Accounting for technology, trade and final consumption in employment: an Input-Output decomposition*

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Abstract

What are the driving forces of changes in employment in France over the last thirty years and how can we explain skill-bias changes in employment? Based on Input-Output analysis we provide a decomposition of changes in employment between the effect of final consumption, technology and trade, in order to assess these effects on employment by skill level. Our analysis builds on textbook methodologies of structural decomposition, but innovative data: Input-Output tables both in current and previous year prices, from 1980 to 2010 based on the new ESA 2010 concepts. The Input-Output approach we develop is nevertheless limited as it cannot reveal long-term underlying links between technology, trade and final consumption. However since we assess short-term changes in employment, this partial equilibrium approach is less of an issue. Unlike previous works on the US, the UK and some European countries, we find no evidence of labour market polarization. However on a short-term basis, we find skill-bias effects of technology on employment, whereas trade and final consumption have limited skill-bias. The development of high-technology manufacturing and R&D over the last thirty years contribute the most to this skill-biased technological changes. Quite strikingly trade's overall effect on employment is positive for every level of skill.

Keywords: Input-Output Analysis, Employment, Trade, Technology, Skill bias
JEL codes: C67, D57, F66, O33

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1 Introduction

In a context of marked technological change and increasing globalisation, there are ongoing debates over the relative influence of trade and technology on employment in advanced economies, and more specifically their effects on the structure of employment.[1] In the case of France, from 1982 to 2010, labour productivity has increased by 52% in real terms and trade openness by 5 points of GDP, while the share of high-skilled workers in the total employment has doubled from 8 to 17% and the share of low-skilled workers decreased from 24 to 21%.

While France displays skill-biased changes in employment, there are evidence of labour market polarization in other advanced economies, i.e. increase in both high-skilled and low-skilled employment at the expense of middle-skilled workers. This phenomenon is highlighted in the US (Autor and Dorn, 2013; Autor, Dorn, and Hanson, 2013), in the UK (Goos and Manning, 2007) and in other European countries (Goos, Manning, and Salomons, 2009, 2011, 2014; Michaels, Natraj, and van Reenen, 2014). Based on the routinization hypothesis of Autor, Levy, and Murnane (2003), technology is considered as the main determinant of employment polarization, as new technologies are substitute for routine jobs which are concentrated in the middle of the skill distribution. To a lesser extent, trade and more specifically offshoring are also considered as candidates to explain changes in employment structure (Goos, Manning, and Salomons, 2011; Foster, Stehrer, and de Vries, 2012; Zeddies, 2013), as international competition can reallocate labour to industries using skill in different proportions. A last determinant is final consumption (Gregory, Zissimos, and Greenhalgh, 2001; Autor and Dorn, 2013; Goos, Manning, and Salomons, 2014; Los, Timmer, and De Vries, 2014): consumer preferences can switch to goods and services whose labour content may differ.

The goal of this paper is to understand the nature of employment changes over the last thirty years in France. More specifically, we try to acknowledge whether France experienced only skill-bias changes in employment or if there is evidence of polarization effects that are offset by other effects. Based on Input-Output Analysis, we provide a breakdown of changes in employment by skill and production between the effects of final consumption, trade and technology (defined here as the use of production factors). Few papers in the literature take into account the effects of these three channels altogether. But a part of this literature does so Input-Output analysis: Gregory, Zissimos, and Greenhalgh (2001) for the UK and Los, Timmer, and De Vries (2014) for both advanced and emerging economies. Our analysis builds on textbook methodologies of structural decomposition (Miller and Blair, 2009, Chapter 13) but innovative data: Input-Output tables both in current and previous year prices, from 1980 to 2010, based on the new ESA 2010 concepts.

[1] See Harrison, McLaren, and McMillan (2010) for a detailed review of literature on the subject

The Input-Output approach we develop is nevertheless limited as it considers only short-term effects and disregards long-term underlying links between technology, trade and final demand. However assessing short-term changes in employment makes this partial equilibrium analysis less of an issue, as it provides a comprehensive evaluation of first round effects altogether. Further our evaluation also allows comparisons of the different mechanisms and can be used as a benchmark for econometric approaches trying to capture also the long-term effect of technology, trade and final consumption on employment.

Our main findings are that on a yearly basis, technology shows marked skill-bias, whereas trade and final consumption have limited skill-biased effects. We find no evidence of polarization effects of technology, trade or final consumption. The development of high-technology manufacturing and R&D over the last thirty years mainly contribute to this skill-bias change in employment. Finally, unlike many papers we find a positive effect of trade on employment at every skill level, as the positive effect of exports offsets the negative effect of offshore outsourcing.

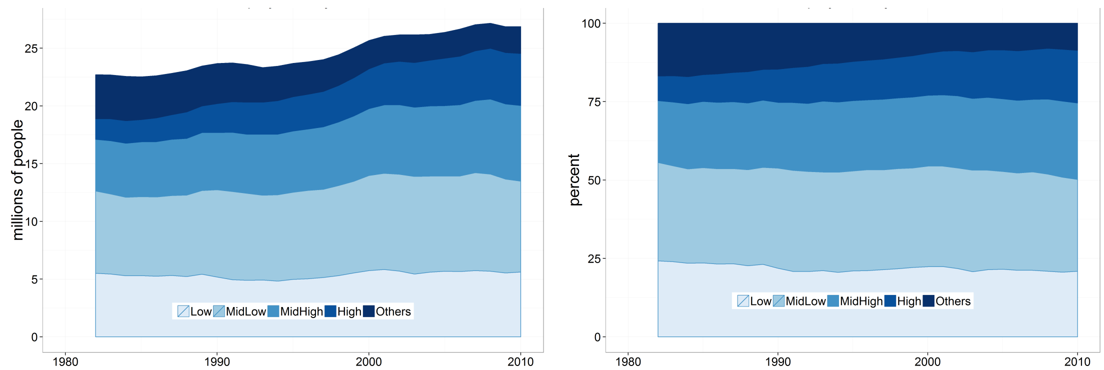
In the remainder of this paper, section 2 reviews the stylized facts behind the present debate, section 3 analyses the labour content of final demand (the framework on which our decomposition is built), section 4 exposes the method we use to decompose changes in employment and section 5 provides an analysis of our results. The construction of the datasets, both Input-Output tables and employment are documented in appendix A and B.

2 Driving forces of employment changes

We decompose employment in five categories: high skill, middle-high skill, middle-low skill, low skill and others (including in particular farmers and self-employed). The structure of employment in France changed over the period 1982-2010. The share of higher skilled workers[2] steadily increased, especially for the highest skilled group: its share markedly increased from 8% to 17% (Figure 1). The share of low-skilled workers slightly decreased over the same period from 24% to 21%. As for the skill group *others*, their share in the total employment dramatically dropped from 17% to 9%, in line with the decline of the agricultural industry.

