways to upgrade the skills of the French workforce. However, these initiatives require an important investment in tertiary education, especially because the number of students has undergone a tremendous increase over the past ten years (2.65 million in 2017 compared to 2.25 million in 2007), and government spending has increased only slightly during the same period (€13.4 billion in 2017 compared to €12.4 billion in 2007). The reform of universities launched by the government in 2018 should be followed by an important investment in tertiary education. The solution could be linked to a financing reform in the context of public spending cuts (Bacache-Beauvalet et al., 2017).

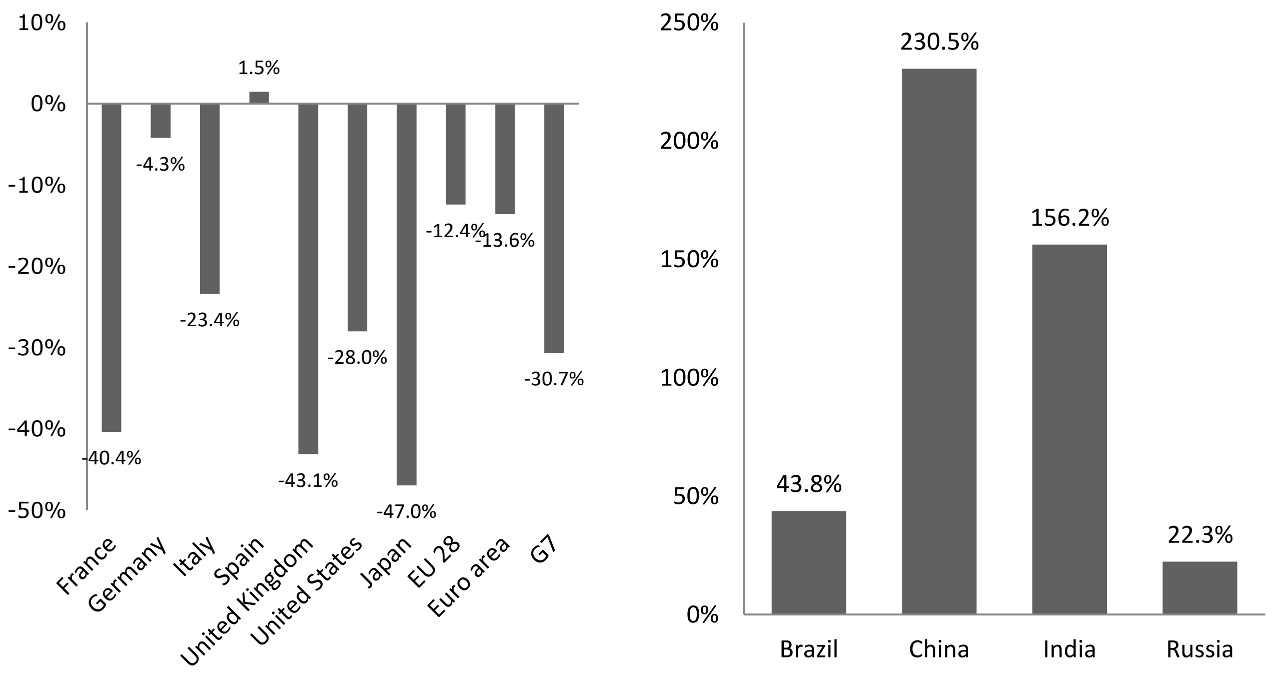
Appendix

Figure 7A.1: World export market shares in goods (%)



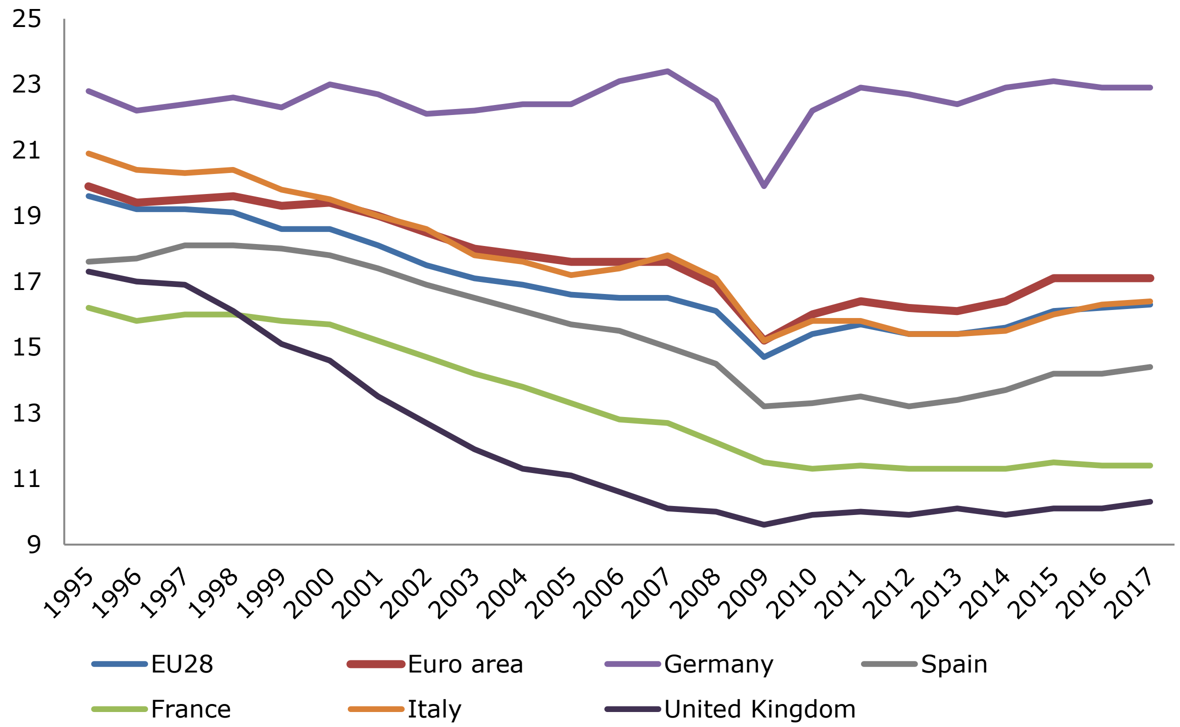
Source: UNCTAD

Figure 7A.2: World export market share variation between 2000 and 2017 (goods)



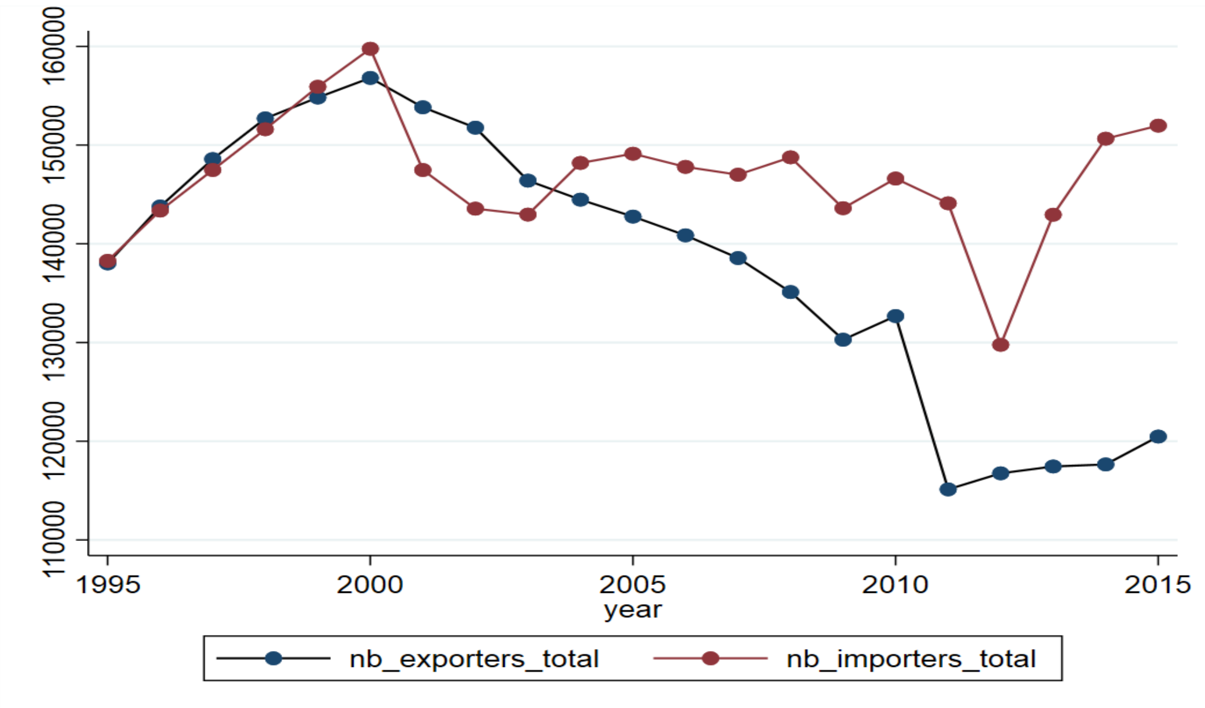
Source: UNCTAD

Figure 7A.3: Share of manufacturing industry in total value added (%)



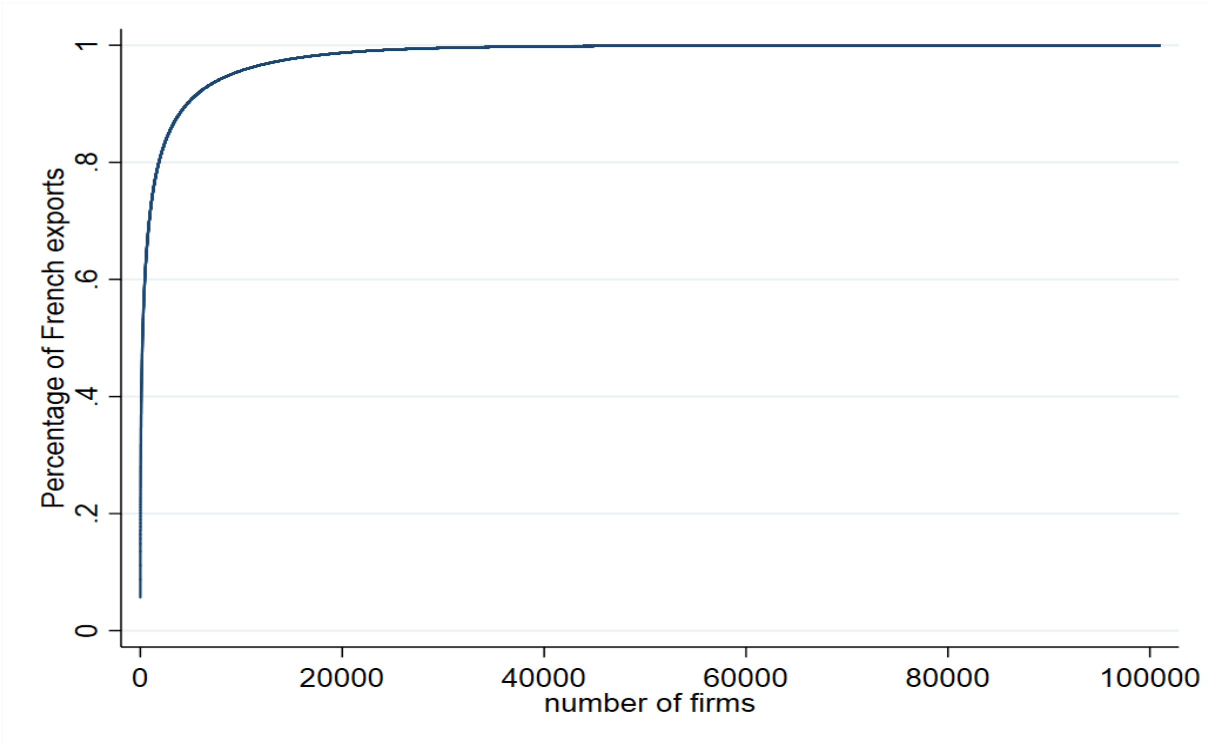
Source: Eurostat

Figure 7A.4: Number of exporting and importing firms in France



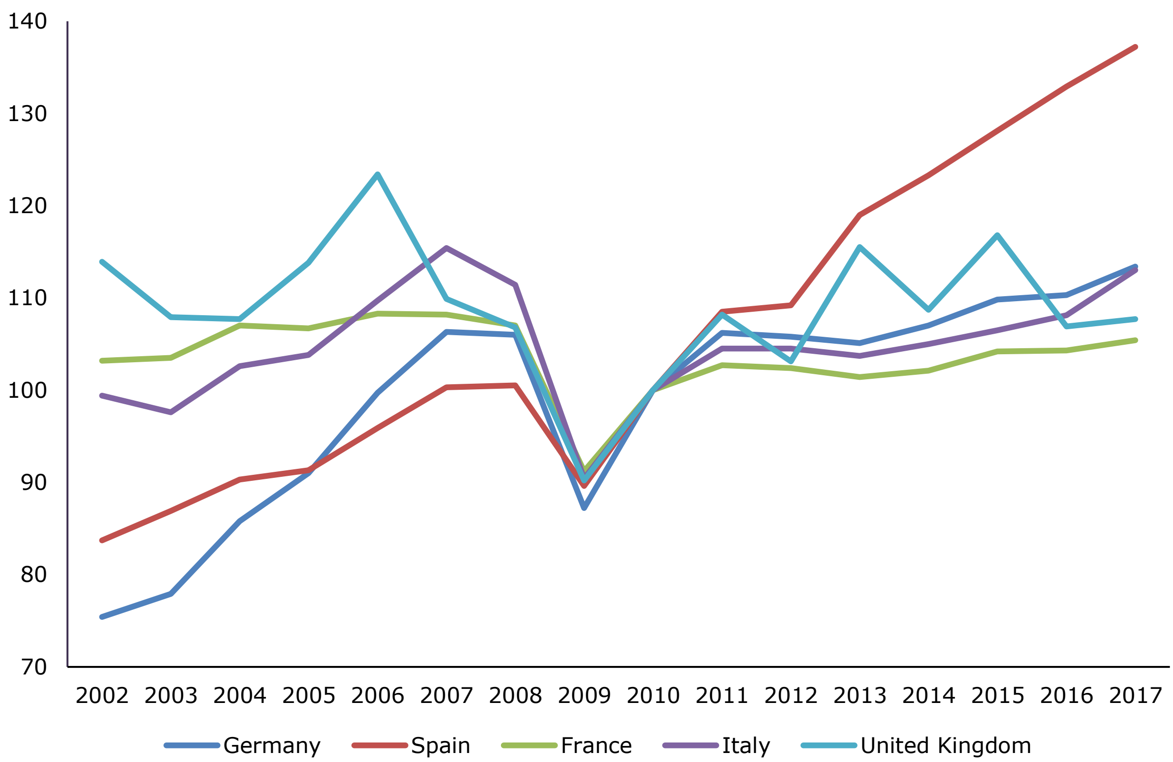
Source: Customs data

Figure 7A.5: Concentration of French exports in 2015



Source: Customs data

Figure 7A.6: Exports of goods by volume (index, basis 100 in 2010)



Source: Eurostat

Table 7A.1: Participation rate and export intensity of French firms in 1995, 2007 and 2015

	1995		2007		2015	
	Participation rate	Export intensity	Participation rate	Export intensity	Participation rate	Export intensity
All French firms						
Micro-firms (1-9 employees)	7%	19%	9%	25%	12%	23%
Medium firms (10-49 employees)	31%	15%	27%	17%	27%	18%
Upper medium firms (50-249 employees)	52%	19%	48%	21%	43%	23%
Intermediary firms (250-4999 employees)	71%	23%	63%	26%	58%	27%
Very large firms (>4999 employees)	88%	23%	72%	20%	76%	26%
Total SME (10-249 employees)	34%	16%	30%	18%	29%	19%
Total large firms (>249 employees)	71%	23%	64%	26%	59%	27%
Manufacturing industries						
	1995		2007		2015	
	Participation rate	Export intensity	Participation rate	Export intensity	Participation rate	Export intensity
Micro-firms (1-9 employees)	12%	17%	16%	19%	20%	19%
Medium firms (10-49 employees)	51%	16%	51%	18%	50%	20%
Upper medium firms (50-249 employees)	79%	23%	80%	27%	83%	31%
Intermediary firms (250-4999 employees)	93%	30%	92%	36%	92%	41%
Very large firms (>4999 employees)	97%	40%	100%	49%	98%	56%
Total SME (10-249 employees)	57%	18%	56%	21%	56%	23%
Total large firms (>249 employees)	93%	30%	92%	37%	92%	41%

Note: Descriptive statistics for French firms with at least one employee. The participation rate is the number of exporting firms over the overall number of firms; the export intensity is the arithmetic mean value of the firm-level ratio of exports over sales for exporters only.

Source: FICUS and FARE

Table 7A.2: Number of products and markets by firm in 1995, 2007 and 2015

			Products per destination		
	Mean	Median	Min.	Max.	Last Decile
1995	3	1	1	1480	7
2007	4	1	1	1584	7
2015	5	2	1	3276	8
			Products per firm		
	Mean	Median	Min.	Max.	Last Decile
1995	7	2	1	3138	15
2007	8	2	1	2939	17
2015	9	2	1	5112	17
			Destinations per firm		
	Mean	Median	Min.	Max.	Last Decile
1995	5	2	1	174	11
2007	6	2	1	168	14
2015	6	2	1	165	15

Note: Descriptive statistics for all French firms

Source: Customs data

Table 7A.3: List of countries retained in the analysis

Albania	United Kingdom	Nigeria
Armenia	Georgia	Netherlands
Argentina	Greece	Norway
Austria	Guatemala	New Zealand
Australia	Croatia	Peru
Azerbaijan	Hungary	Philippines
Bangladesh	Indonesia	Poland
Belgium	Ireland	Portugal
Bulgaria	India	Romania
Brazil	Iran	Russian Federation
Belarus	Iceland	Sweden
Canada	Italy	Slovenia
Switzerland	Jordan	Slovakia
Chile	Japan	Turkey
China	Kyrgyzstan	Taiwan
Cyprus	Republic of Korea	Tanzania
Czech Republic	Lithuania	Ukraine
Germany	Luxembourg	Uganda
Denmark	Latvia	United States of America
Algeria	Morocco	Uruguay
Estonia	Moldova	Venezuela
Egypt	Macedonia	Viet Nam
Spain	Malta	South Africa
Finland	Mexico	Zimbabwe

CHAPTER 8

International Trade, Skilled Labour and Rent Sharing in French Manufacturing: A Firm-Level Analysis

Lionel Nesta, OFCE, University Nice Sophia-Antipolis, France
Stefano Schiavo, University of Trento, Italy

8.1 Introduction

The recent debate on the pros and cons of new trade agreements, exemplified by the US withdrawal from the Trans-Pacific Partnership, the re-negotiation of NAFTA and the difficulty in ratifying the EU-Canada Free Trade Agreement, highlights the existence of widespread concerns about the effects of trade liberalisation on labour markets. This echoes the need to protect domestic workers and jobs from foreign competition, which features prominently in recent electoral campaigns in Europe and elsewhere. Hence, understanding how globalisation affects domestic firms and workers represents a crucial question from both an academic and a policy point of view.

In this chapter, we investigate the role of import penetration as a discipline device in the labour market. In particular, we ask whether exposure to foreign competition affects the relative bargaining power between firms and workers. Our focus stems from the recognition that collective bargaining plays a key role in wage determination and in the transmission of firm performance into earnings. Moreover, since the extent to which productivity growth is reflected in wage increase determines the evolution of the labour income share, the analysis in this chapter also considers the literature that documents the decline in the share of income accruing to labour in many advanced economies (Karabarbounis & Neiman, 2014) and investigates its possible drivers and effects (e.g., OECD, 2012; IMF, 2017).