Three channels are traditionally examined to explain employment changes and particularly changes by skill levels: technology, trade and final demand.

[2]See Appendix B for details about how we define skill levels.



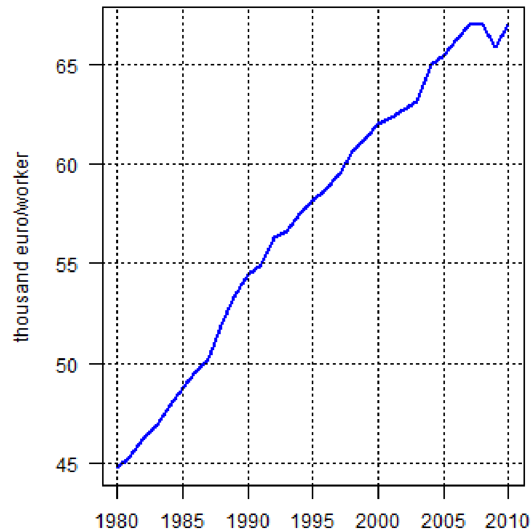
Source: Insee, LFS and national accounts; authors' calculations.

Figure 1: Employment by skill level

2.1 Technology effects

Over the last three decades, technology has dramatically changed. Apparent labour productivity has been steadily increasing (+52% in real terms between 1980 and 2010, Figure 2). The theoretical impact of technology on aggregate employment is ambiguous. A labour saving innovation can be either used to address higher demand – and hence increase employment – or reduce payroll. Using micro-data on firms in concrete industry, Morin (2015) analyses the effects of electricity, a labour saving technology, during the Great Depression and finds on a microeconomic scale that firms have taken advantage of the development of electrical power to reduce employment and payroll.

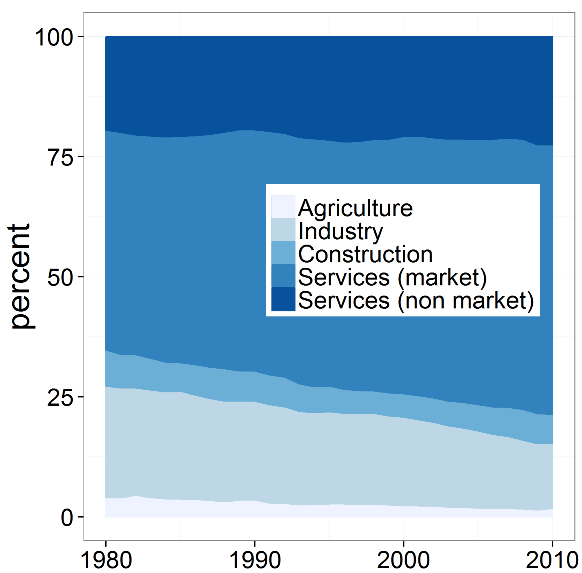
Technological change can also influence job composition and imply important reallocation of labour. Autor, Katz, and Krueger (1998); Autor, Levy, and Murnane (2003); Maurin and Thesmar (2004); Los, Timmer, and De Vries (2014) find evidence of skill-biased technological change, i.e. technology development associated with an increasing demand for high- relative to low-skilled jobs. The *routinization hypothesis* of Autor, Levy, and Murnane (2003) states that new technologies such as computers are substitute for routine tasks – accomplished by following explicit rules or step-by-step procedures – and complementary to nonroutine cognitive ones. Maurin and Thesmar (2004) rely on a similar hypothesis to explain skill-biased technological change in France: new technologies increase the demand for jobs that require constant adaptation to change, while decreasing the demand for jobs that can be programmed in advance. In addition to changes in technology by sector, a composition effect may imply skill bias at the aggregate level as the share of services in value added has significantly increased over the last thirty years to the detriment of the manufacturing sector (Figure 3).



Source: Insee, national accounts.

Note: Labour productivity is defined as the ratio of value added on total domestic employment (in number of persons).

Figure 2: Labour productivity in France



Source: Insee, national accounts.

Note: Non market services comprise public administration, education, human health and social work activities. Market services comprise the remaining services.

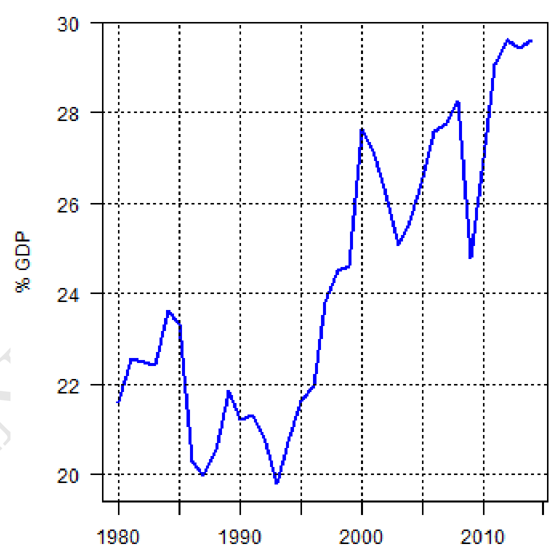
Figure 3: Value added by industry in France

One particular aspect of skill-biased technological change is labour market polarization, i.e. a decline in middle skill labour relative both to skilled and unskilled one. Goos and Manning (2007) argue that routinization as described by Autor, Levy, and Murnane (2003) is the main factor of job polarization, as routine jobs tend to be concentrated in the middle of the skill distribution, and nonroutine cognitive and manual ones in respectively the higher and lower part. On both theoretical and empirical grounds, this labour market polarization is mainly highlighted in the US (Autor and Dorn, 2013; Autor, Dorn, and Hanson, 2013; Morin, 2014), but also in the UK (Goos and Manning, 2007) and some European countries (Goos, Manning, and Salomons, 2009, 2011, 2014; Michaels, Natraj, and van Reenen, 2014).

2.2 Trade openness and offshoring

Trade is also a potential driver of labour market changes. In France, the trade openness ratio has gained 5 points since 1980 (Figure 4).

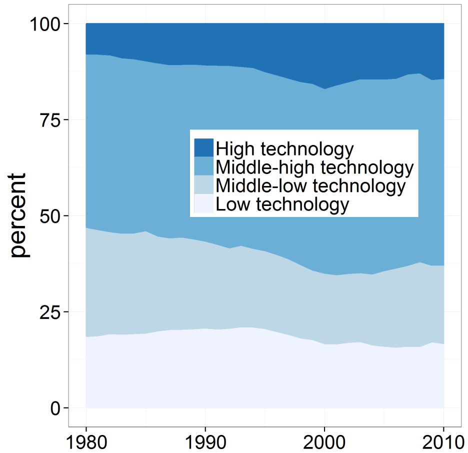
Like technology, trade has opposite effects on aggregate employment. On the one hand, foreign demand can foster domestic employment. On the other hand foreign economies can also supply final and intermediate demand, reducing the domestic market shares.



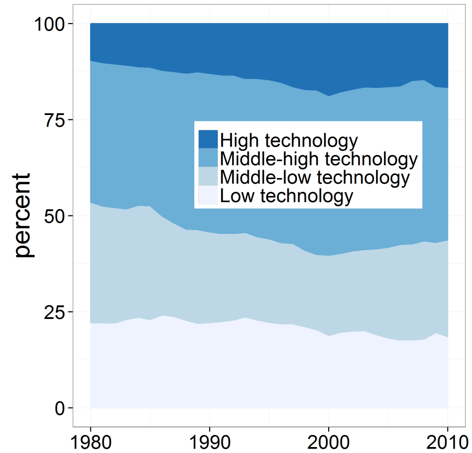
Source: Insee, national accounts.

Note: Trade openness is defined as the sum of total exports and imports on GDP.

Figure 4: Trade openness ratio in France



(a) Exports



(b) Imports

Source: Insee, national accounts; authors' calculations

Note: High technology comprises pharmaceutical, computer, electronic and optical, air and spacecraft. Middle-high technology comprises cheminals, electrical equipment and machinery, motor vehicles. Middle-low technology comprises rubber, plastic, coke and refined petroleum products,ships and boats. Low technology comprises food, beverage, textile, furniture.

Figure 5: Level of technology in manufacturing exports and imports in France,1980-2010

Further, trade can foster reallocation of workers and production to other industries through relative competitiveness. Being more exposed to international competition, a more open economy can specialize in less exposed sectors (e.g. personal services) or where it has a comparative advantage (for instance in terms of production inputs as predicted by the Heckscher-Ohlin theorem). Trade can thus reallocate labour to sectors using skill in different proportions. For instance, the structure of trade in France – especially manufacturing exports – has gradually incorporated more technological content (Figure 5). The share of exports in high-technology manufacturing goods raised from 7.9% to 14.3% between 1980 and 2010, the share of imports in such goods from 9.5% to 16.6%. As high-technology requires more skilled workers, this upgrade in manufacturing exports could imply skill-bias changes in employment.

When analysing the effect of trade on employment, the emphasis is usually put on offshoring (production and jobs are moved abroad (Blinder, 2009)) or offshore outsourcing (moved to a different firm abroad). As information and communication technology develop, and transportation costs and trade barriers are reduced, firms have more opportunities to subcontract to foreign lower-cost firms. A classic example of this phenomenon is presented by Linden, Kraemer, and Dedrick (2007). They analyse the supply chain for Apple's iPod, with Japan providing the most expensive electronic inputs, China assembling them, and the US designing and distributing the final product. Although China exports iPods to the US for $150, its national value added for assembling the electronic inputs represents a few dollars at most. The Input-Output framework is the ideal way to describe the increasing complexity of the value chain due to such outsourcing. Strauss-Kahn (2004); Foster, Stehrer, and de Vries (2012); Zeddies (2013); Ludwig and Brautzsch (2014) use it to measure the effects of trade and offshoring on employment.

Trade effects on skill demand is usually considered smaller than technology (Feenstra and Hanson, 1999; Gregory, Zissimos, and Greenhalgh, 2001; Goos and Manning, 2007), or not significant (Blinder, 2009; Goos, Manning, and Salomons, 2009, 2014; Michaels, Natraj, and van Reenen, 2014). However Krugman (2008) advocates on theoretical grounds that trade may have been recently a more important driver of employment changes than technology. Empirical analyses also assess a significant negative impact of trade on employment changes in developed economies (Autor, Dorn, and Hanson, 2013) and even a job polarization effects of trade (Zeddies, 2013) and offshoring (Goos, Manning, and Salomons, 2011; Foster, Stehrer, and de Vries, 2012), since routine jobs – and hence middle-skilled jobs – tend to be more offshorable. Michaels, Natraj, and van Reenen (2014) finds that trade openness is associated with polarization, but not when they control their estimates for R&D, suggesting that trade is not exogenous to technology but indirectly impacts skill demand through new technologies.

2.3 Final demand

Another determinant of changes in employment is final demand. Gregory, Zissimos, and Greenhalgh (2001) and Los, Timmer, and De Vries (2014) show that changes in final consumption are the main determinant of changes in employment. The effect of consumption is also considered by Autor and Dorn (2013). In their model, it is the combination of preferences with technology which explains labour market polarization.

Like trade, final demand cannot be considered exogenous to technology. The overall increase in consumption parallels that of income and mechanically scales up labour demand for all skill levels. The increase in income per capita is driven by productivity gains, i.e. technology. Aside from this income/productivity per capita effect, changes in the population size and structure also scale-up (or down) final domestic consumption. Contrary to the previous effect stemming from productivity gains, this demographic effect is purely linked to final demand.

In addition, structural effects may be at play. The rational for this structural effect is twofold. First there can be changes in relative prices to which demand reacts. Also, preferences can switch from products to others as explained by *Engel curves*: as incomes grow, relative demand tends to shift to superior goods and services whose labour content may differ. This mechanism is used to explain labour market polarization in Autor and Dorn (2013) and Goos and Manning (2007). For instance, as displayed in figure 6, the share of services in the household consumption has dramatically increased between 1982

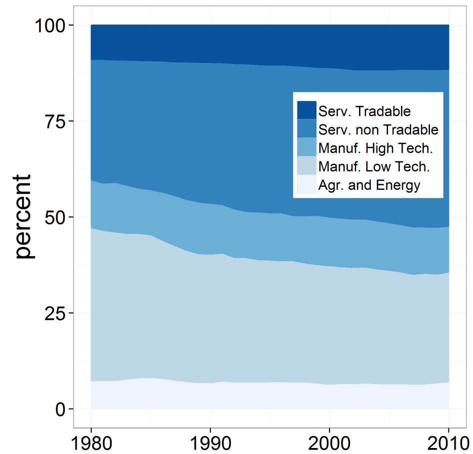


Figure 6: Consumption structure
Source: Insee, national accounts; authors' calculations

and 2010 (from 31 to 41% for non-tradable services and from 9 to 11% for tradable ones), at the expense of low-technology manufacturing products (from 40 to 29%).