Our analysis takes stock of recent advances in the estimation of market imperfections at the firm level to determine the product and labour market regimes in which firms operate and derive a measure of rent sharing for firms classified as operating in an efficient bargaining framework. Specifically, we combine the methodology developed by De Loecker and Warzynski (2012) to estimate firm-level productivity and markups with the approach used by Dobbelaere and Mairesse (2013) and Dobbelaere et al. (2015) to classify sectors according to the existence of product and labour market imperfections. Similar to Dobbelaere & Kiyota (2017), we bring such methodological advances to the level of companies by classifying firms – not sectors – according to various combinations of product and factor market imperfections.

The empirical analysis is based on a large panel of French manufacturing firms between 1997 and 2015. It reveals significant heterogeneity between companies; thus, industry-level analysis may hide significant differences among firms operating within the same sector. Our main finding is that imports from other OECD countries reduce French manufacturing workers' bargaining power, whereas the impact of imports from low-wage countries is more muted.

The rest of the chapter is organised as follows. Section 8.2 provides a quick overview of recent contributions on the effect of import competition on bargaining power. Section 8.3 illustrates the theoretical setup behind the estimation of the rent-sharing parameter, while section 8.4 describes the data and reports some descriptive statistics on the evolution of markups and bargaining power. The chapter investigates the key research question in section 8.5, namely, whether import penetration reduces workers' bargaining power. Section 8.6 concludes the chapter.

8.2 Literature Review

The impact of trade on the labour market, income inequality and the decrease in labour share is a long-standing and important topic both in academic research and in policy debates (Feenstra, 2000). Various policy briefs and reports by international organisations, such as the International Monetary Fund (IMF) or the Organisation for Economic Cooperation and Development (OECD), express this concern (IMF, 2017; OECD, 2012; Crozet & Orefice, 2017). From an academic viewpoint, greater access to detailed firm-level data has given rise to a substantial literature investigating the effect of international trade on wages and inequality (Harrison et al., 2011). The results are mixed and show that technical change is at least as important as globalisation in explaining rising inequality and job polarisation. One channel through which trade may affect the distribution of income across factors of production is relative bargaining power. If import competition acts as a discipline device on the labour market, it may reduce the share of income accruing to labour.

Recent studies (Helpman et al., 2017) find that trade magnifies within-sector differences among firms, and these differences are reflected in workers' wages. Indeed, much of the increase in inequality occurs within sector and occupation and is driven mainly by between-firm dispersion. Works that use China's WTO accession as the trigger of trade-induced changes tend to support the notion that imports from low-wage countries determine a hollowing-of-the-middle effect on labour markets, whereby jobs are increasingly polarised at the bottom and at the top of the distribution (see, for instance, Utar, 2014, for a study on the Danish labour market).

The empirical strategy for unravelling unobserved wage bargaining is to start from a structural model of wage determination in which firms and workers decide on wages. Such wage determination may depend on a host of factors, such as, inter alia, rent sharing, the wage or employment preferences of unions, and the wage elasticity of labour supply. The reduced form is then applied to sector- and/or firm-level data to reveal such unobserved characteristics. Once the labour market has been characterised, the impact of import competition on wage bargaining can be estimated. For example, Dumont et al. (2006) analyse evidence for five European countries during 1994–1998. First, they estimate sector-level bargaining power from firm microdata; then, the investigate its determinant, in particular examining labour composition, R&D intensity, outsourcing practices, market structure and imports from both OECD countries and emerging economies. Regarding trade variables, the results suggest that only imports from OECD countries have a significant effect on rent sharing. A similar picture emerges from a study on the UK performed by Boulhol et al. (2011). The empirical approach is similar: the authors first estimate both markups and bargaining power (by sector, year and firm size class) and then regress them on a series of covariates, including international competition computed as the share of imports in total demand from both industrial and developing countries. As previously found, only imports from high-income countries seem to matter.

In an approach closer to ours, Abraham et al. (2009) develop a structural model that allows for imperfections in both the product and labour markets and apply it to Belgian manufacturing firms in the period 1996–2004. Their model assumes that economic integration increases product market competition, thereby reducing firms' price-cost margins and reducing the size of the rent to be shared with workers. As a result, workers' bargaining power is reduced. The authors then distinguish between import competition from four country groups, namely, EU-15, new EU members, other OECD countries, and the rest of the world. Their findings suggest that import competition puts pressure on both markups and bargaining power, especially when there is increased competition from low-wage countries. The authors conclude that trade integration is associated with wage moderation, which should yield a positive effect on employment.

Moreno and Rodriguez (2011) address a similar question by examining the hypothesis that imports reinforce market discipline in both product and labour markets. Using a small sample of approximately 2,000 Spanish firms over the period 1990–2005, they investigate both markups and bargaining power by assessing whether import competition affects both the size of economic rents (measured by the Lerner's index) and their distribution between firms and workers. They find a negative effect of import competition on Lerner's index, which is larger for firms producing final goods. This is consistent with the idea that imports of final goods compete directly with domestic products, thereby increasing competition for domestic firms. From the point of view of rent sharing, Moreno and Rodriguez (2011) find that bargaining power is smaller for producers of final and homogeneous goods.

Although the abovementioned contributions use firm-level data, all assume that markups and bargaining power are homogeneous among the set of observations used in the econometric exercise, i.e., within the same industry.

The distinctive feature of our contribution is our use of a method that allows us to produce product and labour market imperfections that vary both across firms and over time. Classifying firms into different labour market regimes based on their actual behaviour provides us with firm-year measures that qualify the labour market, such as the elasticity of labour supply with respect to wages and rent sharing. Then, we are able to mobilise panel data techniques with instrumental variables to evaluate the impact of foreign competition on rent sharing.

Our analysis concerns firms active in French manufacturing between 1995 and 2007. As such, it complements recent evidence by Carluccio et al. (2015), who use administrative information on the existence of firm- and industry-level wage agreements to study the impact of exports and offshoring on French manufacturing wages. Indeed, we could argue that bargaining institutions and bargaining power represent crucial transmission belts linking trade and labour market outcomes. However, empirical evidence on how bargaining influences the relationship between trade and wages is scarce due to the lack of precise data on bargaining arrangements (OECD, 2012). The contribution by Carluccio et al. (2015) is an attempt to view wage determination as a product of bargaining institutions. The authors distinguish between firms where collective bargain agreements are in place and those where they are not and find that firms with collective bargaining agreements display a higher elasticity of wages with respect to exports and offshoring. At the same time, wage gains associated with collective bargaining are similar across worker categories; thus, this study confirms that the between-firm dimension of wage inequality matters more than the within-firm component. With a firm-specific, time-varying measure of rent sharing between firms and workers, we can move beyond the binary classification used by Carluccio et al. (2015) based on the mere existence of a firm-level wage agreement with the workers.

Overall, our contribution stems from two key aspects. First, based on a structural model of firm profit maximisation in imperfect markets, we produce measures of rent sharing. In contrast to previous contributions, these unobserved characteristics are both firm-specific and time-varying. Second, the estimated rent-sharing measures are then used to study their sensitivity to measures of foreign competition, distinguishing among various groups of countries, namely, OECD countries, low-wage countries, and China.

8.3 Market Imperfections

8.3.1. Modelling joint market imperfections

Similar to Dobbelaere and Kiyota (2017), we develop a production function-based approach to measure firm-year-specific market imperfections.[42] Let Q be firm output as follows: $Q_{it} = Q_{it}(K_{it}, L_{it}, M_{it})$, where subscripts i and t stand for firm i at time t, K is capital and L and M represent labour and materials, respectively. Capital K is assumed to be dynamic, whereas all the remaining production factors are static. In this framework, we assume that (i) $Q(\cdot)$ is twice differentiable and continuous; (ii) firms produce homogeneous goods by industry and compete in quantities, as in an oligopolistic Cournot setting; (iii) firms are price takers on the market for materials M; (iv) the competitive regime characterising the labour market is firm-specific; and (v) firms maximise short-term profits π. The short-term profit maximisation problem reads as follows:

$$\pi_{it}(Q_{it}, L_{it}, M_{it}) = P_t Q_{it} - w_{it} L_{it} - p_{it}^M M_{it} \qquad (1)$$

Maximisation of Eq. (1) with respect to Q yields the following first-order condition:

$$\frac{P_t}{(C_Q)_{it}} = (1 + \frac{s_{it}}{\epsilon_t})^{-1} = \mu_{it} \qquad (2)$$

where $(C_Q)_{it}$ represents the marginal costs $(\frac{\partial C}{\partial Q} = w \frac{\partial L}{\partial Q} + p^M \frac{\partial M}{\partial Q})$, s_{it} represents firm i's market share, ϵ represents the price elasticity of demand and parameter μ represents the price cost margin (markup). Since firms are price takers on the market for materials, their optimal input choice for M_{it} satisfies the first-order condition $\frac{\partial \pi_{it}}{\partial M_{it}}$:

$$p_{it}^M = (Q_M)_{it} \; P_t \; (1 + \frac{s_{it}}{\epsilon_t}) \qquad (3)$$

The term on the left-hand side of Eq. (3) represents the marginal cost of material, which must be equal to the right-hand term, the marginal revenue, that is, the marginal output of materials $\frac{\partial Q_{it}}{\partial M_{it}} = (Q_M)_{it}$ multiplied by the non-competitive price $P_t \; (1 + \frac{s_{it}}{\eta_t})$. Inserting Eq. (2) into Eq. (3), multiplying both sides by $\frac{M_{it}}{Q_{it}}$ and rearranging terms yields:

$$\mu_{it} = \frac{\theta_{it}^M}{\alpha_{it}^M} \qquad (4)$$

[42] The methodology that we use is based on Dobbelaere and Mairesse (2013) and Dobbelaere et al. (2015), and its presentation draws heavily on Dobbelaere and Kiyota (2017).

where the numerator $\theta_{it}^M = \frac{\partial Q_{it}(M_{it})}{\partial M_{it}} \frac{M_{it}}{Q_{it}}$ represents the output elasticity of materials M_{it} and the denominator $\alpha_{it}^M = \frac{p_{it}^M M_{it}}{P_t Q_{it}}$ is the share of materials M_{it} in total revenues. If the product and factor markets are perfect, the price to marginal cost ratio equals unity, and there is perfect competition (PC) on the product market. Conversely, if product markets are imperfect (IC), then $\frac{\theta_{it}^M}{\alpha_{it}^M} > 1$.

A firm's optimal demand for labour depends on the regime of its labour market. Dobbelaere and Mairesse (2013) distinguish among three regimes: perfect-competition right-to-manage bargaining (PR), efficient bargaining (EB), and static partial-equilibrium monopsony power (MO).

Under the PR regime, firms and workers behave as price takers on the labour market. As in the market for materials, the firm's short-term maximisation problem leads to the following equality:

$$\mu_{it} = \frac{\theta_{it}^L}{\alpha_{it}^L} \tag{5}$$

where the numerator θ_{it}^L represents the output elasticity of labour L_{it} and the denominator α_{it}^L is the labour share L_{it} in total revenues.

An important implication is that if all factor markets are perfect, then the markup derived from materials must yield the same value as the markup derived from labour: $\frac{\theta_{it}^L}{\alpha_{it}^L} = \frac{\theta_{it}^M}{\alpha_{it}^M}$. However, imperfections in the labour market will yield $\frac{\theta_{it}^L}{\alpha_{it}^L} \neq \frac{\theta_{it}^M}{\alpha_{it}^M}$. Hence, under assumptions (iii) and (iv), the wedge between the two ratios will be used to infer the existence of labour market imperfections.

Under the EB regime, risk-neutral firms and workers negotiate simultaneously over the wage w and employment L to maximise their joint surplus. Following McDonald and Solow (1981) and omitting subscripts i and t for clarity, the generalised product is written as follows:

$$\Omega_{EB} = [wL + (\bar{L} - L)\bar{w} - \bar{w}\bar{L}]^{\phi}[PQ - wL - p^M M]^{1-\phi} \tag{6}$$

where $\bar{w}$ and $\bar{L}$ are the competitive levels of wages and employment ($0 < L < \bar{L}$), respectively, and ϕ is the degree of bargaining power of the trade unions (the workers) during the yearly negotiations, also called the absolute extent of rent sharing. Maximisation of Eq. (6) with respect to w and L leads to the following equality (see Appendix A for details):

$$\theta^L = \mu(\alpha^L - \gamma(1 - \alpha^L - \alpha^M)) \tag{7}$$

where $= \frac{\phi}{1-\phi}$. An important implication of Eq. (7), provided that we can measure the output elasticities of labour θ^L and materials θ^M together with their shares in total revenues α^L and α^M, is that it is then possible to retrieve a measure of γ and thereby a measure of the unions' bargaining power ϕ, which is firm-year specific. The estimated parameter ϕ represents the main dependent variable in the empirical analysis described in section 5.

Under the MO regime, labour supply may be less than perfectly elastic, and the wage w may increase. Such elasticity may stem from various factors, such as idiosyncratic – heterogeneous – preferences of workers with respect to their professional environment, implying that workers view firms as imperfect substitutes. Under the MO regime, firms act as price makers and are constrained to set a single wage that applies to all workers. The monopsonist firm's maximisation programme leads to the following equality:

$$\frac{\theta^L}{\alpha^L} = \mu(1 + \frac{1}{\epsilon_w^L}) \qquad (8)$$

where ϵ_w^L represents the wage elasticity of labour supply. Eq. (8) implies that the ratio of the output elasticity of labour θ_L to the labour share in total sales must be equal to a firm's markup on the product market μ augmented by its monopsony power on the labour market $\frac{1}{\epsilon_w^L}$. Eq. (8) implies that if θ^L and α^L are known, it is possible to estimate the wage elasticity of labour supply.

Taking stock of the above, the theoretical setup allows us to characterise market imperfections in the product and labour markets. The strongest working assumption is that in the market for intermediate inputs, firms are price takers. If the assumption holds, then the wedge between the output elasticity of material (θ^M) and the share of materials in revenue (α^M) is due to imperfections in the product market. In other words, the ratio $\frac{\theta^M}{\alpha^M}$ provides information on the price-marginal cost ratio, i.e., on unobservable markups.

Now, if the product market is imperfect, but the two factor markets are perfectly competitive, then we should strictly observe the same value for the markups computed on labour and on materials ($\mu^L = \mu^M$). Any wedge between the two ratios $\frac{\theta^M}{\alpha^M}$ and $\frac{\theta^L}{\alpha^L}$ thus provides us with information on the degree of market imperfection in the labour market. Workers bargain over wages and employment level. In this case, it is possible to derive an expression for the absolute extent of rent sharing. If the gap is negative, firms enjoy *monopsony* power, and we can derive a measure of the elasticity of labour supply with respect to wages ϵ_w^L. In particular, Dobbelaere and Mairesse (2013) define a parameter, $\psi_{it} = \frac{\theta_{it}^M}{\alpha_{it}^M} - \frac{\theta_{it}^L}{\alpha_{it}^L}$, whose sign provides us with information on the presence of labour market imperfections.

1. *Efficient bargaining* (EB, $\psi > 0$). Firms and risk-neutral workers bargain over wages and employment level. It is straightforward to show that $\psi = \mu\gamma[\frac{1-\alpha^L-\alpha^M}{\alpha^L}]$.

2. *Perfect competition – right-to-manage* (PR, $\psi = 0$). The labour market operates under perfect competition.

3. *Monopsony* (MO, $\psi < 0$). Firms enjoy *monopsony* power and set wages by choosing the number of employees, in which case $= -\mu \frac{1}{\epsilon_w^L}$.

It is worth noting that much existing research investigates the extent and determinants of bargaining power in labour markets. The standard reference is Mortensen and Pissarides (1994), who, together with Diamond (1982), assume that job seekers and employers bargain with each other and usually define an equilibrium in terms of Nash bargaining (see Hall and Krueger, 2012 for a concise overview). Here, we do not aim to provide yet another explanation of bargaining power but rather examine whether exposure to import competition affects the share of the economic rent accruing to workers.

Based on the joint market imperfection parameter ψ, Dobbelaere and Mairesse (2013) identify six different regimes – each a combination of the types of competition in both the product and the labour market – in which they classify each industry. Table 8.1 presents the various combinations of joint market imperfections. In the rest of the chapter, we bring the same logic to the firm level and classify each firm-year observation in one of the six regimes.

Table 8.1: Product and labour market regimes

		Product Market	
		PC	IC
Labour market	PR	PC-PR	IC-PR
	EB	PC-EB	IC-EB
	MO	PC-MO	IC-MO

8.3.2 Estimating joint market imperfection

To compute the markup μ_{it}, we need to compute both θ_{it}^X and α_{it}^X, with $(X = L, M)$, per firm and per time period. Although computing α_{it}^X is straightforward, the estimation of θ_{it}^X is more demanding.

A key choice involves the functional form of $Q(\cdot)$. The most common candidate is the Cobb-Douglas framework. This functional form would yield an estimate of the output elasticity of labour that would be common to the set of firms to which the estimation pertains: $\hat{\theta}_{it}^L = \hat{\theta}^L$. It follows that any heterogeneity in firm markups would simply reflect heterogeneity in the revenue share of, for example, labour: $\mu_{it}^L = \frac{\theta^L}{\alpha_{it}^L}$. Therefore, we opt for a translog production function because it features heterogeneity in factor elasticities and thus yields markups whose distribution is not fully determined by heterogeneity in the revenue share of labour.

To obtain consistent estimates of the output elasticity of labour θ_{it}^L, we restrict our attention to production functions with a scalar Hicks-neutral productivity term and with technology parameters that are common across firms. Thus, we obtain the following expression for the production function:

$$Q_{it} = F(K_{it}, L_{it}, M_{it}; \boldsymbol{B}), \quad (9)$$

where $\boldsymbol{B}$ is a set of technology parameters to be estimated. The translog production function reads as follows:

$$\begin{aligned} q_{it} &= \beta_K k_{it} + \beta_L l_{it} + \beta_M m_{it} \\ &+\beta_{KL} k_{it} l_{it} + \beta_{KM} k_{it} m_{it} + \beta_{LM} l_{it} m_{it} \\ &+\beta_{KK} k^2 + \beta_{LL} l^2 + \beta_{MM} m^2 + \omega_{it} + \varepsilon_{it} \end{aligned} \quad (10)$$

The proper estimation of vector $\boldsymbol{B}$ is complicated by the correlation of variable inputs L and M with the productivity term ω_{it}, which is known by the entrepreneur but not by the econometrician. The resulting endogeneity of inputs would yield inconsistent estimates for the coefficients in $\boldsymbol{B}$. To overcome the problem of endogeneity, we use the control function approach originally developed by Olley and Pakes (1996) and extended by Levinsohn and Petrin (2003) and Ackerberg et al. (2015). Among the different available estimators, we follow the Wooldridge-Levinsohn-Petrin (WLP) procedure derived by Wooldridge (2009) and implemented by Petrin and Levinsohn (2012). This approach uses inputs to control for unobserved productivity shocks (as in Levinsohn & Petrin 2003) and tackles potential endogeneity by introducing lagged values of specific inputs as proxies for productivity. Moreover, the WLP estimator does not assume constant returns to scale and is robust to the Ackerberg et al. (2015) criticism of the Levinsohn and Petrin (2003) methodology. Finally, it has been routinely applied in the empirical literature to estimate production functions (e.g., De Loecker et al. 2016).

We assume that productivity is a function of a second-order polynomial in the logarithms of lagged capital and materials. In addition, following De Loecker (2013), we include in the productivity process a dummy for export status to control for the potential effects of international trade on productivity.