3 A preliminary investigation: the labour content of final demand

As underlined in the previous section, the skill structure of employment changed over the last 30 years. In this preliminary investigation, we introduce the first Input-Output elements to analyse employment changes by skill level [3].

3.1 Defining the labour content of final demand

From the Input-Output framework, we have for every year[4] the following equilibrium and division between imported and domestic shares:

$$P + M = IC + FD \quad \Rightarrow \quad \begin{cases} P = IC^d + FD^d \\ M = IC^m + FD^m \end{cases} \tag{3.1}$$

with P, M, IC, FD respectively the vectors of production, imports, intermediate consumption, and final demand (vectors of length p, with p the number of products).

[3]Employment changes are expressed in terms of headcounts and not full-time equivalents (FTEs)
[4]The time index is omitted for simplification.

We denote $\mathbf{A}$ the matrix of technical coefficients, such that $IC = \mathbf{A}P$ (hence $\mathbf{A}$ is the matrix of intermediate consumption of each product (in lines) for the production of all products (in columns) divided in columns by the production of these products).

The (diagonal) matrix of domestic shares for each demand is denoted $\mathbf{S}^z$ with z the corresponding demand, such that $FD^d = \mathbf{S}^{FD}FD$ is the final demand supplied by domestic production (and $I - \mathbf{S}^z$ is the imported share).[5]

We can then write:

$$P = (I - \mathbf{S}^{IC}\mathbf{A})^{-1}\mathbf{S}^{FD}FD = \mathbf{R}\mathbf{S}^{FD}FD \quad (3.2)$$

Let N denote a vector of employment detailed by product and workers' skill level. Hence N is a vector of length $q \times p$, with p the number of products and q the number of skill groups. We define a matrix T such that:

$$N = \mathbf{T}.VA \quad (3.3)$$

with VA the vector of value added. $\mathbf{T}$ is a matrix of skill-use coefficients. More precisely, it is a concatenation of diagonal matrices for each skill where the diagonal elements are the level of employment of the corresponding skill used for each production divided by the corresponding value added.

For each product p, the value added of p is equal to the production of p minus the intermediate consumption used to produce it.

$$VA_p = P_p - \sum_{i=1}^{p} a_{i,p}P_p \quad (3.4)$$

with $a_{i,p}$ the intermediate consumption of a product i required for the production of p, divided by the production of p, i.e. the coefficients of matrix ${}^t\mathbf{A}$.

So VA is related to P through the following relation:

$$VA = diag((I - {}^t\mathbf{A})\mathbf{1})P = \mathbf{M}P \quad (3.5)$$

with $\mathbf{1}$ a vector of ones and of length p. $\mathbf{M}$ is a diagonal matrix of size $p \times p$ which allows us to subtract

[5] Due to aggregation effects, these shares differ across operations at the A38 level we work with. They are however based on homogenous assumptions at the underlying level used for IOT retropolation (F48).

the share of intermediate consumption required to produce each product[6].

Equations (3.2), (3.3) and (3.5) combined provide an initial framework to measure the labour content of final demand by skill and product.

$$N = \mathbf{TMRS}^{FD} FD \tag{3.6}$$

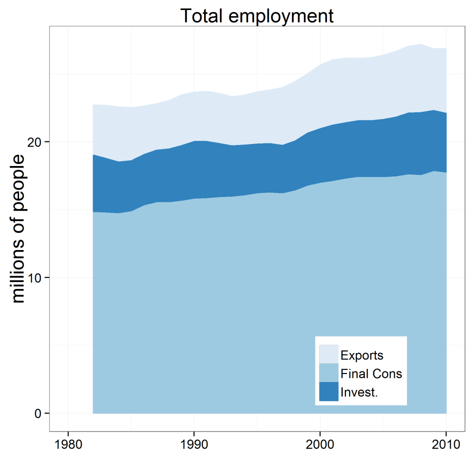
Under this form, we can identify the product of matrices $\mathbf{TMRS}^{FD}$ as the employment content of final demand. It is a $pq \times p$ matrix. For each product in column, it corresponds to the number of workers of each skill level and for each product (lines) required to provide 1 € of this product (in column) to final consumers.

3.2 How many workers are required to address final domestic demand and exports?

We can further decompose total employment and employment by skill level into the shares used to address final consumption (including changes in inventories), investment and exports (Figures 7 and 8).

Final consumption requires the largest share of employment: on average two thirds of employment serve it. From 1982 to 2010 the labour force required to address final demand has been steadily increasing (Figure 7). This increase (+0.7% per year on average) is however less than the increase in the three components of final demand (+3.3% per year on average, in volume); this differential is a consequence of the labour productivity gains. The labour content of final demand measured in employment per € (corrected for inflation) has thus decreased.

[6]Intermediate consumption defined in equation 3.2 is different to the one defined in equation 3.5. In the first case, it represents the use of a product p as an intermediate consumption in the production of all products. In the second case, it represents all intermediate consumptions used to produce p. Hence we cannot write $VA = (I - A)P$.

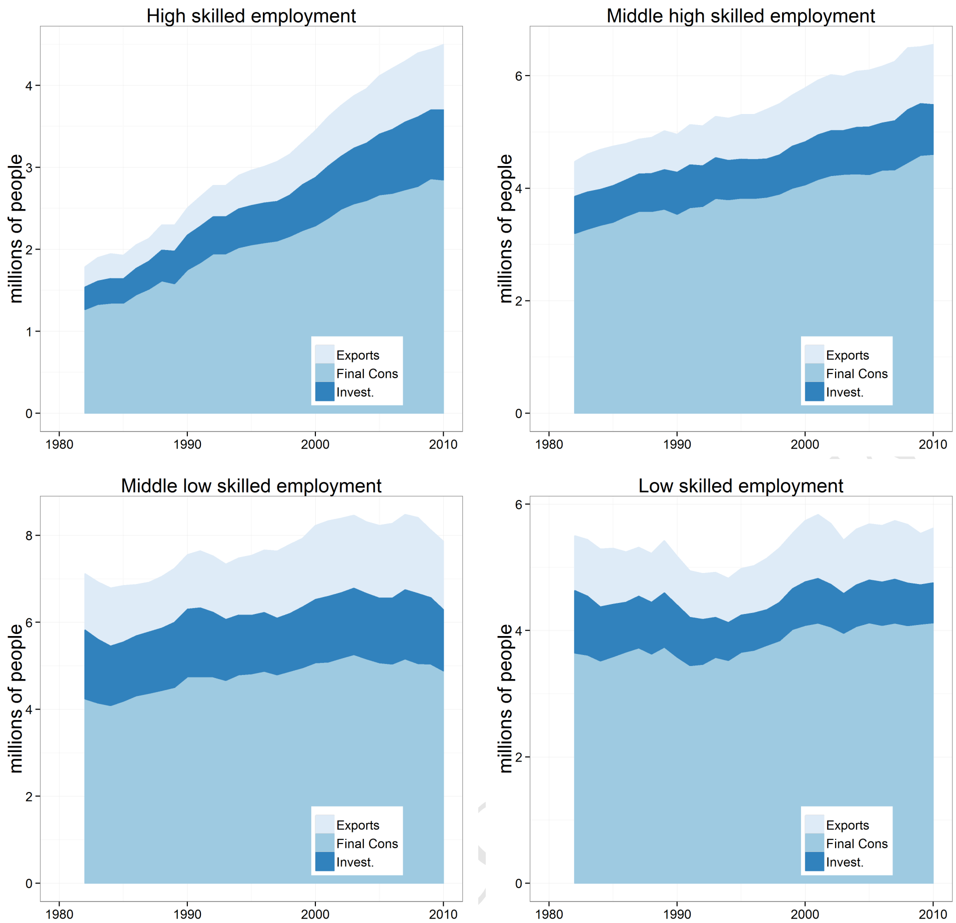


Source: Insee, national accounts; authors' calculations.

Note: In 2010, 18, 4 and 5 millions of people are required to address respectively final consumption, investment and exports.

Figure 7: Labour content of final domestic demand and exports

While the increase in employment is more sizeable for higher skilled workers (+5.4% and +1.7% per year for high- and middle high-skill), it is insignificant for low-skilled workers (Figure 8). More precisely buoyancy in high-skilled employment reflects the increasing need of investment and exports for high-skilled labour content, as R&D develops and manufacturing exports are more specialised in high-technology. The share of high-skilled employment dedicated to investment increased from 17% in 1982 to 23% in 2010, while it increased from 17% to 20% in the case of exports. Conversely, the share of low-killed workers dedicated to investment dropped over the same period (from 18% to 11%), while the share dedicated to consumption dramatically increased (from 66% to 77%).



Source: Insee, LFS and national accounts; authors' calculations.

Note: In 2010, 3, 0.9 and 0.8 millions of high-skilled workers are required to address respectively final consumption, investment and exports.

Figure 8: Labour content of final domestic demand and exports, by skill level

3.3 Skilled and unskilled, direct and indirect labour content

Table 1 provides a comparison of the labour content of final domestic demand by product between 1982 and 2010.[7] This analysis confirms the overall decrease in the labour content: fewer workers are required to produce each good and service, in line with productivity gains. In 1982, 17.8 workers are required to produce 1 million € of 2010 of final domestic demand products. They are 12.7 in 2010. This decrease in the labour content of final domestic demand is effective for all products but more sizeable for

[7]A table for 17 products and complementary figures are available in a separate appendix.

goods than services. For instance, one million euro of high-technology manufacturing goods requires 24.6 workers in 1982 and only 7.3 in 2010, while labour content in non-tradable services decreases only from 17 to 13.7 workers per million euro. This sizeable decrease in the labour content of manufacturing products seems to confirm the routinization hypothesis of Autor, Levy, and Murnane (2003): new technologies replace human labour in routine tasks in industrial sectors while low skilled workers in services, engaged in more interactive and social tasks (sales, catering, house care...) are less impacted.

In 30 years, the share of higher skilled labour content increased for all products, conversely to the other skill levels. This increase is particularly important in tradable services and more specifically in information and communication and in business services where R&D is accounted.[8] As for high-technology manufacturing products, high-skilled workers represented 7.3% of the labour content in 1982, against 19.9% in 2010. As underlined by Autor, Katz, and Krueger (1998), computer-intensive industries in developed economies – and by extension new technology-intensive industries – require higher skilled workers. The skill level *Others* includes farmers together with other self-employed workers; the content of agriculture and energy but also low technology manufactured goods (incl. food products) in this kind of workers has dramatically decreased, reflecting the decline of employment in the agricultural sector.

The direct labour content of a product is defined as the labour involved in the production of final demand within the corresponding sector, whereas the indirect labour content is the labour content of intermediate consumption used to address final demands [9]. For instance, to produce cars, workers on a car assembly line – direct labour content – will be required, as well as indirect labour content such as workers in a tire factory, advertising, power plants. Vertical specialization would imply an increasing share of indirect labour content both or either domestic or imported. Looking only at the domestic labour content, this is the case only for high-technology manufactured goods and more specifically transport equipment.

[8] A table for 17 products is available in a separate appendix.

[9] More technically, the direct labour content of a product is estimated through **TM** and the indirect labour content through **TMR-TM**.

	Product	Skill level					Total	Direct	Indirect
		High	Mid-high	Mid-low	Low	Others			
1982	Manuf. High Tech.	1.8	5.1	9.4	6.5	1.8	24.6	10.3	14.2
		7.3	20.7	38.1	26.4	7.5	100	42	58
	Manuf. Low Tech.	0.9	2.4	5.5	5.9	6.6	21.2	8.4	12.8
		4.2	11.2	25.9	27.6	31.2	100	39.5	60.5
	Serv. non Tradable	1.4	3.8	5.2	4.2	2.3	17	12.7	4.3
		8.4	22.4	30.4	25	13.8	100	74.7	25.3
	Serv. Tradable	2.4	4	7.4	3.2	1.5	18.5	10.9	7.6
		13	21.6	40	17.3	8.1	100	59	41
	Agr. Energy	0.6	1.8	2.4	2.4	8.9	16	9.8	6.2
		3.5	11	15.2	14.9	55.4	100	61.4	38.6
	Total	1.4	3.6	5.4	4.3	3	17.8	11.8	6
		8.1	20.3	30.6	24.4	16.6	100	66.4	33.6
2010	Manuf HighTech	1.5	1.9	2.4	1.1	0.4	7.3	2.5	4.8
		19.9	26.4	32.4	15.4	5.8	100	34.8	65.2
	Manuf LowTech	1.3	2.2	3.3	2.5	2	11.2	4.8	6.4
		11.4	19.3	29.4	22	17.8	100	42.6	57.4
	Serv. non Tradable	2	3.5	3.9	3.2	1	13.7	10.5	3.2
		14.7	25.7	28.7	23.3	7.6	100	76.6	23.4
	Serv. Tradable	3.4	2.4	2.9	1.2	0.6	10.5	5.9	4.6
		31.9	23.1	27.8	11.8	5.4	100	56.4	43.6
	Agr. Energy	1.2	1.9	1.9	1.8	2.5	9.3	4.6	4.7
		12.9	20.5	20.8	19.3	26.6	100	49.7	50.3
	Total	2.1	3.2	3.6	2.7	1.1	12.7	9	3.7
		16.8	24.8	28.5	21.5	8.4	100	70.7	29.3

Source: Insee, LFS and national accounts; authors' calculations.