8.4 Data and descriptive Statistics

The FICUS and FARE databases contain the income statements and balance sheets of all enterprises (with the exception of microenterprises and agricultural holdings) from 1997 to 2015 whose turnover exceeds 75000 euros. All nominal variables are deflated using various deflators made available online by the INSEE: deflators of production, value added, intermediate consumption, investment, and hours worked. From these deflated data, and therefore by volume, we calculate the levels of labour productivity and total factor productivity. Businesses without employees (self-employed craftsmen in general) are excluded from the analysis, even though they contribute to the national added value. This selection is motivated by the impossibility of calculating the productivity indexes for such enterprises. Of the 45 million observations over the period, the database has approximately 23 million observations after such a selection. This reduction by half in the number of observations is equivalent to excluding a mass of companies representing less than 7% of the total value added.

The minimum threshold of 75000 euros has consequences for the analysis. With more than 23 million companies included in the analysis, we remain confident in the economic coverage of the database. However, this threshold induces a selection against admittedly smaller companies, such as auto-entrepreneurs, and also against some "young high-tech companies" with virtually no revenue in the first years of their existence. For example, although biotechnology companies are at the scientific frontier of the pharmaceutical industry, they struggle to generate revenues and to become profitable.

There is another pitfall for the analysis. The year 2008 was pivotal for data producers. Two changes strongly influence the quality of data for this particular year. The first concerns the change in industrial nomenclature. This classification change necessitated the implementation of a data harmonisation procedure by "retro-polating" the new nomenclature to observations prior to 2008. In the absence of a bijective relationship between the old and the new nomenclature, this effort requires a degree of arbitrariness and ad hoc choices that we do not report here. The second change concerns the definition of the unit of analysis, which moved from the legal unit to the economic unit. For the INSEE, "The legal unit is a legal entity governed by public or private law and may be: (i) a legal person whose existence is recognised by law independently of the persons or institutions have or are members of it; (ii) a natural person, who, as an independent, may carry on an economic activity." This definition of the legal unit should not be confused with that of the enterprise, which is considered a relevant statistical unit in the analysis as of 2008. This economic unit – the enterprise – is defined as a decision-making unit for the affection of current and strategic resources. This second definition has been adopted since 2008, leading to variations in the number of observations and associated economic quantities unrelated to actual economic activity.

Importantly, the location of firms is not necessarily equivalent to the location of production activities, as the latter pertains to establishments. Although the vast majority of companies have only one establishment (93.5% of the companies in our sample), multi-establishment firms represent 53% of added value and 56% of employment in our base. From a geographical perspective (chapter 3), these multi-establishment companies include a sizeable bias for the benefit of heavily agglomerated territories since companies prefer to have their headquarters near major administrative, political and economic centres. To correct the geographical bias, the annual Declarations of Social Data of the companies (DADS) base establishment is used, which makes it possible to determine each company's workforce by establishment. Since these establishments are geo-located by municipality and under the assumption of a proportional relationship between the proportion of staff per establishment and the other production variables (turnover, value added, investment, capital stock, intermediate consumption), it is possible to correct the aggregation bias mentioned above.

Finally, for each geo-located establishment, the level of productivity (whether labour productivity or TFP) of the parent company prevails. This is consistent with the idea that productive efficiency can be grasped at the level of companies as a whole and has little economic meaning at the plant level. The same applies to participation in international trade: an establishment is considered an exporting establishment if the enterprise as a whole declares that it exports part of its turnover. Once again, the strategic choices of the company are deemed to govern the characterisation of the establishments.

A valuable piece of information provided by the DADS data is the composition of the workforce. Using the 5 DADS classification codes, "firm owners", "upper management and skilled workers", "middle management", "employees" and "operators", we measure skilled labour as the ratio of "upper management and skilled workers" to the overall workforce.

Table 8.2: Output Elasticities $\hat{\theta}$ for K, L and M and the corresponding scale economies $\hat{\lambda}$. Translog estimates per industry

NACE	# Obs.	# Firms	α_L	α_M	$\hat{\theta}_K$	$\hat{\theta}_L$	$\hat{\theta}_M$	$\hat{\lambda}$
10	94,177	7,521	0.300	0.625	0.026	0.288	0.648	0.942
11	9,767	737	0.151	0.740	0.110	0.153	0.474	0.725
13	18,540	1,477	0.331	0.605	0.064	0.285	0.632	0.974
14	17,021	1,497	0.396	0.548	-0.032	0.381	0.728	1.296
15	6,445	500	0.387	0.553	0.003	0.355	0.760	1.379
16	24,617	1,799	0.286	0.642	-0.007	0.269	0.757	1.014
17	14,306	1,022	0.262	0.662	0.047	0.230	0.790	1.073
18	27,495	2,091	0.372	0.555	0.023	0.316	0.732	1.077
20	18,010	1,299	0.229	0.682	0.086	0.202	0.650	0.936
21	4,291	310	0.239	0.631	0.065	0.187	0.742	0.990
22	33,925	2,379	0.273	0.645	0.043	0.227	0.700	0.967
23	2,2348	1,583	0.294	0.621	0.026	0.241	0.775	1.049
24	8,634	642	0.272	0.662	0.196	0.248	0.229	0.622
25	111,018	7,880	0.367	0.551	0.087	0.315	0.490	0.890
26	18,145	1,362	0.355	0.577	-0.010	0.239	0.869	1.136
27	13,761	973	0.295	0.630	0.075	0.247	0.554	0.870
28	40,753	2,882	0.303	0.631	0.036	0.266	0.657	0.952
29	11,149	792	0.264	0.682	0.036	0.238	0.592	0.854
30	4,364	336	0.307	0.641	0.064	0.282	0.571	0.911
31	15,692	1,187	0.341	0.607	0.040	0.259	0.705	1.004
32	16,805	1,215	0.385	0.530	0.086	0.341	0.484	0.903
33	51,030	3,775	0.367	0.569	0.031	0.352	0.592	0.970
All sectors	582,293	43,259	0.323	0.603	0.047	0.285	0.621	0.953
LT	235,727	18,396	0.314	0.614	0.028	0.287	0.673	0.987
MLT	226,934	16,263	0.342	0.580	0.066	0.301	0.561	0.926
MHT	95,967	6,838	0.295	0.632	0.057	0.258	0.610	0.919
HT	23,665	1,762	0.332	0.589	0.008	0.231	0.814	1.083

(C) All manufacturing (C1) Low tech (C2) Middle-low tech (C3) Middle-high tech (C4) High tech. (10) Food products (11) Beverages (13) Textiles (14) Wearing apparel (15) Leather and related products (16) Wood and products of wood and cork, except furniture articles of straw and plaiting materials (17) Paper and paper products (18) Printing and reproduction of recorded media (20) Chemicals and chemical products (21) Basic pharmaceutical products and pharmaceutical preparations (22) Rubber and plastic products (23) Other non-metallic mineral products (24) Basic metals (25) Fabricated metal products, except machinery and equipment (26) Computer, electronic and optical products (27) Electrical equipment (28) Machinery and equipment n.e.c. (29) Motor vehicles, trailers and semi-trailers (30) Other transport equipment (31) Furniture (32) Other manufacturing (33) Repair and installation of machinery and equipment.

The FICUS/FARE data also report the 4-digit code of activities in which each firm operates. We use this information to link firms with foreign competition using data on imports. Such data are retrieved from the BACI dataset maintained by CEPII (Gaulier and Zignago, 2010). We obtain a sector-specific measure of competition from foreign countries, low-wage countries, China, and OECD members at the 4-digit level. Low-wage countries are defined following Bernard et al. (2006): a country is classified as low-wage if its per capita GDP is less than 5% of the US value. The import competition measure is the ratio of French imports (from any specific country or group of countries) to the domestic consumption of products from the 4-digit sector, i.e., total sales plus imports minus exports. Since the trade data are reported according to the HS classification, while the FICUS-FARE data use revision 2 of the NACE industrial classification system (NACE, revision 2), we develop a concordance between the HS and NACE codes.

Table 8.2 displays the factor shares in total sales of labour L and materials M. It also shows the results of the industry-specific translog estimations for all manufacturing and by industry. The sample contains almost 600,000 observations pertaining to more than 43,000 manufacturing firms with an average number of at least 10 employees over the period. The factor shares conform to the usual manufacturing characteristics, with materials representing most of the costs (60% of total sales for all manufacturing), whereas labour costs represent, on average, one-third of the total sales (32% for all manufacturing). The translog factor elasticities θ^M and θ^L amount to .603 and .285, respectively. Overall, manufacturing firms operate near constant returns to scale $\lambda = .953$, although λ appears to be significantly below unity. If we take average shares α^M and α^L, it immediately follows that there are, on average, product markups above unity μ^M and that the dominant labour regime should be efficient bargaining. These preliminary remarks should not conceal the fact that there is substantial heterogeneity across industries in the parameter estimates. The capital output elasticities θ^K are suspiciously negative in wearing apparel, wood and products of wood and cork, and *computer, electronic and optical products*.

Having obtained firm-year-specific output elasticities, we can now compute the various parameters that characterise product and labour market imperfections. Table 8.3 displays the average values of the price markup μ, parameters ψ and γ, rent sharing ϕ and the elasticity of labour supply with respect to wages ϵ_w^L. Because ϕ is computed exclusively for firms belonging to the efficient bargaining regime, and ϵ_w^L is computed only for firms belonging to the monopsony regime, the observations underlying the two statistics do not overlap.

The markup across all industries and over the time period is 11%, a value that is similar in magnitude to that reported by Bellone et al. (2016), which amounts to 14.8%. The computed markups are significantly smaller, however, than the average of 29% provided by Dobbelaere et al. (2015) for French companies. Not surprisingly, economic markups are also of a smaller magnitude than accounting markups (measured as the ratio of operating income over value added), whose average values exceed 23%. Last, the overall computed means conceal substantial cross-industry heterogeneity. For example, sectors such as *automobile*, *fabricated metal products* and *beverages* seem to operate in highly competitive markets, whereas sectors such as *computer, electronic and optical products* enjoy significant markups. A sharp contrast appears between high-technology sectors with a sizeable markup (56%) and middle-low- and middle-high-technology sectors with very low markups.

Table 8.3: Joint market imperfection estimates per industry

NACE	μ_M	ψ	γ	ϕ	ϵ_W^{LS}
10	1.093	0.159	1.909	0.526	3.970
11	0.917	-0.199	2.845	0.614	1.027
13	1.111	0.242	2.473	0.591	2.399
14	2.221	1.322	6.022	0.796	2.069
15	2.215	1.325	5.452	0.772	-
16	1.241	0.352	1.842	0.538	3.008
17	1.249	0.383	1.974	0.555	1.792
18	1.388	0.522	2.518	0.606	2.698
20	0.995	0.028	2.388	0.589	1.905
21	1.231	0.358	2.350	0.584	0.755
22	1.115	0.267	1.598	0.491	3.713
23	1.329	0.509	2.064	0.545	2.469
24	1.036	-0.930	7.155	0.751	0.598
25	0.941	0.056	1.502	0.476	4.807
26	1.769	1.081	3.647	0.698	1.997
27	0.933	0.078	2.331	0.569	2.027
28	1.067	0.193	1.628	0.494	4.875
29	0.913	0.008	2.471	0.591	2.283
30	0.952	0.034	2.055	0.573	1.860
31	1.196	0.395	2.751	0.620	3.154
32	0.993	0.111	2.307	0.577	1.507
33	1.074	0.114	1.830	0.522	4.708
All sectors	1.113	0.225	2.087	0.542	4.111
LT	1.188	0.296	2.337	0.570	3.356
MLT	1.046	0.155	1.746	0.505	4.758
MHT	1.010	0.116	1.759	0.509	3.159
HT	1.568	0.824	3.521	0.687	1.337

(C) All manufacturing (C1) Low tech (C2) Middle-low tech (C3) Middle-high tech (C4) High tech. (10) Food products (11) Beverages (13) Textiles (14) Wearing apparel (15) Leather and related products (16) Wood and products of wood and cork, except furniture articles of straw and plaiting materials (17) Paper and paper products (18) Printing and reproduction of recorded media (20) Chemicals and chemical products (21) Basic pharmaceutical products and pharmaceutical preparations (22) Rubber and plastic products (23) Other non-metallic mineral products (24) Basic metals (25) Fabricated metal products, except machinery and equipment (26) Computer, electronic and optical products (27) Electrical equipment (28) Machinery and equipment n.e.c. (29) Motor vehicles, trailers and semi-trailers (30) Other transport equipment (31) Furniture (32) Other manufacturing (33) Repair and installation of machinery and equipment.

Turning to labour market imperfections, a positive ψ parameter implies that on average, labour markets operate under the efficient bargaining regime. We observe that the absolute extent of rent sharing φ amounts to 0.542. Hence, under the EB regime, profits are shared almost equally between the shareholders and workers, with the latter obtaining 54% of the overall profit. The elasticity of labour supply with respect to wages ϵ_W^{LS} exceeds 4, implying that a 1% increase in wages entails a 4% increase in labour supply. Again, Table 8.3 exhibits substantial cross-industry variations in both φ and ϵ_W^{LS}.

To classify each firm-year observation in a specific regime, we proceed as follows. Let $\mu^L = \frac{\theta^L}{\alpha^L}$. First, we compute the confidence intervals (CIs) at the 90% level for each firm-level measure of μ^M and μ^L in a classical fashion ($\mu_{it}^X < \hat{\mu}_{it}^X \pm h \times \sigma_{\mu_X,it}$), where X stands for either M or L, $h = 1.64$ and $\sigma_{\mu_X,it}$ is given by

$$(\sigma_{\mu_X,it})^2 = (\alpha_{it}^X)^{-2}\left[\sum_w w_{it}^2 \cdot (\sigma_{\beta_x})^2 + 2 \cdot \sum_{x,z,x\neq z} x_{it} \cdot z_{it} \cdot cov_{\beta_x\beta_z}\right] \qquad (9)$$

where $w = \{1, l, k, lk\}$ and $x, z = \{m, lm, mk\}$ when $X = M$ and $w = \{1, m, k, mk\}$ and $x, z = \{l, lm, lk\}$ when $X = L$, where lowercase denotes the log-transformed variables of capital K, labour L and materials M. Second, and consistent with the above classification, the comparison of the two confidence intervals allows us to classify the labour market in which each firm operates:

1. EB: *efficient bargaining*. If the lower bound for the 90% CI μ_{it}^M exceeds the upper bound of the 90% CI for μ_{it}^L, then μ_{it}^M is significantly greater than μ_{it}^L: $\mu_{it}^M > \mu_{it}^L \Rightarrow \psi_{it} > 0$, at the 90% level.

2. PR: *perfect competition – Right-to-manage*. If the two confidence intervals overlap, then μ_{it}^M is not significantly different from μ_{it}^L: $\mu_{it}^M = \mu_{it}^L \Rightarrow \psi_{it} = 0$, at the 90% level.

3. MO: *monopsony*. If the lower bound for the 90% CI μ_{it}^L exceeds the upper bound of the 90% CI for μ_{it}^M, then μ_{it}^M is significantly lower than μ_{it}^L: $\mu_{it}^M < \mu_{it}^L \Rightarrow \psi_{it} < 0$, at the 90% level.

Classifying firms as operating under perfect or imperfect product markets is now straightforward. Using the confidence interval for μ^M, firms are considered to operate in perfect markets if the lower bound of the 90% CI is below unity. Table 8.4 displays the distribution of firm-year observations across the six regimes.

We observe that there is substantial heterogeneity both across and within different sectors. When we examine the whole economy, approximately 41% of firm-year observations operate under imperfect competition on the product market, implying that the price-to-marginal cost ratios are significantly greater than unity. This fraction varies from a lower bound of 0% for *basic metals* and .4% for *beverages* to a higher bound of almost 100% for *computer, electronic and optical products.* For the labour market, efficient bargaining represents nearly 48% of firm-year observations, followed by right-to-manage (37%). Firms that enjoy monopsony power on the labour market represent less than 15% of the observations. The single most common joint regime is the IC-EB combination, whereby firms enjoy some degree of market power on the product market, and this extra rent is shared with workers. This regime accounts for 34% of the sample, closely followed by perfect competition in both markets (PC-PR regime, amounting to 32%).[43]

Table 8.4 also suggests the presence of widespread variations for some sectors. In fact, while in some sectors, it is possible to identify a prominent regime (IC-EB in *wearing apparel*, *leather and related products*, *printing and reproduction of recorded media*, and *computer, electronic and optical products*), in several instances, there is at least a second

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[43] It is worth noting that the relatively large standard errors associated with the fixed-effects IV estimations of the translog production function result in wide confidence intervals for the markups μ and the joint market imperfection parameter. This tends to inflate participation in the PC-PR regime. In fact, unreported OLS results characterized by lower standard errors – albeit plagued by a possible endogeneity bias – produce a significantly smaller fraction of firms operating under perfect competition in both markets.

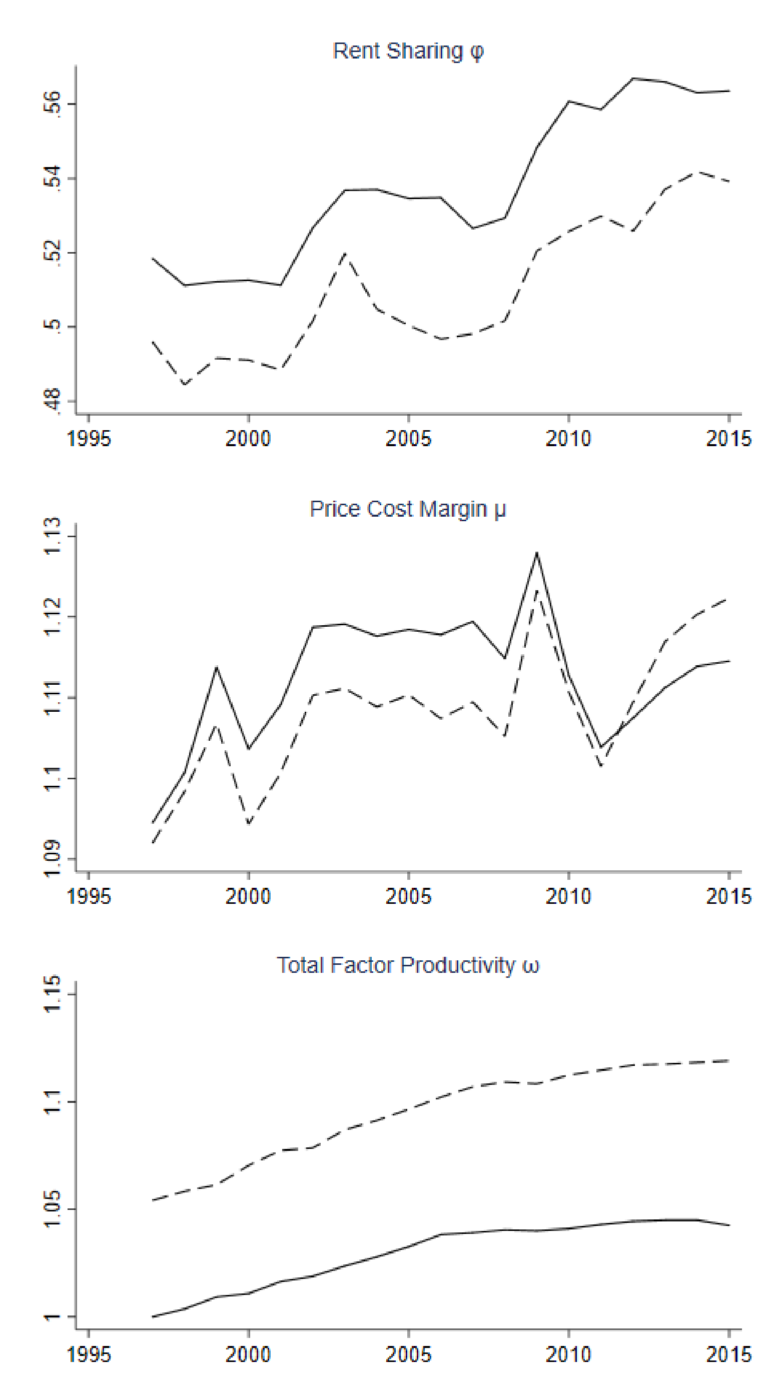
and often a third relevant regime that covers a significant fraction of firm-year observations. For instance, 38% of the observations within *food products* are classified as IC-EB, while 25% belong to the PC-MO regime and another 18% fall under the PC-PR regime. Likewise, in *paper and paper products,* the most common regime (IC-EB) covers 40% of the observations, while 29% are classified as PC-PR and 18% as IC-PR. Hence, characterising all firms within a sector as belonging to the same regime would imply a significant loss of information and conceal substantial heterogeneity across firms operating in the same sector.