Note: In 1982, for the total economy, the labour content of final domestic demand is 17.8 employees per million € of 2010. This content is down to 12.7 in 2010. In 1982 for high technology manufactured goods, 58% of the labour content is indirect, i.e. due to intermediate consumption while in 2010 it is 65%, reflecting vertical specialisation in this sector.

Table 1: Labour content of final domestic demand by product (in employment per million euro of 2010)

4 Decomposition methodology of employment changes

4.1 Changes in production

Between two periods t and τ, changes in production can be related to changes in final demand (domestic or foreign), changes in openness ($\mathbf{S}^z$) and changes in technology ($\mathbf{A}$). From the previous structural decomposition, we built on (Miller and Blair, 2009, Chapter 13) and (Gregory, Zissimos, and Greenhalgh, 2001) to identify the contribution of each effect to changes in production. We apply the following methodology to changes in Input-Output data in prices of the previous year at time t and in current prices at time $t-1$, following in that sense the concept of chain linked volumes applied in national accounts. The retropolation of Input-Output is detailed in Appendix A. Note however, that deflation of each operation is based on its specific price index (consumption, investment...) and that the relative prices of domestic and imported shares of a specific operation reflect the relative prices of production and imports.

$$\Delta P_{t,\tau} = P_t - P_\tau = \mathbf{R}_t(\Delta \mathbf{S}^{FD} FD_t + \mathbf{S}^{FD}_\tau \Delta FD) + \Delta \mathbf{R}(\mathbf{S}^{FD}_\tau FD_\tau) \tag{4.1}$$

We can rearrange the terms

$$\Delta \mathbf{R}(\mathbf{S}^{FD}_\tau FD_\tau) = \mathbf{R}_t(\mathbf{S}^{FD}_\tau FD_\tau) - \mathbf{R}_\tau(\mathbf{S}^{FD}_\tau FD_\tau) = (\mathbf{R}_t \mathbf{R}_\tau^{-1} - I)P_\tau \tag{4.2}$$

$$= \mathbf{R}_t(\mathbf{R}_\tau^{-1} - \mathbf{R}_t^{-1})P_\tau = \mathbf{R}_t(\mathbf{S}^{IC}_t \mathbf{A}_t - \mathbf{S}^{IC}_\tau \mathbf{A}_\tau)P_\tau \tag{4.3}$$

and

$$\mathbf{S}^{IC}_t \mathbf{A}_t - \mathbf{S}^{IC}_\tau \mathbf{A}_\tau = \Delta \mathbf{S}^{IC} \mathbf{A}_t + \mathbf{S}^{IC}_\tau \Delta \mathbf{A} \tag{4.4}$$

It follows that changes in production can be decomposed as :

$$\Delta P_{t,\tau} = \mathbf{R}_t(\Delta \mathbf{S}^{FD} FD_t + \mathbf{S}^{FD}_\tau \Delta FD) + \mathbf{R}_t(\Delta \mathbf{S}^{IC} \mathbf{A}_t + \mathbf{S}^{IC}_\tau \Delta \mathbf{A})P_\tau \tag{4.5}$$

with $FD = FDD + X$ (FDD is the final domestic demand and X are the exports).

Eventually, we can decompose changes in production in three terms:

$$\Delta P_{t,\tau} = \underbrace{\mathbf{R}_t \mathbf{S}^{FDD}_\tau \Delta FDD}_{\text{Changes in Final Domestic Demand}} + \underbrace{\mathbf{R}_t(\Delta \mathbf{S}^{FDD} FDD_t + \Delta(\mathbf{S}^X X)) + \mathbf{R}_t \Delta \mathbf{S}^{IC} \mathbf{A}_t P_\tau}_{\text{Changes in exports and imports}} + \underbrace{\mathbf{R}_t \mathbf{S}^{IC}_\tau \Delta \mathbf{A} P_\tau}_{\text{Changes in technology}} \tag{4.6}$$

Is GFCF demand or technology? In the former decomposition in section 3, we take a standard accounting approach and consider gross fixed capital formation (GFCF) as final domestic demand along with final consumption. However, changes in GFCF can also be related to future changes in production factors, i.e. technology. Hence in this paper, we consider GFCF changes as technological changes.

We then write in a slightly different fashion:

$$\begin{aligned}\Delta P_{t,\tau} = & \underbrace{\mathbf{R}_t\mathbf{S}_\tau^{FC}\Delta FC}_{\text{Changes in Final Domestic Consumption}} \\ & + \underbrace{\mathbf{R}_t(\Delta\mathbf{S}^{FC}FC_t + \Delta\mathbf{S}^{GFCF}GFCF_t + \Delta(\mathbf{S}^X X)) + \mathbf{R}_t\Delta\mathbf{S}^{IC}\mathbf{A}_t P_\tau}_{\text{Changes in exports and imports}} \\ & + \underbrace{\mathbf{R}_t\mathbf{S}_\tau^{IC}\Delta\mathbf{A}P_\tau + \mathbf{R}_t\mathbf{S}_\tau^{GFCF}\Delta GFCF}_{\text{Changes in technology}}\end{aligned} \tag{4.7}$$

4.2 Changes in employment

Changes in production can be related to changes in employment through equations (3.3) and (3.5). Employment changes can then be decomposed between a production, an intermediate consumption and a skill-use effect:

$$\Delta N_{t,\tau} = \mathbf{T}_t\mathbf{M}_t\Delta P + \mathbf{T}_t\Delta\mathbf{M}P_\tau + \Delta\mathbf{T}\mathbf{M}_\tau P_\tau \tag{4.8}$$

Replacing changes in production by its expression (4.7) we can relate the changes in employment by skill level to changes in final domestic consumption, changes in foreign trade and changes in technology:[10]

$$\begin{aligned}\Delta N_{t,\tau} = & \underbrace{\mathbf{T}_t\mathbf{M}_t\mathbf{R}_t\mathbf{S}_\tau^{FC}\Delta FC}_{\text{Changes in Final Domestic Consumption}} \\ & + \underbrace{\mathbf{T}_t\mathbf{M}_t\mathbf{R}_t(\Delta\mathbf{S}^{FC}FC_t + \Delta\mathbf{S}^{GFCF}GFCF_t + \Delta(\mathbf{S}^X X)) + \mathbf{T}_t\mathbf{M}_t\mathbf{R}_t\Delta\mathbf{S}^{IC}\mathbf{A}_t P_\tau}_{\text{Changes in exports and imports}} \\ & + \underbrace{\mathbf{T}_t\mathbf{M}_t\mathbf{R}_t\mathbf{S}_\tau^{IC}\Delta\mathbf{A}P_\tau + \mathbf{T}_t\mathbf{M}_t\mathbf{R}_t\mathbf{S}_\tau^{GFCF}\Delta GFCF + \mathbf{T}_t\Delta\mathbf{M}P_\tau + \Delta\mathbf{T}\mathbf{M}_\tau P_\tau}_{\text{Changes in technology}}\end{aligned} \tag{4.9}$$

Final domestic demand The first term measures the effect of changes in final consumption on employment, given the skill-use coefficients **T**, the technology (**R**, **M**) and domestic shares **S**. To provide further insights on the effect of changes in consumption we further decompose ΔFC into household consumption and other final consumptions (including changes in inventories). Households' consumption

[10] By multiplying this decomposition by a diagonal matrix of the inverse of the elements of N, decomposition (4.9) becomes a decomposition of the growth rate of each level of employment per production and skill.

is then decomposed into a composition effect (weight of each product in the consumption basket), population size (measured in consumption units), the purchasing power of gross domestic income (GDI[11]) per consumption unit[12] and the consumption to GDI ratio:

$$FC_{val} = P^{tot} \frac{FC_{val}}{FC_{val}^{tot}} cu \; PP^{GDI/cu} \frac{FC_{val}^{tot}}{GDI} \tag{4.10}$$

with P^{tot}, cu, $PP^{GDI/cu}$ respectively the price index for aggregate households consumption, the number of consumption units and the purchasing power of GDI per consumption unit. FC_{val}^{tot} is the aggregate households' consumption as opposed to the vector of households' consumptions FC_{val}.

With this decomposition, it is possible to directly relate the increase in purchasing power with the increase in labour productivity (hidden in $\Delta\mathbf{T}$), two factors which are related in the long run but dissociated in our decomposition. The sociodemographic effect cu can be seen as a pure demand effect. The composition effect $\frac{FC_{val}}{FC_{val}^{tot}}$ is ambiguous, as we do not disentangle changes in the consumption basket composition linked to changes in relative prices from those linked to households' preferences. As for the contribution of changes in $\frac{FC^{tot}}{GDI}$, it can be directly interpreted in terms of savings ratio. Apart from the development of financial savings in the late eighties early nineties, the savings ratio has been stable in France. Its contribution to changes in employment should be only transitory (akin to the long-term imbalances correction in an error correction model for consumption) and null on average in our analysis.

Trade The second term combines the effect of foreign demand addressed to France ($\Delta(\mathbf{S}^X X)$) and changes in openness (ΔS). In this term, the part related to changes in the domestic share of intermediate consumption ($\Delta\mathbf{S}^{IC}\mathbf{A}$) can be interpreted as the effect of *offshore outsourcing* (also referred to as international vertical specialisation) in the *broad sense* (Strauss-Kahn, 2004; Foster, Stehrer, and de Vries, 2012). Isolating the diagonal elements (imports of the same product) provides a measure of the offshore-outsourcing effect in the *narrow sense* (Feenstra and Hanson, 1999; Strauss-Kahn, 2004; Foster, Stehrer, and de Vries, 2012). According to Feenstra and Hanson (1999), the narrow measure best captures the essence of fragmentation which occurs within the industry. We focus on offshore outsourcing in the broad sense, so that all contributions sum to employment changes, but nonetheless assess the effect of narrow offshore outsourcing.

[11]The GDI has been modified to be valued at basic prices like the rest of the Input Output Table, instead of being valued at purchasing price.

[12]Purchasing power per consumption unit takes into account not only demographic changes, but also changes in household size and composition. An increase in consumption units reflects population growth or social changes such as divorces or youngsters leaving with their parents. According to the OECD-modified scale, the household head is assigned 1 CU, then each additional person older than 14 and each child younger than 14 respectively represents 0.5 and 0.3 CU. Compared to the mere purchasing power, this indicator is more relevant to assess changes in the average standard living of households.

Technology The third term gathers changes in technology, not only through changes in skill-use coefficients (ΔT, labour-saving effect) and in future capital ($\Delta GFCF$), but also through changes in the production process like outsourcing (captured by ΔA and ΔM). Here we define technology as the observed use of production factors, i.e. effective technology rather than potential technology (as postulated by a CES, Cobb-Douglas or translog cost function for instance). As a consequence, we also capture under technology effects the reallocation of production factors following changes in their relatives prices.

Due to the overall increase in labour productivity, the contribution of changes in matrix **T** will be largely labour saving. This effect, as we have mentioned, can be interpreted in parallel with the increase in income per capita, which also reflects the increase in productivity but with a positive effect on employment through consumption. We may also expect changes in the indirect labour content of output (GFCF and intermediate consumption) to have positive effect on labour. For intermediate consumption this contribution would reflect vertical specialisation (although our preliminary analysis suggest it is very limited). For GFCF it would reflect an upgrade in the technology of production.

4.3 Input-Output analysis: a comprehensive framework with some limitations

The main caveat of our approach is also its main strength. By relying on the Input-Output analysis framework we can exactly disentangle changes in employment into various effects (technology, trade and final demand). However, this approach cannot reveal the underlying causal links between employment and its determinants in the long run (Martin and Evans, 1981). Indeed, this approach captures what we may call first round, short-term or partial equilibrium effects. It does not take into account long-term closure effects.

Trade openness can introduce new varieties of goods in the consumption basket, a structural change we identify in the final demand effect. It can also induce opportunities to adopt new technologies as a "defensive innovation" strategy (Acemoglu, 2003) or increase the productivity of factors (both offshored and not offshored ones) (Grossman and Rossi-Hansberg, 2008), an indirect trade effect we identify as technology. Goos, Manning, and Salomons (2014) also point out a positive correlation between offshoring and routine-biased technological change which we separate into trade and technological effects respectively. Technology can work in the same way. It can be imported from trading partners or foster export competitiveness. By enhancing apparent productivity, technology can also increase wages and hence households' purchasing power, which in turn raises final demand and employment.

In the case of technology, we can solve in part the latter issue by identifying the contribution of purchasing power gains in employment changes (equation 4.10). Nonetheless overlooking long-term closure effects in our analysis does not stand as an issue, since our analysis is restricted to short-term effects of technology, trade and final consumption. Even if long-term effects offset negative effects on employment at time t, employment destruction did occur and should be accounted for at time t (Barlet, Blanchet, and Crusson, 2009).