Table 8.4: Product and labour regime classification per industry

NACE	PC-PR	PC-EB	PC-MO	IC-PR	IC-EB	IC-MO
10	17.9	12.3	25.7	3.5	38.5	2.2
11	73.0	-	26.6	0.2	-	0.2
13	65.7	19.9	5.7	1.3	7.2	0.2
14	0.4	-	0.1	2.6	96.6	0.3
15	2.5	-	-	3.4	94.0	0.2
16	18.7	2.4	3.2	14.5	60.2	1.0
17	29.3	11.6	0.6	18.2	39.9	0.5
18	3.4	0.2	0.4	11.1	84.8	0.1
20	69.6	11.2	14.8	1.6	2.7	0.2
21	76.1	12.4	4.2	2.6	3.6	1.1
22	28.7	22.2	3.1	5.7	39.3	1.1
23	6.7	2.6	0.4	9.0	81.2	0.1
24	42.9	-	57.1	-	-	-
25	40.4	27.0	21.4	1.7	8.9	0.7
26	0.7	0.0	0.3	5.0	93.3	0.7
27	83.8	9.3	5.7	0.4	0.6	0.2
28	23.8	14.4	10.5	6.4	42.0	2.9
29	79.9	4.6	13.5	0.6	1.1	0.3
30	85.4	4.0	8.7	0.8	0.8	0.3
31	18.8	10.4	1.9	4.7	64.2	0.1
32	83.2	8.9	5.2	1.0	1.1	0.5
33	23.4	7.2	20.8	8.2	38.1	2.3
All sectors	32.0	13.5	13.8	5.2	34.3	1.2
LT	23.2	9.9	13.8	6.4	45.4	1.3
MLT	30.8	18.8	16.1	4.8	28.5	1.1
MHT	54.3	11.2	10.5	3.4	19.3	1.5
HT	31.4	4.6	1.7	4.0	57.6	0.8

(C) All manufacturing (C1) Low tech (C2) Middle-low Tech (C3) Middle-high tech (C4) High tech. (10) Food products (11) Beverages (13) Textiles (14) Wearing apparel (15) Leather and related products (16) Wood and products of wood and cork, except furniture articles of straw and plaiting materials (17) Paper and paper products (18) Printing and reproduction of recorded media (20) Chemicals and chemical products (21) Basic pharmaceutical products and pharmaceutical preparations (22) Rubber and plastic products (23) Other non-metallic mineral products (24) Basic metals (25) Fabricated metal products, except machinery and equipment (26) Computer, electronic and optical products (27) Electrical equipment (28) Machinery and equipment n.e.c. (29) Motor vehicles, trailers and semi-trailers (30) Other transport equipment (31) Furniture (32) Other manufacturing (33) Repair and installation of machinery and equipment.

Figure 8.1: Evolution of rent sharing $\hat{\phi}$ (top panel), price cost margins $\hat{\mu}$ (middle panel) and total factor productivity $\widehat{\omega}$ (bottom panel). Solid lines indicate arithmetic averages, and dashed lines denote weighted averages using employment share for $\hat{\phi}$ and market shares for $\hat{\mu}$ and $\widehat{\omega}$.



Finally, Figure 8.1 displays the evolution of rent sharing (top panel), price cost margins (middle panel) and total factor productivity (bottom panel) over the sample period. Solid lines indicate arithmetic averages, and dashed lines denote weighted averages using employment shares for rent sharing and market shares for price cost margins and total factor productivity. For rent sharing, we observe a positive trend with sharp non-linearities corresponding to the two crises of 2000 and 2008. This must reflect the business cycle, when the burst of the dotcom bubble and the financial turmoil resulted in a slowdown of economic growth, mechanically increasing the labour share in value added. The weighted average is lower than the arithmetic mean, implying that larger firms redistribute less of their rent to workers. In the same vein, the evolution of markups shows an upward trend when focusing on the arithmetic mean but is lower for the weighted average before 2010. This is in line with the findings of De Loecker and Eeckhout (2017), although it contradicts various models of imperfect competition in which firms with larger market shares have higher markups. Finally, the productivity trend is positive for both the unweighted and weighted means. The weighted average exceeds the unweighted mean because more productive firms enjoy larger market shares. This implies the presence of allocative efficiency (Olley & Pakes 1996), the idea that the market selects more efficient companies. Finally, the bottom panel of Figure 8.1 shows a positive evolution of total factor productivity, which grows by approximately 11% over the sample period.

8.5. Rent Sharing and International Trade

8.5.1 Econometric setting

We now focus on the estimation of the effect of international competition on rent sharing. Our intuition is that firms seek to reduce production costs, of which labour costs have an important share. Hence, fierce foreign competition may act as a discipline device in the labour market, encouraging firms to retain part of the rent – for example, to invest in new production tools – at the expense of wages. This in turn would reduce rent sharing as defined in this chapter.

The choice of focusing on rent sharing implies that we consider only firms operating in the efficient bargaining labour market regime. In contrast to previous work in which all firms are assumed to engage in rent sharing (e.g., Crepon et al. 2005, Abraham et al. 2009, Boulhol et al. 2011, Dumont et al. 2012), the methodology allows us to identify firms that do so and to distinguish them from others that either are price takers on the labour market or enjoy some degree of monopsony power. Moreover, working with a continuous measure of rent sharing implies that we are able to move beyond the binary classification used by Carluccio et al. (2015), who distinguish between firms where collective bargain agreements are in place and those where they are not.

However, this more precise identification of the relevant firms to analyse comes at a potential cost: because the measures of market imperfections behind the classification into different regimes are firm-year specific, it is possible that our estimation produces labour-market regimes that change frequently from one year to the next. From an economic point of view, this should not be the case simply because firms need to be able to ensure workers' collaboration in the long term. From an econometric viewpoint, it is dangerous to select observations randomly, interrupting the time series of companies. Table 8.3 displays the short-term (from $t-1$ to t), middle-term (from year $t-5$ to year t) and long-term (from year $t-10$ to year t) transition matrixes across the three labour-market regimes, EB, PR and MO. Focusing on all the columns, we observe that the diagonal elements dominate all the matrixes, implying that firms tend to remain in the same regime: 90% of firms remain in EB from one year to the next, 86% from year $t-5$ to year t and a substantial 84% from year $t-10$ to year t. Hence, when focusing exclusively on rent sharing, we are essentially selecting firms rather than single observations.

Table 8.5: Transition matrixes for labour market regimes

		EB	PR	MO	Total
EB	$(t-1)$	231,130 88.8	24,902 9.6	4,185 1.6	260,217 100.0
PR	$(t-1)$	29,945 17.7	123,992 73.1	15,665 9.2	169,602 100.0
MO	$(t-1)$	4,317 5.4	17,767 22.3	57,610 72.3	79,694 100.0
Total	$(t-1)$	265,392 52.1	166,661 32.7	77,460 15.2	509,513 100.0
EB	$(t-5)$	147,420 84.3	21,411 12.3	5,990 3.4	174,821 100.0
PR	$(t-5)$	34,835 28.8	72,023 59.6	14,072 11.6	120,930 100.0
MO	$(t-5)$	6,868 12.4	17,506 31.6	30,969 56.0	55,343 100
Total	$(t-1)$	189,123 53.9	110,940 31.6	51,031 14.5	351,094 100.0
EB	$(t-10)$	73,638 81.2	12,576 13.9	4,530 5.0	90,744 100.0
PR	$(t-10)$	24,027 34.9	35,413 51.5	9,365 13.6	68,805 100.0
MO	$(t-10)$	5,613 18.6	10,219 33.8	14,379 47.6	30,211 100.0
Total	$(t-10)$	103,278 54.4	58,208 30.7	28,274 14.9	189,760 100.0

(EB) Efficient bargaining; (PR) Perfect competition right-to-manage; (MO) Monopsony power.

Our baseline regression model reads as follows:

$$\widehat{\Phi_{it}} = \beta_0 + \beta_1 IMP_{it-\tau} + \beta_2 SK_{it} + \beta_3 IMP_{it-\tau} \times SK_{it} + \boldsymbol{BX} + \nu_i + \rho_t + e_{it}, \qquad (12)$$

where subscripts i and t stand for firm i at year t. Parameters ν and ρ represent the firm and the year fixed effects to account for idiosyncratic differences across firms in their relationship with workers and for temporal shocks common to all companies in the sample. Variable IMP_{it} is import penetration at the four-digit level:

$$IMP_{kt} = \frac{M_{kt}}{Y_{kt} - X_{kt} + M_{kt}} \qquad (13)$$

where k identifies all the different industrial sectors, and M_{kt} denotes imports in sector k at time t and is divided by domestic absorption, i.e., total production minus exports plus imports $(Y_{kt} - X_{kt} + M_{kt})$.[44] We expect parameter β_1 to be negative, suggesting that international competition acts as a discipline device for companies by lowering the bargaining power of workers. Variable SK denotes the share of skilled labour in total employment using the DADS data. We expect the parameter β_2 to be positive since we expected more rent sharing for skilled workers. Key to the model is the interaction term $IMP_{it-\tau} \times SK_{it}$. We expect β_3 to be positive; that is, rent sharing in companies with a

[44] One more remark is worth making here. In equation (12), we set τ to unity, although we have explored the model with $\tau = (0;1;3)$ to estimate the impact of import penetration for three different lags to account for inter-temporal adjustments by firms in their labour relations. The results are available upon request.

higher share of skilled workers will be less sensitive to international competition. The rationale is that skilled workers act as a shelter against international competition by allowing companies to adapt more swiftly and to compete more successfully, both at home and abroad. Table 8.6 displays the share of skilled workers for all manufacturing companies and for those operating under the efficient bargaining labour regime and by sector classified according to their technological intensity, as proposed by the OECD. Overall, the share of skilled workers is approximately 8%. As we would intuitively expect, the share of skilled workers increases with the technological intensity of the sector. The average share ranges from 5% in low-technology sectors to 20% in high-technology sectors. When we focus on firms operating under the efficient bargaining labour regime, firms active in high-technology sectors are overrepresented.

Table 8.6: Share of skilled labour by sector, classified according to technological intensity, as proposed by the OECD

	Obs.	Mean	P5	P25	P50	P75	P95
All manufacturing firms							
Low-technology sectors	235,727	0.058	0.000	0.000	0.038	0.084	0.200
Middle-low technology sectors	226,934	0.074	0.000	0.000	0.057	0.103	0.222
Middle-high technology sectors	95,967	0.122	0.000	0.042	0.092	0.169	0.353
High-technology sectors	23,665	0.207	0.000	0.077	0.157	0.297	0.579
All sector types	*582,293*	*0.081*	*0.000*	*0.000*	*0.055*	*0.111*	*0.267*
Manufacturing firms operating in the efficient bargaining labour regime							
Low-technology sectors	135,448	0.055	0.000	0.000	0.032	0.084	0.197
Middle-low technology sectors	108,657	0.087	0.000	0.017	0.067	0.121	0.257
Middle-high technology sectors	30,505	0.158	0.000	0.063	0.128	0.222	0.421
High-technology sectors	17,519	0.199	0.000	0.066	0.147	0.290	0.562
All sector types	*292,129*	*0.087*	*0.000*	*0.000*	*0.058*	*0.120*	*0.294*

Vector $\boldsymbol{X}$ contains a series of control variables. First, we include total factor productivity ω, defined as the translog residual. We also control for size, defined as the number of employees. We introduce two variables characterising the tightness of the local labour market: employment growth at the level of the employment area and a measure of a firm's relative size, that is, the share of employees working for firm i in the employment area. We expect the effect of these variables on rent sharing to be positive and negative, respectively. Finally, we introduce a measure of capital intensity to control for production technology, hypothesising that workers in more capital-intensive companies have less bargaining power. Tables (7) and (8) present the summary statistics and the correlation matrix of the 200,000 observations representing firms operating under the EB regime.

Table 8.7: Summary statistics for firms belonging to the efficient bargaining labour regime

Variables	Obs.	Mean	St. Dev.	Min.	Max.
Rent sharing $\hat{\phi}$	204,886	0.543	0.206	0.000	0.950
Price cost margins $\hat{\mu}$	200,619	1.249	0.278	0.805	3.000
Import penetration (all countries)	204,886	0.249	0.241	0.000	0.985
Import penetration (OECD)	204,886	0.204	0.197	0.000	0.924
Import penetration (LWC, incl. China)	204,886	0.026	0.055	0.000	0.583
Import penetration (LWC, excl. China)	204,886	0.006	0.018	0.000	0.327
Import penetration (China)	204,886	0.019	0.042	0.000	0.538
Size (log of employees)	204,886	3.246	0.928	0.000	10.209
Translog residual $\hat{\omega}$ (TFP)	204,886	2.913	0.771	-0.889	8.066
Employment growth in EA	204,886	0.316	1.347	-8.203	12.575
Firm share of employment in EA	204,886	0.047	0.105	0.000	1.000
Share of skilled labour	204,886	0.081	0.100	0.000	1.000
Capital intensity	204,886	2.637	0.984	-7.500	7.847

Import penetration measures are computed at the NACE revision 2 4-digit classification level.
Abbreviations: LWC: low-wage countries; TFP: total factor productivity; EA: employment area.

Table 8.8: Correlation matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13
1	1.000												
2	0.157	1.000											
3	0.076	0.172	1.000										
4	0.021	0.096	0.954	1.000									
5	0.171	0.238	0.587	0.347	1.000								
6	0.158	0.230	0.437	0.211	0.773	1.000							
7	0.153	0.209	0.571	0.358	0.961	0.568	1.000						
8	-0.119	-0.020	0.192	0.207	0.051	0.025	0.055	1.000					
9	-0.271	-0.533	-0.190	-0.096	-0.264	-0.292	-0.216	0.020	1.000				
10	-0.015	0.001	0.045	0.041	0.033	0.015	0.036	-0.005	0.003	1.000			
11	0.030	0.119	0.150	0.118	0.159	0.133	0.148	0.402	-0.180	0.006	1.000		
12	-0.007	0.002	0.181	0.211	0.035	-0.052	0.068	0.226	0.134	-0.013	0.058	1.000	
13	-0.335	-0.148	-0.093	-0.031	-0.207	-0.169	-0.195	0.179	0.050	-0.013	0.062	0.036	1.000

(1) Rent sharing; (2) Price cost margins; (3) Import penetration (all countries); (4) Import penetration (OECD); (5) Import penetration (LWC, incl. China); (6) Import penetration (LWC, excl. China); (7) Import penetration (China); (8) Size (log of employees); (9) Translog residual TFP; (10) Employment growth in employment area; (11) Firm share of employment in employment area; (12) Share of skilled labour; (13) Capital intensity.

The estimation of Eq. (12) raises three difficulties. The first challenge is selection bias. While we observe $\hat{\phi}$ only for companies operating under the EB regime, we can expect such a selection to not be random. The second challenge is the potential endogeneity of imports. Following a common strategy in the recent literature (see, for instance, Autor et al. 2013, Hummels et al. 2014, Ashournia et al. 2014), we instrument import competition to account for a possible omitted variable bias stemming from factors that simultaneously affect both French imports and a firm's bargaining power vis-à-vis its workers. In Eq. (13), French imports from source country s in any given 4-digit sector k are substituted with country s exports to all countries except France.

To simultaneously address the issues of endogeneity and selection in a panel datasetting, we follow Semykina and Wooldridge (2010) and adapt their methodology to a case of an unbalanced panel. Their approach entails a first step in which, for each time t, a probit model is estimated in which the time means of all the endogenous variables are included (Mundlak 1978). From the results of the probit model, we retrieve the inverse Mill's ratio (IMR). The second step in Semykina and Wooldridge (2010) procedure requires the estimation of a fixed-effect two-stage least squares model augmented with the inverse

Mill's ratio (FE-2SLS). A standard t-test on the coefficient of the IMR can be used to test for selection bias: if the IMR is not significant, then there is no selection bias, and the FE-2SLS is consistent. Otherwise, Semykina and Wooldridge (2010) show that a pooled OLS augmented with the time-means of all exogenous variables, following Mundlak (1978), delivers consistent results as long as the time means are computed on the entire sample and not only on the "selected observations" (in our case, firms classified under the EB regime). Semykina and Wooldridge (2010) also suggest an alternative specification whereby the IMR is interacted with time dummies to allow for a richer (time-varying) correlation structure. The results presented below display the Semykina and Wooldridge (2010) estimator with only one inverse Mill's ratio.[45]

8.5.2 Results

Table 8.9 reports the results from a specification that includes imports of goods from all countries in the world; from OECD and low-wage countries, alternatively including and excluding China; and from China (all lagged one year). In model (1), we find a positive relationship between total imports of goods and rent sharing. This comes as a surprise because we would expect foreign competition to lower the bargaining power of workers. When interacting with skilled labour (model 2), import penetration becomes nonsignificant, and the interaction term is positive and significant. Overall, the results suggest that foreign competition favours rent sharing in manufacturing firms. This is counter to our intuition. We suspect the presence of heterogeneous effects according to the source of imports (according to country type), the type of sector (according to technological intensity), and the period of analysis (before or after the crisis).

To further investigate the potential impact of import penetration on bargaining power, we take stock of the existing literature, which suggests that such an effect may depend on the countries from which imports are sourced. To explore the heterogeneous effect of imports on French workers, we introduce two additional specifications: the first distinguishes between imports from OECD and low-wage countries (lagged one year), and the second singles out imports from China (as opposed to imports from other low-wage countries and OECD members) to check whether such a country has a specific effect on workers' bargaining power. In models (3) and (5), we introduce import penetration without interactions. All effects are positive when significant. A more fine-grained picture emerges when we interact import penetration with skilled labour. When we focus first on OECD countries (model 4), it appears that the effect of OECD firms on rent sharing in France is negative. Indeed, calculating $\partial\phi/\partial M = \beta_1 + \beta_3 \times SK_{it}$ and setting the derivative to 0 shows that the impact of foreign competition on rent sharing becomes positive when SK_{it} exceeds 17.7%. This corresponds to the 86th percentile of the distribution of skilled labour. In other words, foreign competition from OECD countries

[45] Standard errors can then either be adjusted analytically or obtained by means of block-bootstrapping, which leads us to the third econometric concern, which we do not address in this research due to time constraints. The third econometric challenge is that we do not directly observe some of the variables. In particular, the left-hand variable is an estimate of rent sharing $\hat{\phi}$. As argued by Ashraf and Galor (2013), a least square estimator would yield inconsistent standard errors as it would fail to account for the presence of a generated dependent variable. This causes wrong inferences in favor of rejecting the null hypothesis. To overcome this problem, we rely on a two-step block-bootstrapping algorithm to estimate the standard errors.[45] A random sample of firms (not observations) is drawn with replacement from the original dataset (181,901 observations). The Wooldridge (2009) estimator of the translog production function is then applied to the block-bootstrapped sample, allowing us to compute a new measure of rent sharing ($\hat{\phi}$) for the companies that are originally classified under EB as well as a new measure of productivity ($\hat{\omega}$). Eq. (12) is then estimated for firms in the EB regime. The process is performed 1,000 times, and the standard deviation of the estimated coefficients represents the bootstrap standard errors.

leads to a decrease in rent sharing for 86% of French manufacturing firms, whereas for 14% of the firms in the sample, this effect is either null or positive. Moreover, this confirms the idea that skilled labour – qualifications in general – are necessary to ensure appropriate remuneration. In model 4, competition from low-wage countries is positive and significant, whereas the interaction term is also positive and significant. As we see in model (6), our preferred specification, this result is not robust.

Model 6 is our key regression. It breaks down imports according to three types of origin: OECD countries; low-wage countries, excluding China; and China. We observe that imports from OECD countries actually boost rent sharing. This may be because OECD imports occur for relatively similar products, forcing firms to upgrade their production along the quality ladder and, therefore, to increase their share of skilled workers. A similar yet not identical interpretation is possible when examining the effect of imports from low-wage countries, excluding China. The effect is globally always positive (up to the 99th percentile of the distribution of skilled labour). The major difference is that the effect of skilled labour is negative, diminishing the positive effect of import penetration. Our interpretation is that a higher share of skilled labour may include more awareness of foreign competition, especially from low-wage countries (LWC), implying that firms devote more efforts to coping with the upsurge of price competition from these countries. Another possibility is that French companies that are more severely affected by price competition may drop out of the EB regime and move to monopsony, i.e., a situation in which all the bargaining power is in the hands of the employer. Last, the effect of China appears negative on rent sharing but is less so for firms with a higher number of skilled workers. Hence, in contrast to the competition emanating from low-wage countries, a higher share of skilled workers lowers the negative effect of foreign competition.

Table 8.9: International Competition and rent sharing in French Manufacturing

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Imp. pen. (all countries)	0.670*** (0.020)	0.001 (0.010)				
Imp. pen. (OECD)			0.544*** (0.020)	-0.036*** (0.014)	0.506*** (0.027)	0.094*** (0.029)
Imp. pen. (LWC, incl. China)			0.357*** (0.068)	0.473*** (0.073)		
Imp. pen. (LWC, excl. China)					-0.965 (0.718)	8.000*** (1.123)
Imp. pen. (China)					0.430*** (0.122)	-0.729*** (0.200)
Size (log of employees)	0.017*** (0.003)	0.013*** (0.003)	-0.003 (0.003)	0.003 (0.003)	-0.004 (0.003)	0.004 (0.003)
Translog residual $\hat{\omega}$ (TFP)	-0.969*** (0.017)	-0.940*** (0.017)	-0.807*** (0.014)	-0.853*** (0.014)	-0.802*** (0.014)	-0.839*** (0.015)
Employment growth in EA	0.003*** (0.001)	0.004*** (0.001)	0.001 (0.001)	0.002*** (0.001)	0.001 (0.001)	0.003*** (0.001)
Firm share of employment in EA	-0.065*** (0.016)	-0.055*** (0.015)	-0.033** (0.015)	-0.048*** (0.015)	-0.027* (0.015)	-0.052*** (0.019)
Share of skilled labour	-0.021** (0.010)	-0.138*** (0.017)	0.030*** (0.009)	-0.064*** (0.016)	0.031*** (0.009)	-0.056*** (0.016)
Capital intensity	-0.061*** (0.002)	-0.066*** (0.002)	-0.049*** (0.002)	-0.054*** (0.002)	-0.049*** (0.002)	-0.053*** (0.002)
Inverse Mill's ratio	-0.532*** (0.010)	-0.526*** (0.010)	-0.359*** (0.006)	-0.410*** (0.007)	-0.358*** (0.006)	-0.403*** (0.008)
Imp. pen. All countries × skilled labour		0.426*** (0.045)				
Imp. pen. OECD × skilled labour				0.203*** (0.062)		0.207*** (0.071)
Imp. pen. LWC × skilled labour				1.077*** (0.274)		
Imp. pen. LWC w/o CH × skilled labour						-9.510*** (1.947)
Imp. pen. China × skilled labour						3.214*** (0.488)
Observations	202,201	202,201	202,201	202,201	202,201	202,201
R^2	0.316	0.472	0.356	0.456	0.372	0.279

Superscripts *, **, and *** denote significance at the 10, 5, and 1% levels, respectively. Constant omitted for simplicity. Import penetration measures are computed at the NACE revision 2 4-digit classification level. Abbreviations: LWC: low-wage countries; TFP: total factor productivity; EA: employment area.

Our interpretation is that competition stemming from China and LWCs is equal. Presumably, LWCs compete in low-technology sectors, where there is little choice but to enter into price competition. Chinese competition appears more subtle and also acts on high-technology sectors. This is further confirmed when examining our data (see Table 8.10) for the mean of foreign competition (import penetration) according to the type of country of origin. We observe that whereas competition from OECD countries dominates all types of foreign competition, it is fiercer in the middle-high- and high-technology sectors. Competition from low-wage countries tends to be U-shaped along the technological intensity of sectors. It is high in low-technology sectors due to China and other countries. It is also high in high-technology sectors, but this is mainly due to imports from China (6.6% of domestic consumption) and is virtually non-existent from low-wage countries excluding China (0.5% of domestic demand).

Table 8.10: Mean values for import penetration by country of origin and sector type

	All countries	OECD	LWC w/CN	LWC wo/CN	China
Low-technology sectors	0.256	0.173	0.049	0.018	0.031
Middle-low-technology sectors	0.167	0.144	0.015	0.002	0.013
Middle-high-technology sectors	0.564	0.511	0.031	0.003	0.027
High-technology sectors	0.627	0.479	0.071	0.005	0.066
All sectors	0.277	0.216	0.036	0.010	0.026
F statistics	40,132***	59,340***	5,470***	8,061***	5,473***
R^2	0.311	0.400	0.058	0.083	0.058

We now turn to the other control variables. The features of the local employment area behave as expected when significant: employment growth increases workers' bargaining power across all estimators, whereas the firm's share of employment in the local labour markets reduces rent sharing. Capital intensity conforms to our intuition: more capital-intensive companies are less exposed to workers' bargaining power. Moreover, workers in larger firms do not seem to enjoy higher bargaining power (apart from models 1 and 2). This comes as a surprise since data about unionisation in France indicate that the share of workers belonging to a union is strongly correlated with size, ranging from as low as 5% within small private firms with less than 50 employees to 14.4% among large enterprises with more than 200 employees (Pignoni, 2016). Finally, higher productivity is associated with a lower degree of rent sharing.[46] This is consistent with the evidence regarding the fall in labour share, which is ultimately determined by wage growth falling short of productivity gains.

In Tables 8.11 and 8.12, we consider the effect of import penetration for each sector type, following the classification by the OECD of the technological intensity of sectors (Table 8.11), and before and after the crisis (Table 8.12). We obtain the following results. The striking result from Table 8.11 is that import penetration in the middle-high- and high-technology sectors does not influence rent sharing. Hence, in these sectors, rent sharing seems to be sheltered from foreign competition. This finding reinforces the conclusion that France should focus on the high-technology sectors as a way to cope with foreign competition, regardless of the country of origin. A possible extension of this conclusion is that French manufacturing firms should focus on the high-quality end of the markets regardless of the sector type. In low-quality sectors, the effect of foreign competition depends on the origin of imports. In low-technology sectors (model 7), we find a globally positive effect of OECD country imports on rent sharing. The effect becomes negative when the share of skilled workers exceeds 12%, that is, when it exceeds the 88th percentile of the distribution of skilled workers in low-technology sectors.

Again, we conclude that OECD country imports occur for relatively similar products, forcing firms to upgrade their production along the quality ladder and, therefore, to increase their share of skilled workers. In a symmetric fashion, the effect of low-wage countries (including China) is always negative, but the effect becomes less negative as the firms increase their share of skilled workers. This conforms to our intuition that firms with a larger proportion of skilled labour are better able to cope with foreign competition

[46] This negative effect does not stem from a mechanical algebraic relationship between ω and ϕ. In fact, it can be shown that $\partial\omega/\partial\theta^X < 0$, with $X = (K, L, M)$, whereas $\partial\widehat{\emptyset}/\partial L < 0$ and $\partial\widehat{\emptyset}/\partial M > 0$. We conclude that the direction of the relationship between productivity and bargaining power is undetermined: $\partial\omega/\partial\phi \lesseqgtr 0$.

stemming from countries that have a strong cost advantage. A strong policy recommendation is that if certain qualifications, that is, primary education and professional training, are the chief way to cope with competition from low-wage countries, and reducing French wages to cope with this competition cannot be viewed as a sustainable solution, improving education and professional skills can be viewed as the chief solution for reconciling wages with the marginal product of labour. The conclusion for the middle-low-technology sectors is less clear because the effect of foreign competition is positive, which is in line with the competition escape strategy previously mentioned: foreign competition forces firms to upgrade their production along the quality ladder and, therefore, to increase their share of skilled workers.

Table 8.11: International Competition and rent sharing in French Manufacturing by sector type ranked by technological intensity

	Model 7 LT	Model 8 MLT	Model 9 MHT	Model 10 HT
Imp. pen. (OECD)	0.142*** (0.041)	0.007 (0.055)	0.239* (0.128)	-0.528 (0.325)
Imp. pen. (LWC, incl. China)	-0.491*** (0.111)	3.885*** (0.262)	0.007 (0.161)	-0.267 (1.463)
Size (log of employees)	-0.033*** (0.004)	0.049*** (0.005)	-0.010 (0.008)	-0.054*** (0.013)
Translog residual $\hat{\omega}$ (TFP)	-0.747*** (0.021)	-1.084*** (0.022)	-0.868*** (0.039)	-0.281*** (0.041)
Employment growth in EA	0.001 (0.001)	0.005*** (0.002)	-0.003 (0.002)	-0.005 (0.004)
Firm share of employment in EA	-0.039** (0.019)	-0.103*** (0.033)	0.091* (0.052)	0.003 (0.030)
Share of skilled labour	0.183*** (0.030)	0.007 (0.019)	0.321 (0.230)	-0.725 (2.282)
Capital intensity	-0.395*** (0.011)	-0.055*** (0.003)	-0.035*** (0.005)	0.007 (0.012)
Inverse Mill's ratio	-0.404*** (0.011)	-0.348*** (0.008)	-0.098*** (0.010)	-0.151*** (0.029)
Imp. pen. OECD × skilled labour	-1.099*** (0.193)	0.670*** (0.190)	-0.418 (0.455)	1.586 (4.886)
Imp. pen. LWC × skilled labour	1.344*** (0.490)	-2.508* (1.416)	0.979* (0.571)	0.851 (1.522)
Observations	92,264	79,420	22,981	7,536
R^2	0.407	0.302	0.336	0.347

Superscripts *, **, and *** denote significance at the 10, 5, and 1% levels, respectively. Constant omitted for simplicity. The choice of model is based on the significance of the import penetration variables. Import penetration measures are computed at the NACE revision 2 4-digit classification level. Abbreviations: LWC: low-wage countries; TFP: total factor productivity; EA: employment area.

Table 8.12 displays the results of focusing on the effect of the crisis on the relationship between rent sharing and foreign competition with the three types of country decomposition (all imports; OECD country imports and low-wage countries; OECD country imports, low-wage countries with China, and China). We comment only on models (15) and (16), reporting the results for the finest-grained decomposition. As far as imports from OECD countries are concerned, we find that the relationship remains positive over the whole sample from 1997 to 2015. However, in the period that follows the financial crisis (2009-2015), the positive effect of OECD imports on rent sharing is moderated by the share of skilled workers in the labour force. This suggests that competition from OECD countries stimulates quality upgrading (an overall positive effect on rent sharing) but without a corresponding increase in costs. Across developed economies, especially within the European Union (and the Eurozone), countries have entered an era of both price and non-price competition.

Table 8.12: International Competition and rent sharing in French Manufacturing by period

	Model 11 1997-2007	Model 12 2009-2015	Model 13 1997-2007	Model 14 2009-2015	Model 15 1997-2007	Model 16 2009-2015
Imp. pen. (all countries)	0.046*** (0.011)	-0.028* (0.015)				
Imp. pen. (OECD)			0.113*** (0.026)	0.056 (0.045)	0.385*** (0.044)	0.715*** (0.142)
Imp. pen. (LWC, incl. China)			4.773*** (0.463)	-2.841*** (0.384)		
Imp. pen. (LWC, excl. China)					23.724*** (3.043)	8.566*** (2.667)
Imp. pen. (China)					-0.063 (0.884)	-7.935*** (1.177)
Size (log of employees)	0.018*** (0.003)	0.021*** (0.006)	0.016*** (0.004)	-0.022*** (0.006)	0.004 (0.007)	-0.012 (0.010)
Translog residual $\hat{\omega}$ (TFP)	-1.053*** (0.017)	-0.969*** (0.031)	-1.084*** (0.025)	-0.842*** (0.029)	-1.205*** (0.037)	-0.806*** (0.036)
Employment growth in EA	0.001 (0.002)	-0.180*** (0.032)	-0.002 (0.002)	-0.049 (0.038)	-0.003 (0.004)	-0.085* (0.050)
Firm share of employment in EA	0.026 (0.018)	-0.169*** (0.028)	-0.050 (0.033)	-0.092*** (0.036)	0.011 (0.054)	-0.150** (0.065)
Share of skilled labour	-0.069*** (0.019)	-0.293*** (0.034)	-0.009 (0.020)	-0.209*** (0.034)	-0.013 (0.023)	-0.139*** (0.042)
Capital intensity	-0.105*** (0.003)	-0.042*** (0.003)	-0.084*** (0.003)	-0.057*** (0.004)	-0.100*** (0.006)	-0.057*** (0.006)
Inverse Mill's ratio	-0.612*** (0.012)	-0.615*** (0.017)	-0.515*** (0.012)	-0.449*** (0.015)	-0.541*** (0.017)	-0.441*** (0.021)
Imp. pen. All countries × skilled labour	0.357*** (0.059)	0.431*** (0.085)				
Imp. pen. OECD × skilled labour			-0.014 (0.085)	0.023 (0.156)	-0.087 (0.113)	-1.184*** (0.306)
Imp. pen. LWC × skilled labour			2.321*** (0.839)	4.022*** (0.786)		
Imp. pen. LWC w/o CH × skilled labour					-25.417*** (4.814)	4.033 (6.165)
Imp. pen. China × skilled labour					17.612*** (2.503)	11.045*** (2.584)
Observations	114,201	77,168	114,201	77,168	114,201	77,168
R^2	0.495	0.470	0.190	0.181	-1.124	-0.761

Superscripts *, **, and *** denote significance at the 10, 5, and 1% levels, respectively. Constant omitted for simplicity. The choice of model is based on the significance of the import penetration variables. Import penetration measures are computed at the NACE revision 2 4-digit classification level. Abbreviations: LWC: low-wage countries; TFP: total factor productivity; EA: employment area.

Low-wage countries excluding China have a singular pattern. Before the crisis, LWCs have a globally positive effect on rent sharing, although this effect is milder for firms with a high share of skilled labour. Again, our interpretation is that this is due to the strategic response by French manufacturing firms, which increased product quality by attracting skilled labour and increasing rent sharing. The impact of Chinese imports on rent sharing changes from a positive effect to a negative effect on rent sharing with the upsurge of the crisis. Prior to the crisis. Chinese competition acts as an incentive to escape price competition via an increase in rent sharing. After the crisis, Chinese imports relate negatively to rent sharing, suggesting that Chinese competition forces firms to enter into price competition by means of wage moderation. This effect becomes milder with the share of skilled labour, implying that such efforts are essentially borne by low-skilled workers.

8.6 Conclusion

The chapter exploits recent advances in the estimation of firm-level markups to classify firms into different market regimes based on the presence of imperfections in both the product and labour markets. In particular, we are able to distinguish between firms that take the wage rate as given, those enjoying monopsony power, and those engaging in rent sharing with their workers. Using a large sample of French manufacturing firms, we show that there is substantial heterogeneity in firm behaviour both across and within industries, such that being able to properly account for firm-level differences provides us with relevant information and allows us to move one step further than the existing literature based on industry-level data or using administrative information about the presence of firm-level wage agreements.

Focusing on firms classified into an efficient bargaining regime, the methodology we adopt allows for the estimation of rent sharing between firms and workers. We then relate this index to a firm-level measure of import competition from different countries to investigate how globalisation has affected the bargaining power of workers in an industrial economy such as France. In so doing, we shed new light on the role played by collective bargaining as a mechanism that links firm performance to earnings and, as a consequence, on the relationship between trade, wages (for which evidence is still very scarce, as noted in Carluccio et al., 2015), and the labour share of income.

We have found that when controlling for a number of firm-level characteristics, such as productivity and size, import competition has a heterogeneous effect on workers' bargaining power, depending on both the source of imports and the characteristics of the firm in terms of skilled labour. Overall, our results can be summarised as follows: (i) the effect of OECD country competition is always positive but becomes weaker after the crisis, especially for firms with a larger share of skilled labour; (ii) low-wage countries have a positive impact on rent sharing, mainly because the strategy of French manufacturing firms is to escape competition from these countries, thereby increasing the French firms' share of skilled labour; (iii) Chinese imports drive rent sharing down after the crisis; (iv) workers in high-technology sectors are immune to foreign competition; and (v) the effect of the crisis globally worsens rent sharing.

Our methodology can be used in several different applications: in particular, the possibility of linking firm-level results with detailed information about employees (e.g., their composition in terms of occupation, skill, and educational attainment) represents an ideal extension of the work that would further contribute to our understanding of the (within-firm) effects of import competition on different types of workers. More generally, the approach used in the analysis could be easily applied to several other determinants of wage bargaining, such as product and labour market liberalisation and unionisation.

APPENDIX A. MEASURES OF MARKET IMPERFECTIONS

Similar to Dobbelaere and Kiyota (2017), we develop a production function-based approach to measure firm-year-specific market imperfections. Let Q be firm output as follows: $Q_{it} = Q_{it}(K_{it}, L_{it}, M_{it})$, where subscripts i and t stand for firm i at time t, K is capital, and L and M represent labour and materials, respectively. Capital K is assumed to be dynamic, whereas all remaining production factors are static. In this framework, we assume that (i) $Q(\cdot)$ is twice differentiable and continuous; (ii) firms produce homogeneous goods and compete in quantities as in an oligopolistic Cournot; (iii) firms are price takers in the market for materials M; (iv) the competitive regime characterising the labour market is firm-specific; and (v) firms maximise short-term profits π. The short-term profit maximisation problem reads as follows:

$$\pi_{it}(Q_{it}, L_{it}, M_{it}) = P_t Q_{it} - w_{it} L_{it} - p_{it}^M M_{it} \tag{A1}$$

where P_t is the price of the homogeneous goods, w represents the cost of labour and p^M represents the price of materials. Firms decide on the optimal quantities of output Q, materials M and labour L. The optimal output choice for Q_{it} satisfies the first-order condition $\frac{\partial \pi_{it}}{\partial Q_{it}} = 0$:

$$\frac{P_t}{(C_Q)_{it}} = (1 + \frac{s_{it}}{\epsilon_t})^{-1} = \mu_{it} \tag{A2}$$

where $(C_Q)_{it}$ represents the marginal costs $(\frac{\partial C}{\partial Q} = w\frac{\partial L}{\partial Q} + p^M \frac{\partial M}{\partial Q})$, s_{it} represents firm i's market share and ϵ represents the price elasticity of demand.

Firms are price takers in the market for materials. The optimal output choice for M_{it} satisfies the first-order condition $\frac{\partial \pi_{it}}{\partial M_{it}}$:

$$p_{it}^M = (Q_M)_{it}\ P_t\ (1 + \frac{s_{it}}{\epsilon_t}) \tag{A3}$$

The term on the left-hand side of Eq. (A3) represents the marginal cost of materials, which must equalise the left-hand term, the marginal revenue, that is, the marginal output of materials $\frac{\partial Q_{it}}{\partial M_{it}}$, noted as $(Q_M)_{it}$ multiplied by the non-competitive price $P_t\ (1 + \frac{s_{it}}{\eta_t})$.

Inserting Eq. (A2) into Eq. (A3), multiplying both sides by $\frac{M_{it}}{Q_{it}}$ and rearranging the terms yields:

$$\theta_{it}^M = \mu_{it} \alpha_{it}^M \tag{A4}$$

where $\theta_{it}^M = \frac{\partial Q_{it}(M_{it})}{\partial M_{it}} \frac{M_{it}}{Q_{it}}$ represents the output elasticity of materials M_{it}, and $\alpha_{it}^M = \frac{p_{it}^M M_{it}}{P_t Q_{it}}$ is the share of materials M_{it} in total sales. If the product and factor markets are perfect, then the price to marginal cost ratio equalises unity. Conversely, if the product markets are imperfect, then $\frac{\theta_{it}^M}{\alpha_{it}^M} \neq 1$.

Firms' optimal demand for labour depends on the regime of their labour market. We distinguish three regimes: perfect competition right-to-manage bargaining (PR), efficient bargaining (EB), and static partial-equilibrium monopsony power (MO). Under the PR regime, firms and workers all behave as price takers on the labour market. The firm's short-term maximisation problem satisfies the first-order condition $\frac{\partial \pi_{it}}{\partial L_{it}} = 0.$:

$$w = (Q_L)_{it}\ P_t\ (1 + \frac{s_{it}}{\epsilon_t}) \tag{A5}$$

Inserting Eq. (A2) into Eq. (A5), multiplying both sides by $\frac{L_{it}}{Q_{it}}$ and rearranging the terms yields:

$$\theta_{it}^L = \mu_{it}\alpha_{it}^L \tag{A6}$$

where, again, θ_{it}^L represents the output elasticity of labour L_{it} and α_{it}^L is the labour share L_{it} in total sales. An important implication is that if all factor markets are perfect, then the markup derived from materials must yield the same value as the markup derived from labour: $\frac{\theta_{it}^L}{\alpha_{it}^L} = \frac{\theta_{it}^M}{\alpha_{it}^M}$. However, imperfections in the labour market will yield $\frac{\theta_{it}^L}{\alpha_{it}^L} \neq \frac{\theta_{it}^M}{\alpha_{it}^M}$. Hence, under assumptions (iii) and (iv), the wedge between the two ratios will be used to infer imperfections.

Under the EB regime, risk-neutral firms and workers negotiate simultaneously on optimal wage w and employment L to maximise their joint surplus. Following McDonald and Solow (1981) and leaving subscripts i and t for clarity, the generalised product is written as follows:

$$\Omega_{EB} = [wL + (\bar{L} - L)\bar{w} - \bar{w}\bar{L}]^{\phi}[PQ - wL - p^M M]^{1-\phi} \tag{A7}$$

where $\bar{w}$ and $\bar{L}$ are the competitive levels of wages and unemployment ($0 < L < \bar{L}$), respectively, and ϕ is the degree of bargaining power of the trade unions (the workers) during the yearly negotiations, also called the absolute extent of rent sharing. Eq. (A7) simply states that under the EB regime, part of the profit is captured by the unions as a result of their bargaining power. The maximisation of Eq. (A7) with respect to w and L yields, respectively,

$$w = \bar{w} + \gamma[\frac{PQ - wL - p^M M}{N}] \tag{A8}$$

where $\gamma = \frac{\phi}{1-\phi}$ and

$$w = R_L + \phi[\frac{PQ - R_L L - p^M M}{N}] \tag{A9}$$

where R_L represents the marginal revenue of labour $\frac{\partial PQ(L)}{\partial L}$.

Efficient bargaining is achieved by simultaneously solving Eq. (A8) and Eq. (A9). The equilibrium condition is given as follows:

$$R_L = \bar{w} \tag{A10}$$

Eq. (A10) provides us with all wage-employment pairs known as the contract curve. It states that the firm's decision about hiring workers until the marginal revenue R_L equalises the non-bargaining marginal cost w. In other words, the firm hires workers until the marginal revenue product of labour equalises the alternative wage or the worker is fired.

Let R_Q and Q_L denote marginal revenue and marginal product of labour, respectively. Provided that $R_Q = C_Q$, markup can be written as $\mu = \frac{P}{R_Q}$ in equilibrium, where P is the output price. The marginal revenue of labour reads $R_L = R_Q Q_L = \frac{PQ_L}{\mu}$. Observe that the output elasticity of labour $\theta^L = Q_L \times \frac{Q}{L}$. Combining this with Eq. (A10), under the EB regime, the output elasticity of labour is as follows:

$$\theta^L = \mu \frac{\bar{w}L}{PQ} = \mu\bar{\alpha}^L \tag{A11}$$

where $\bar{\alpha}^L$ represents the labour share evaluated at the reservation wage. Multiplying Eq. (A8) by L and dividing by PQ yields $\alpha^L = \bar{\alpha}^L + \gamma(1 - \alpha^L - \alpha^M)$. Combining this with Eq. (A11) to obtain an expression for the output elasticity of labour under EB reads as follows:

$$\theta^L = \mu[\alpha^L - \gamma(1 - \alpha^L - \alpha^M)] \tag{A12}$$

An important implication of Eq. (A12) is that, provided that we can measure the output elasticities of labour θ^L and materials θ^M, together with their shares in total sales α^L and α^M, we can then retrieve a measure of γ and thereby a measure of the unions' bargaining power ϕ that is firm-year specific.

As Dobbelaere and Kiyota (2017) write, the above model assumes that the supply of labour is infinite so that a marginal reduction in wages would result in an immediate withdrawal of all workers from the markets. However, under the MO regime, labour supply may be less than perfectly elastic and increases with wages w. Such elasticity may stem from various factors, ranging from idiosyncratic – heterogeneous – preferences to work environment, implying that workers view firms as imperfect substitutes. Under the MO regime, then, firms are constrained to set a single wage that applies to all workers. The monopsonist firm's objective is then to maximise the following short-term profit:

$$\pi(Q, L, M) = PQ - w(L)L - p^M M \tag{A13}$$

Maximisation of Eq. (A13) with respect to labour gives the following first-order condition:

$$\frac{\partial Q}{\partial L} P(1 + \frac{s_{it}}{\epsilon_t}) = w(1 + \frac{1}{\epsilon_w^L}) \tag{A14}$$

where ϵ_w^L represents the wage elasticity of labour supply. Eq. (A14) states that the marginal revenue valued at the non-competitive price must equalise the marginal cost wage valued at the marginal employee. Because $(1 + \frac{1}{\epsilon_w^L})$ is greater than unity, Eq. (A14) implies that the marginal wage applies to all workers already hired in the company. Inserting Eq. (A2) into Eq. (A14), multiplying both sides by $\frac{L_{it}}{Q_{it}}$ and rearranging the terms yields:

$$\theta^L = \mu\alpha^L \left(1 + \frac{1}{\epsilon_w^L}\right). \tag{A15}$$

Appendix B. Data Appendix

All nominal output and input variables are available at the firm level. Industry-level information is used for price indexes, number of hours worked and depreciation rates of capital.

Output. Our output variable, Q, is revenues corrected by variations in inventories. Nominal values are deflated by sector-specific price indexes that are available at the 2-digit level from the INSEE (the French National Statistical Office).

Labour. We define our labour variable, L, as the number of effective workers multiplied by the number of hours worked in a year. The annual series for worked hours are available at the 2-digit industry level and are provided by *the Groningen Growth Development Centre (GGDC)*. This choice was made because there are no data on hours worked in the EAE datasets.

Capital input. Capital stocks, K, are computed using information on the investment and book value of tangible assets (we rely on book value reported at the end of the accounting exercise) following the traditional permanent inventory methodology:

$$K_t = (1 - \delta_{t-1})\ K_{t-1} + I_t \tag{B1}$$

where δ_t is the depreciation rate and I_t is real investment (deflated nominal investment). Both investment price indexes and depreciation rates are available at the 2-digit industrial classification level from the INSEE data series.

Intermediate inputs. Intermediate inputs, M, are defined as purchases of materials and merchandise, transport and travel, and miscellaneous expenses. They are deflated using the sectoral price indexes for intermediate inputs published by the INSEE.

Revenue shares. To compute the revenue share of labour, we rely on the variable *wages and compensation*. This value includes total wages paid to salaries plus social contribution and income tax withholding.

APPENDIX C. WAGE BARGAINING IN FRANCE

The French labour market features specific institutions and principles that make it both an interesting case study [6,15] and one that is consistent with our priorities. First, with respect to the relevance of firm-level heterogeneity, the [??0] classifies France as a system featuring a "*combination of industry and firm/plant level bargaining with an important share covered by company bargaining*", while the 2012 version of the Employment Outlook [43] reports a shift from a sectoral to a more local level of wage bargaining in France since the 1990s. This picture is consistent with the data collected by [50], who suggests that wage bargaining has undergone a significant decentralisation process in the last 25 years.

Moreover, in France, wage agreements do not cover only unionised workers, whose number is small but increases sharply with firm size, especially in the private sector [46], but are often extended to all employees within the firm or the industry (depending on the level of the agreement): this explains the gap between the low rate of unionisation and the wide coverage of collective agreements.

From an institutional point of view, a 1982 law (Law Auroux) stipulates a legal obligation for firms to negotiate wages with unions every year, even if an agreement cannot be reached. In fact, the average duration of negotiated wages ranges from 10 to 12 months [6,50]; thus, an empirical framework based on within-firm annual variations is well placed to capture changes in bargaining power.

PART IV

Structural Reforms

CHAPTER 9

Policy Recommendations[47]

Lionel Nesta, OFCE, University Nice Sophia-Antipolis, France

9.1 Overall assessment: increasing concentration of activities

The previous chapters highlight the following findings. First, the French economy suffers from over-investment in intangibles and lacks investments in "machines and equipment", that is, in productive capacities that increase output in the short term. A simple simulation shows that if France had the same structure of investments (tangibles, intangibles, ICT) as Germany, the GDP would grow by 3.5%. This brings into question the very existence of the CIR as currently designed to spur investment in intangibles.

Second, human capital, meaning skilled labour, has been shown to increase firm survival and growth and to improve the capacity of firms to reach foreign markets. Skilled labour is also the means by which workers can sustain their bargaining power with companies that compete with foreign companies on the domestic market. Firms where the share of unskilled labour is high face several difficulties, namely, that of surviving and that of coping with foreign competition, whether in domestic markets or in distant ones.

Third, there is a general trend of increasing concentration over time in various dimensions: (i) increased market concentration; (ii) increased concentration of investments; (iii) increased concentration of skilled labour; (iv) increased concentration of market shares among the most productive firms; (v) increased sigma divergence[48] in GDP among NUTS3 levels, implying that some regions win and others lose; and (vi) increased concentration of exports among fewer exporters. These trends corroborate the idea that global firms drive the overall dynamics. Increased concentration goes hand in hand with reduced rent sharing for workers.

Policy recommendation 1. Excessive concentration is likely to exert excessive market power on companies. As of 2013, France remains a highly regulated economy (see Figure 9.1) that suffers from excessive state control and excessive barriers to entrepreneurship.[49] These features hamper competition by protecting incumbents from competition by new players in the product markets. Hence, the chief policy recommendations are to restore competition in product markets to limit the drawbacks of excessive concentration. Increased market concentration is a problem because it limits production and leads to diminished labour demand and higher markups, and hence higher prices, which in turn reduces final demands and diminishes social welfare. Overall,

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[47] The views and opinions expressed in this chapter are those of Lionel Nesta and do not necessarily reflect the official policy or position of the European Commission, the views of the Austrian Institute for Economic Research, or the views of the other authors of the final report. Lionel Nesta wishes to thank Raphael Chiappini and Benjamin Montmartin for their valuable help in completing this chapter.

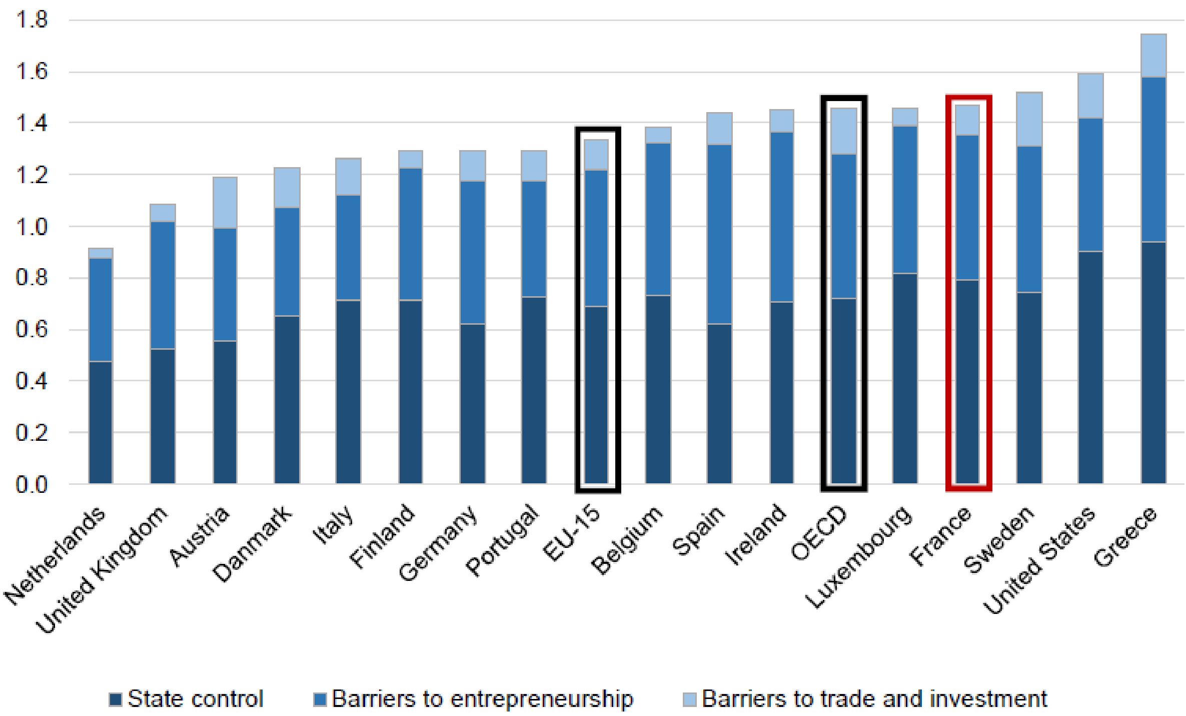
[48] Sigma divergence refers to an increase in the standard deviation of a distribution over time. In this particular space, this means that there are increasing differences in terms of GDP across NUTS3 regions in France.

[49] State control includes public ownership of businesses and state involvement in business operations. Barriers to entrepreneurship include complex regulatory processes, administrative burdens on startups, and regulatory protection of incumbents. Barriers to trade and investments concern explicit barriers to trade and investments and other barriers to trade and investment. See Pratx and Daoudi (2017).

we view Macron's set of reforms as moving in the right direction to cope with this global trend.

The reforms of product market regulation and of the factor markets that are currently under way (Figure 9.1) are viewed as the solution to restore the productive capacity of the country by revitalising its capacity to innovate, to export and to adapt to the new challenges stemming from increased international competition. Following the "simplification shock" of 2013, PACTE (Plan d'Action pour la Croissance and la Transformation des Entreprises) is a new law that aims to reduce both entry barriers and barriers to firm growth. In practice, PACTE consists of a series of measures that simplify, inter alia, the thresholds for number of employees that accompany, and often hamper, firm growth. It also simplifies firm creation, liquidation, and transmission (to third parties) and supports innovation and exports. Altogether, this series of measures should reduce barriers both to entrepreneurship and to trade and investments. Sector-wise, the railway reform aims to open railway transport to competition in France (while not privatising the construction and maintenance of railway infrastructures) to transform the public company into a private company with public equity. This moves one step further towards disentangling a public monopoly. Other sectors, especially in network industries, such as electricity, gas, air transport, post and telecommunication, are not involved in these reforms.

Figure 9.1: Product Market Regulation in major OECD Countries



Sources: OECD data from Pratx and Daoudi (2017)

With increased concentration comes the prospect of increasing wage inequality. With both the CICE and the CIR, the French tax incentive system promotes both ends of the labour market. The former (CICE) allows tax reduction on the basis of the wage bill, applying to workers whose monthly wage rate is below 2,500 euros and who are therefore considered unskilled labour. The latter (CIR) is a tax credit corresponding to 30% of a firm's R&D spending. Since wages constitute the bulk of R&D spending, the CIR can also be viewed as an incentive to hire qualified labour. Hence, in the context of increasing polarisation of the job market, the French tax incentives may reinforce polarisation and thereby wage inequalities.

Insert 9.1. Macron's Structural Reforms in a Nutshell

Macron's set of reforms concerns:

(i) *Investment*. Le grand plan d'investissement of 57 billion euros over a period of years, concerning the four realms of carbon emissions, access to employment, non-price competition through innovation, and the transition to a digital economy.

(ii) *PACTE. The "Plan d'Action pour la Croissance and la Transformation des Entreprises"* is a law that aims to facilitate firm growth and innovation by firms. PACTE is augmented by up to 10 billion euros to support so-called disruptive innovation (Fonds pour les innovations de rupture).

(iii) *Labour market reforms (Ordonnances Travail)* aiming to restore the dialogue within firms by favouring the feasibility of a local, i.e., firm-level, agreement rather than a national one.

(iv) *Vocational and life-long learning*: A national vocational training budget of 15 billion euros was voted for in August 2018.

(v) *Education*: The government intends to halve class size to 12 pupils for grade 1 and grade 2 in poor neighbourhoods (priority education schools), with implementation starting in the 2017-18 school year. Universities will be granted more autonomy to recruit their professors and define their teaching programmes.

(vi) *Reform of unemployment benefits*: the government intends to extend unemployment benefits to all, including self-employed workers and, once every five years, employees who resign.

(vii) *Public spending*: the government's effort to cut public spending by 3 percentage points of GDP by the end of the administration is currently under way.

(viii) *P*ension reform.

(ix) *Tax reform* concerning various aspects, ranging from lowering the corporate tax rate from 33 to 25% to eliminating local residency taxes, reducing the social contribution of employees and transferring to the CSG. The CICE will be generalised as an overall tax reduction on the social contribution of employers.

9.2 Investments

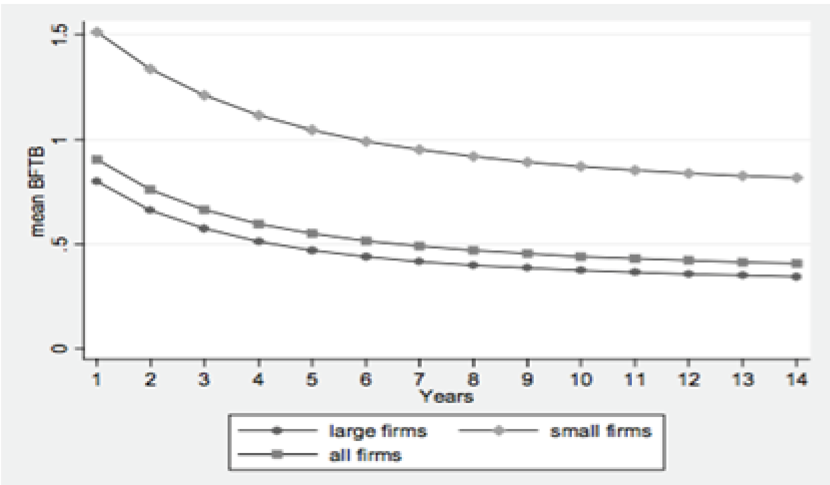
The overall French gross fixed capital formation (GFCF) has been relatively higher than that of its key partners for the past 20 years. This is essentially due to the importance of investment in intangibles (R&D and software and databases). Investments in "machines and equipment" are lower than those in other countries. France invests more than twice as much in intangibles as Germany, although intangibles appear to be the least productive type of investment. Assuming that France invests as much as Germany in terms of magnitude and structure, the calculated scenarios show that if France aligned its investment structure with that of Germany, it could gain up to 3.5% in output. When reducing its investment intensity to the German level, France could even compensate for the loss in output by the gain in a restructured investment portfolio. Hence, France does not suffer from a problem of volume of investments (or investment rate). Rather, it suffers from overinvestment in intangibles.

In designing a fiscal incentive scheme, an important choice to be made by policy makers is between a level-based and an increment-based R&D tax credit system. With a level-based system, any R&D performed is eligible for tax credits, whereas with an increment-based system, only R&D that exceeds a base level is eligible for R&D tax credits. Most countries that have a fiscal incentive scheme opt for volume-based regulation. A specific issue for France is that before 2004, R&D tax credit was purely incremental, and it became purely volume based after the 2008 reform. The cost of tax credit thus increased from less than 500 million in 2001 to more than 6 billion in 2014 (MESR).

In their paper based on Dutch firms, Lokshin and Mohnen (2009) perform a number of policy experiments to examine the relative effectiveness of the incremental changes in fiscal incentives schemes' parameters for stimulating additional private R&D. Based on their experiments, they conclude that the response, especially for large firms, to changes in the first bracket rate in terms of additional R&D is negligible. In other words, changing the value of the R&D tax parameters does not make a great difference in terms of net welfare gains. The authors also discuss the advantage of both policy schemes and claim that volume-based schemes are inefficient because they involve large transfer costs by supporting pre-existing R&D that would have been performed even in the absence of R&D tax credits. This weakness is not shared by incremental R&D tax credit schemes.

Another result of this study concerns the effect of R&D tax credit according to the size of companies. To perform that experiment, the authors use the well-known "bang for the buck" (BFTB) or "cost effectiveness ratio" approach, which compares tax expenditures with the additional amount of R&D spending by private firms. In practice, the BFTB is the ratio of the amount of R&D generated by the R&D tax incentives to the net tax revenue loss (also called tax expenditures). Figure 9.2 represents the authors' estimations of BFTB for SMEs and large firms.

Figure 9.2: "Bang for the buck" (BFTB) effect of R&D tax credit by company size



Source: Lokshin and Mohnen (2009)

Figure 9.2 highlights a stronger effect of R&D tax credit on SMEs than on large firms. More importantly, although the authors find a leverage effect for SMEs (i.e., a BFTB over 1) for up to 6 years, they never find such a leverage effect for large firms (i.e., a BFTB under 1). In their recent paper, Montmartin et al. (2018) highlight two main interesting results concerning the effect of the French R&D tax credit in France. First, after comparing the efficiency of various R&D policy instruments in France, they find no evidence of a significant effect of R&D tax credit on privately financed business R&D. Second, by testing for structural breaks in the effect of policies, they obtain evidence that the passage from a purely incremental scheme to a purely volume-based scheme for the French tax credit modified the response of firms to this fiscal incentive. Specifically, they find a strong negative change in the impact of tax credits on R&D investment between the first period (2002-2005) and the second (2006-2011). This corroborates the idea of Mohnen and Lokshin that a purely volume-based scheme generates more windfall effects than an incremental scheme.

Policy recommendation 2. The generosity of the French tax cut on R&D spending must be questioned. Although we encourage policies that aim to encourage investments in R&D to encourage firms to enter into non-price competition, the sharp reduction in corporate taxes proportional to total investment in R&D gives rise to opportunistic behaviour by firms to artificially increase their overall R&D investments. This, in turn, significantly decreases both the efficiency of the R&D tax credit and the productivity of the R&D itself. The efficiency of the CIR has been challenged in a series of statistical evaluations. First, tax reduction corresponding to the marginal increase in R&D has been shown to be more efficient in leveraging R&D investments. Second, for knowledge to become more diffused across public and private research organisations, a tax reduction corresponding to public and private research collaborations could be envisaged.

9.3 Human Capital

One of the main conclusions of chapters 6 to 8 is that the workforce composition of firms is one of the most important factors influencing countries' competitiveness. Indeed, we demonstrate that skilled labour can help protect against competition from China and other low-wage economies; positively influences firm survival; and allows firms to record higher exports, sell more products and compensate for cultural differences. As a consequence, increasing the qualifications and skills of the French labour force must be one of the highest priorities of the French government to improve French non-price competitiveness. In fact, France lags in terms of the skills developed by its workforce compared to other developed economies.

9.3.1 The labour market and employment protection legislation

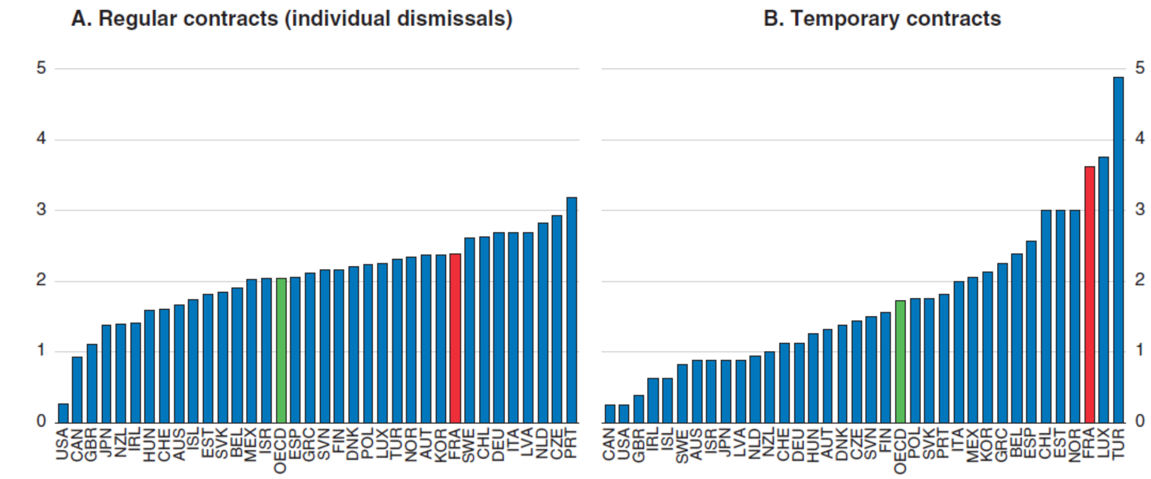
The labour market in France appears to be dual. Open-ended contracts represent only 15% of new job openings in 2015, and the remainder 85% concern fixed-term labour contracts. Moreover, the transition rate from fixed-term to open-ended contracts is one of the lowest among the OECD countries (approximately 10%), and these fixed-term contracts hamper access to open-ended contracts, essentially for youths. One reason is that regulatory constraints are relatively high in France (see Figure 9.3). Employment protection legislation (EPL) comes at a cost. First, in a recent study, Fialho (2017) shows that dismissal costs for open-ended contracts significantly increase workers' chances to obtain a permanent contract (for skilled workers only). Fixed-term contracts increase the initial probability of finding a job but do not act as a stepping-stone to the primary labour market for low-skilled workers. Hence, EPL prohibits job creation, whereas fixed-term contracts fail to act as bridges for less educated individuals. Combining an improvement in the quality of labour with training reform and reducing dismissal costs would be particularly effective in increasing the use of permanent contracts and productivity and should make a reform package more attractive to employees. This seems all the more reasonable in a context in which, due to international competition stemming from lower-wage countries (Eurozone countries, the BRIICS), wage moderation cannot reasonably be considered a possible policy solution. If wages cannot reflect labour quality, then the quality of labour can reflect wages.

In what follows, we display evidence of the relative quality of labour in France from an international perspective in terms of technical skills and managerial and cultural skills.

Figure 9.3 Employment Protection Legislation in France

Figure 31. **Employment Protection Legislation appears to be restrictive overall**

Index scale of 0 to 6, from least to most restrictive, 2013[1]



1. Or most recent available year.

Source: OECD (2017), *Employment Protection Legislation Indicators Database.*

StatLink http://dx.doi.org/10.1787/888933577496

Source: Employment Protection Legislation Indicators Database in OECD (2017)

9.3.2 Lack of technical skills

First, as depicted in Figures 9.4 and 9.5, we observe that the score obtained by French adults in the PIAAC Survey in Literacy and Numeracy is below the average of OECD countries. Indeed, France is ranked 19th (of 26) in terms of numeracy and 21st (of 29) in terms of literacy, far behind Japan (first in both criteria). If we consider the labour force with a master’s degree, the picture is slightly less deceiving, with France ranking 12th in literacy and 13th in numeracy with an average score above the OECD average. Furthermore, as displayed in Table 9.1, France is characterised by strong inequalities in terms of the skills of the labour force according to qualifications and parents’ educational attainment. We can observe that the percentage of adults who score at or below level 1 in literacy and/or numeracy is higher than the OECD average for lower than upper secondary education (64.1% for France and 54.2% for the average of OECD countries) and for upper secondary education (31.7% against 26.4%), whereas the percentage of the labour force with a tertiary education is below the OECD average (8.5% against 10.6%). These strong inequalities in education are also stressed by the results of the PISA survey. Indeed, approximately 17% of the variance in the PISA reading score for children aged 15 years is explained by the family environment in France compared with only 12% for the OECD average. These social inequalities that shape French human capital beginning in primary school are not erased in secondary school, as emphasised in Figures 9.4 and 9.5.

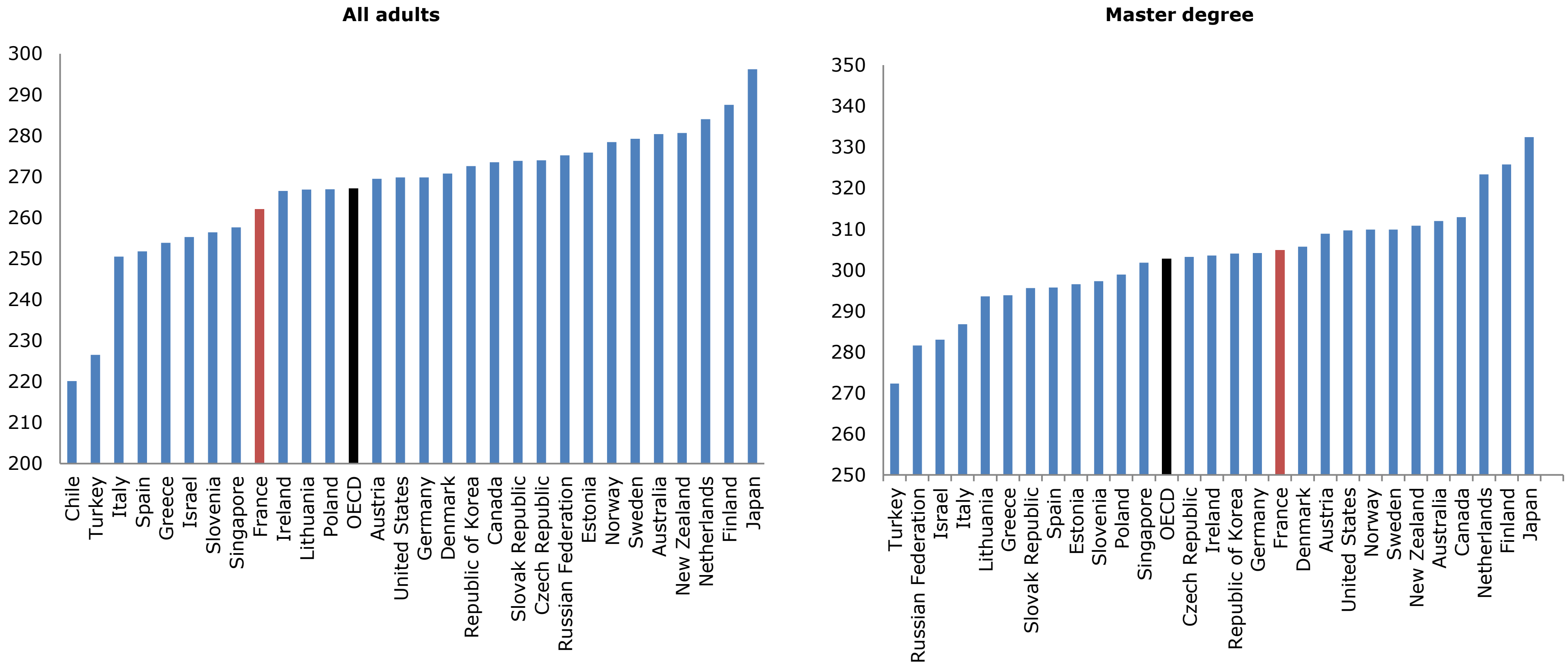
Second, the skills obtained during initial education can rapidly become obsolete with technological progress. Adaptation of the labour force to innovations is necessary to capture productivity gains. This requires easy access to training for each employee. According to the Adult Education Survey from Eurostat, the rate of access to training increased to 48% in 2015 (compared to 45% in 2010), slightly above the EU average of 40% and far above the rate for Germany (38%). However, access to formal and informal training remains strongly unequal. Indeed, the participation rate not only is higher for high-skilled workers than for low-skilled workers but also depends on the status of the labour force. Indeed, the participation rate is far higher for employed persons (59%) than for unemployed persons (44%). This illustrates the difficulty for unemployed persons in obtaining access to training, which distances them from the labour market.

This diagnosis highlights the weaknesses of France in terms of the quality of its workforce, which increases its non-price competitiveness and decreases its potential productivity and trade gains. Structural reforms are, therefore, necessary to improve the skills of the French labour force.

Policy recommendation 3. Primary and secondary education must be improved to contain the reduction of the relative position of French students in international comparison. The first issue that must be addressed is learning achievement inequalities. One way to solve the problem is to focus means on primary school, as we observe that secondary and tertiary schools fail to decrease inequalities. Therefore, the implementation of a split in first-year primary school classes in poor areas (REP+) launched in 2017 by the government is a measure that moves in the right direction. However, it should not be at the expense of other areas and should be reflected by an increase in the number of teachers and a real decrease in the teacher/student ratio in France. Furthermore, the measure should also be extended to other areas (e.g., REP or other poor areas) to achieve a decrease in school inequalities. Finally, teachers should be offered attractive conditions, for example, in terms of wages, if they decide to work in poor areas. This could create an optimal allocation of resources because the best teachers with stronger abilities to adapt to the different needs of pupils will work in poor areas. Furthermore, if the focus on primary school should be a priority for the government, then tertiary education must also to be fostered to achieve the skills upgrading of the French labour force. It is therefore important for the government to increase public spending on tertiary education because the number of students has increased greatly over the past ten years (+18% between 2007 and 2017), and the budget devoted to tertiary education is stagnating (+8% over the past ten years). The Parcoursup reform is not sufficient to achieve the skills upgrading of students.

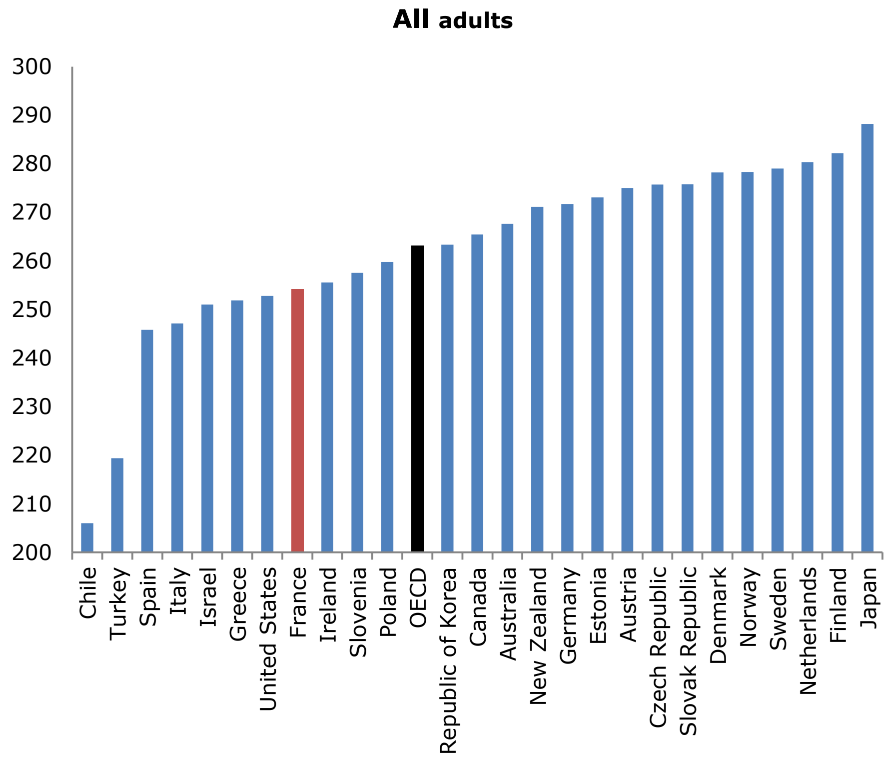
Policy recommendation 4. Access to training via life-long learning must be facilitated for both employed and unemployed people. This implies a reform of the actual personal training account (Compte Personnel de Formation – CPF), which appears far too complex. The reform presented by the French minister of labour, Muriel Penicaud, in March has strong implications for French labour markets. First, systematic certification is proposed as a means to increase the quality of training for both employees and unemployed individuals. Second, the transformation of the personal training account (CPF) to be credited in euros rather than hours will decrease inequalities in training since training hours are more expensive for white-collar than for blue-collar workers. Our own assessment leads us to remain sceptical about the reform. First, this personal account, amounting to 500 euros for employees and 800 euros for unemployed people, remains low, especially because training prices are increasing. Second, the reform in itself could be insufficient, and other forms of training should be developed, especially online training, which currently remains underdeveloped.

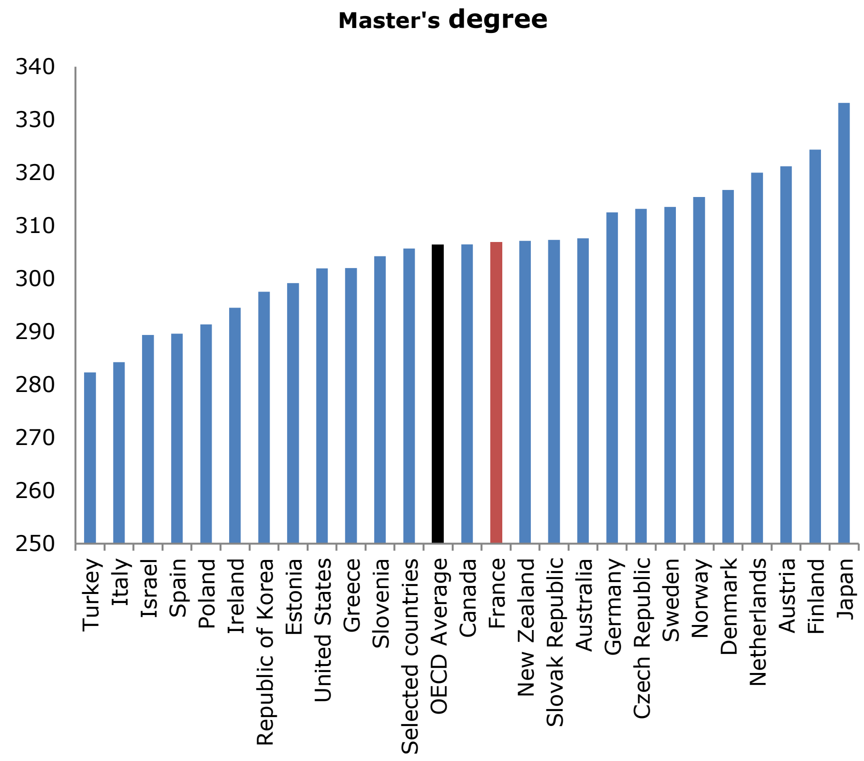
Figure 9.4: Results of the PIAAC survey in Literacy for all adults (left) and for adults with a Master's degree (right)



Source: OECD PIAAC survey, 2012

Figure 9.5 Results of PIAAC survey in Numeracy for all adults (left) and for adults with a Master's degree (right)





Source: OECD PIAAC survey, 2012

There is a persistent decline in the performance of human capital in terms of competencies. International comparisons reveal the poor performance of the French labour force compared to the average of other OECD countries. This diagnosis highlights the weakness of France in terms of the quality of its workforce, which increases its non-price competitiveness and decreases its potential productivity and trade gains. First, the PISA investigation, which assesses students' skills in secondary education, reveals the poor performance of initial training in France. Second, the OECD surveys also reveal the rapid obsolescence of the skills acquired in initial training, indicating a life-long learning problem. Third, and more generally, international comparisons show that there is a lack of managerial competencies within French companies that extends to the poor quality of the social dialogue. Structural reforms are, therefore, necessary to improve the skills of the French labour force. One key explanation for this is inequality in access to education due to social background.

Table 9.1 Percentage of adults who score at or below level 1 in literacy and/or numeracy by socio-demographic characteristics (in percentage)

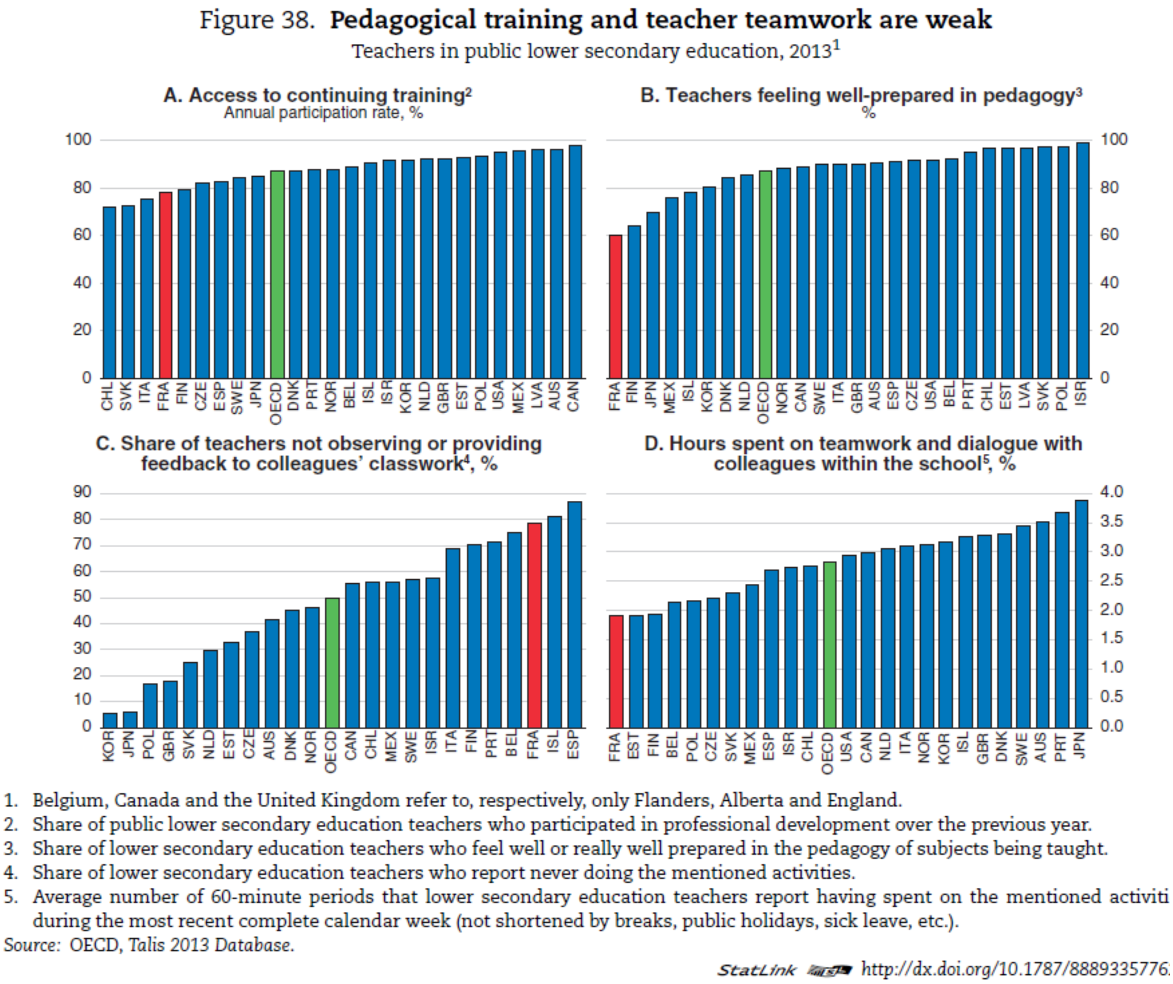
	Educational attainment			Parents' educational attainment		
	< Upper secondary	Upper secondary	Tertiary	Neither parent up. secondary	At least one parent up. secondary	At least one parent tertiary
Australia	43	20	10	27	18	10
Austria	44	17	6	32	16	10
Canada	67	30	15	39	24	15
Chile					96	73
Czech Republic	45	18	3	34	16	6
Denmark	45	20	7	30	19	9
England (UK)	48	25	13	43	20	12
Estonia	44	22	10	26	17	10
Finland					38	20
Flanders (Belgium)	48	21	4	29	12	5
France	64	32	9	43	22	9
Germany	67	25	8	48	22	11
Greece	55	34	19	42	27	19
Ireland	55	26	10	36	22	12
Israel	72	48	22	57	32	20
Italy	56	24	15	45	22	16
Japan	33	10	3	16	7	4
Korea	59	23	6	30	12	6
Netherlands	39	13	4	23	11	5
New Zealand	45	21	10	29	16	11
Northern Ireland (UK)	50	24	9	40	22	8
Norway	34	18	7	28	16	9
Poland	58	34	9	42	23	10
Slovak Republic	50	13	4	33	11	4
Slovenia	66	33	10	48	26	9
Spain	59	29	12	42	23	13
Sweden	43	16	7	25	14	10
Turkey	74	40	25	62	35	25
United States	78	38	11	60	29	17
OECD average	54	26	11	38	21	12

Source: OECD Survey of Adult Skills, 2016

Policy recommendation 5. As the number of students has strongly increased over the past ten years, and the budget devoted to tertiary education is stagnating, tertiary education must be fostered. It is therefore important for the government to increase public spending on tertiary education. The *Parcoursup* reform that is currently under way is far from sufficient to achieve the skills upgrading of students.

Policy recommendation 6. Beyond the supply of human capital, skill upgrading also concerns the series of teachers from primary through tertiary education (Figure 9.5). Access to training via life-long learning must be re-thought to encourage innovation in teaching and interactions among teachers and disciplines.

Figure 9.5 Pedagogical training and teacher teamwork in France



Source: OECD Labour force statistics in OECD (2017)

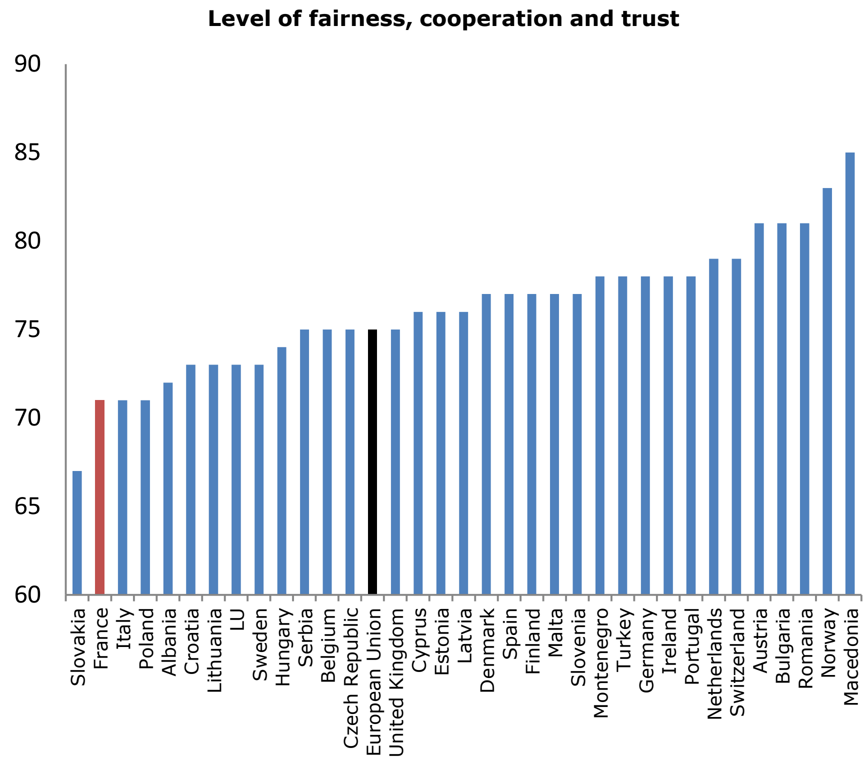
9.3.2 Lack of managerial skills

Second, this lack of skills of the French labour force could result in bad managerial practices that increase French non-price competitiveness. Indeed, as shown by Bloom et al. (2018), better-managed firms are more likely to export, to export a larger number of products, to export to a larger number of countries, to earn more profits and to display higher-quality products. Therefore, the quality of managerial practices is important for firms' competitiveness. In this area, France lags behind other developed economies.

Indeed, the quality of management index, developed by Eurofound and derived from the European Working Conditions Survey, reveals that France displays a very low value for this index compared to other European countries (left panel of Figure 9.5). Similarly, France is second lowest in the level of fairness, cooperation and trust at work reported by its own workers (right panel of Figure 9.5). Finally, as reported in the World Management Survey of 2016 from the World Economic Forum, France is also characterised by poor relations between employers and employees and is ranked 25th of the 27 OECD countries studied.

These cultural traits are, almost by definition, structural. It is therefore extremely difficult to modify them in the short term, whereas the policy tools needed to intervene are themselves rather difficult to develop. Our understanding is that lack of managerial skills and lack of trust may be related to a lack of mutual understanding within firms. Therefore, we advance our policy recommendation. First, we observe that economic literacy can be significantly improved in France. As shown in Figure 9.6, although France is ahead of neighbouring countries, such as Spain and Italy, it lags behind most developed economies. Awareness of the rudimentary principles of finance and economics could improve the social dialogue in France.

Figure 9.5 Quality of Management Index (left) and level of fairness, cooperation and trust Index (European Working Conditions Survey, Eurofound, 2015)



Source: European Working Conditions Survey, Eurofound, 2015

Figure 9.6: Economic Literacy in France and in OECD Countries

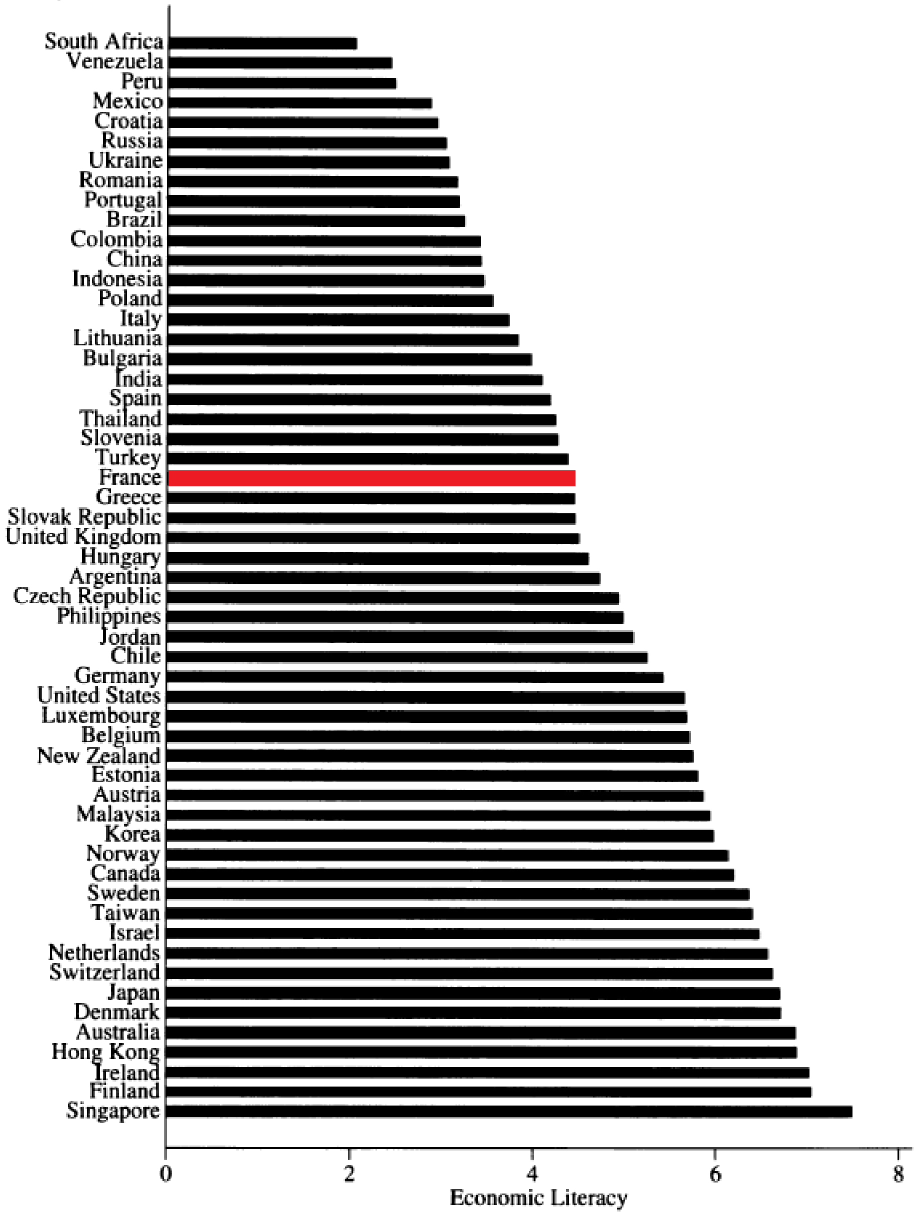


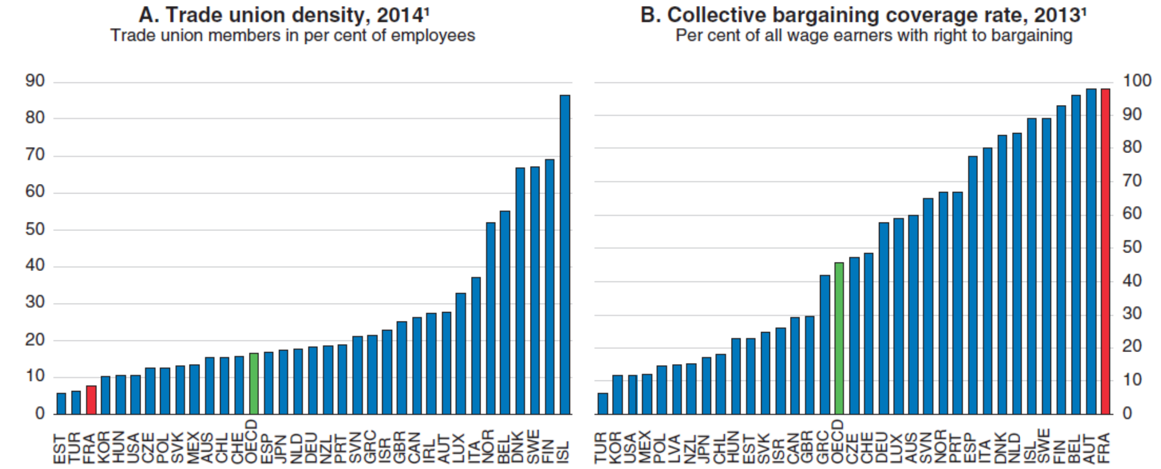
Fig. 1. *Economic Literacy Around the World*

Source: IMD World Competitiveness Yearbook in Jappelli (2010), highlighted by the author.

Second, the significant gap between union density and the coverage rate of collective bargaining is striking. This is very likely to yield conflictual relationships between employees and managers/stakeholders. Although trust in unions is high overall, many employees say that the unions fail to understand their concerns. A 2008 reform is intended to improve participation in the elections of worker representatives and trust while reducing the average number of unions in individual firms (Askenazy and Breda, 2017). The reform requires unions to achieve 10% in elections to be considered representative and to be allowed to negotiate. Increasing union density will increase representativeness and enhance accountability while favouring coalitions and incentives to seek compromises.

Figure 9.6: Unionisation and coverage rate in France and in OECD Countries

Figure 32. **Unionisation is weak, while coverage of collective agreements is pervasive**



1. Or latest year available.

Source: OECD (2017), *OECD Labour Force Statistics Database*; Amsterdam Institute for Advanced Labour Studies (2017), *ICTWSS Database*.

StatLink http://dx.doi.org/10.1787/888933577515

Source: OECD Labour force statistics in OECD (2017)

Policy recommendation 7. In addition to improving tertiary education, efforts to improve managerial practices and economic literacy must be performed, as France performs rather poorly in both of these areas. Although we are unsure of how to improve economic literacy, greater access to economic literacy could improve the social dialogue, management practices and awareness of the basic principles of a market economy. Moreover, substantially increasing union density should facilitate social dialogue by making unions more oriented towards seeking compromise.

9.4 The Search for a Comprehensive Strategy

More fundamentally, France needs to decide between two broad options, which we label large versus the small economy strategy (or Ricardian strategy). In the latter strategy, France chooses to become an important yet small player in the global value chain. In following such a strategy, France will not specialise in a particular industry or sector. Rather, it will specialise in transversal activities that are pervasive across sectors, for example, high-technology services such as research and development, engineering, and marketing. In the former strategy (large economy), France will commit to a given specialisation in key industries.

Policy recommendation 8. France must re-industrialise. First, manufacturing represents the bulk of investment in machines and equipment. Hence, re-industrialising is tantamount to modernising the supply side of the economy. Second, manufacturing industries represent more than 70% of overall private R&D investments and 70% of exports. If the country wishes to recover its (non-price) competitiveness and its previous account balance, it must contain de-industrialisation and identify industries where a clear comparative advantage exists. Third, manufacturing sectors are important consumers of services, whether high-technology (R&D services, marketing, engineering, etc.) or low-technology (mainly back office) services. Re-industrialisation will increase private demand for such services. Fourth, France must keep its strategic productive competencies in-house. Although the long-term consequences of the loss of productive competencies may be detrimental to upstream R&D activities, we believe that separating production from such upstream activities with high value added may further weaken the

French economy. Fifth, investments in sectors that generate externalities by diffusing over the whole productive system must be encouraged. We mainly mean sectors such as energy, transportation, aeronautics, pharmaceuticals and, more generally, health. The absence of a strong French actor, and even a European leader, in digital business is likely to be harmful in the future.

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