We do not isolate the effect of relative prices either. This accounting approach cannot disentangle changes in the relative use of production inputs stemming from changes in relative prices and from changes in the underlying function of production. Likewise our approach cannot disentangle the relative demands for different products or for imported/domestic products stemming from changes in relative prices and from changes in preferences. In other terms, we do not differentiate changes along the demand curves from change of the demand curves.

The underlying causalities may be better identified with econometric methods. These methods however focus mainly on technology and/or trade, leaving out final demand (Feenstra and Hanson, 1999; Amiti and Wei, 2009; Goos, Manning, and Salomons, 2009, 2014; Autor, Dorn, and Hanson, 2013; Michaels, Natraj, and van Reenen, 2014; Morin, 2015). Our methodology complements these econometric approaches by providing a benchmark evaluation for the effects at play altogether.

4.4 $n!$ decompositions

When decomposing the variation of the product of n terms into the contribution of each term's variation, there are $n!$ equally valid decompositions. The choice of a particular decomposition corresponds to the choice of reference years to weight each term's variation, i.e. t or τ in the previous equations can switch places. This can be compared, in the context of prices and volumes, to a choice between Paasche and Laspeyre indices.

In our case, there are up to 9! ways to compile each element of equation (4.9), once the decomposition of households consumption is accounted for. We restrict our analysis to the 4! decompositions of $\mathbf{TMR}FD^{d}$[13] and breakdown the components of final domestic demand domestically produced (FDD^{d}) into up to 5! more ways (i.e. up to 2 880 potential decompositions). We compute and average all these decompositions to measure each effect on the changes in employment by skill [14]. To address criticisms associated with these numerous decompositions (Martin and Evans, 1981), we show that the choice of a particular decomposition would have a relatively small impact on our analysis in a separate appendix: the methodological uncertainty associated with these decompositions is small relative to the differences between two contributions.

[13] The product $S^{FD}FD$ is equal to FD^{d} and is hence considered as one single aggregate.

[14] Also see Miller and Blair (2009, Chapter 13) for an alternate solution to decompose a product of n terms.

5 What are the main direct channels of employment changes?

Results from the decomposition (4.9) are displayed both graphically and in tables and are expressed in terms of average annual changes in the following tables and figures. Table 2 displays the general decomposition by skill level, while Tables 3, 4 and 5 focus on final consumption, trade and technology effects respectively. Table 6 (and 8, 9 and 11 in Appendix) extend the decompositions of these tables by distinguishing the contributions for five main products (a more detailed decomposition for 17 products is available in a separate appendix). Figures 9 to 13 in Appendix display these decompositions over the whole period.

As displayed in Table 2, between 1982 and 2010, the overall employment increases on average by 0.6 % each year (i.e. approximately 150 000 jobs per year). The main driver of this increase is final consumption (average contribution of +1.2 percentage point per year to employment growth) along with trade growth (+0.3 pp), while technology has a labour-saving effect (-0.9 pp). More precisely, on a short-term basis, technology has a direct labour saving effect (-1.2 pp, Table 5). However in the long run, these gains imply wage increase and hence contribute to the increase in households' purchasing power (+0.4 pp, Table 3). Compared to final consumption and technology, trade has a more limited impact on employment, in line with other works based on Input-Output analysis (Gregory, Zissimos, and Greenhalgh, 2001; Los, Timmer, and De Vries, 2014). However, unlike these works it has a positive short-term impact: foreign demand has an employment-enhancing effect (+0.7) that offsets the negative effect of offshoring and lost market shares (-0.4, i.e. 99 000 jobs per year on average). By comparison Barlet, Blanchet, and Crusson (2009) find that globalisation eliminated 340 000 jobs on average each year over the period 2000-2005[15]. The gap between these two estimates mainly relies in the way we cleared our decomposition from price effects[16].

5.1 Sources of skill-bias in employment changes

As previously mentioned, higher skilled employment dramatically increased over the last decades, conversely to lower skilled ones. In this section we examine the short-term implications of final consumption, trade and technology on this skill-biased change in employment. We also investigate whether one of these three channels implies jobs polarization. As displayed in Table 2, on average employment of higher skilled workers increases substantially over the period 1982-2010 (respectively +3.4 % per year for high- and +1.4 % for the higher part of middle-skilled workers). In comparison the increase in lower skilled categories is rather small. Employment destructions are mainly focused on farmers, craft workers and chief executives (-1.7 % per year), in line with the decline of agriculture.

[15] Over the period 2000-2005, imports weigh slightly more on employment: -129 000 jobs on average per year.

[16] Barlet, Blanchet, and Crusson (2009) use for manufacturing products unit value indices (dollar per kilogram), averaged over 2000-2005. In the case of services they estimate the contributions on employment in value, since there is no unit value indices for services.

The overall effect of final consumption displays neither a polarization effect on employment nor a skill-biased one. It is driven by household purchasing power gains and the growth in public consumption (Table 3). However changes in the consumption structure is slightly skill-biased. These changes benefit to high-skilled workers (+0.1 percentage point per year), while they are detrimental to the other skill groups (-0.2 for the low-skilled group). The negative effect is even stronger for the other skills (including farmers), a result in line with the prediction of Engel curves theory for food products.

The skill-bias of trade is by construction[17] also limited (Table 4). However offshore outsourcing has been slightly more detrimental to lower skills (including in the narrow sense, see Table 10). This bias remains quantitatively very low compared to technology. Furthermore, on a short-term basis, the impact of vertical specialisation on lower skilled workers is stronger: narrow offshore outsourcing represents 48% of broad offshore outsourcing for low-skilled workers, while it represents 41% for high-skilled ones. Our results relate to other works: Goos, Manning, and Salomons (2009, 2014); Michaels, Natraj, and van Reenen (2014) find no significant effect of offshoring on job polarization in Europe. Likewise, Blinder (2009) finds a weak correlation between educational attainment and offshorability (+0.08). However other works show evidence of skill-bias, as trade's negative impact on employment is stronger for lower-skilled workers (Gregory, Zissimos, and Greenhalgh (2001) for UK and Autor, Dorn, and Hanson (2013) for the US). Goos, Manning, and Salomons (2011); Foster, Stehrer, and de Vries (2012); Zeddies (2013) even find a polarization effect of offshoring.

The most skill-biased determinant is technology. While technological change is largely labour saving on a short-term basis, this shows mainly on the lowest skilled workers (Table 5). Only high-skilled workers benefit from changes in technology (+1.4 percentage point on average per year). According to Autor, Levy, and Murnane (2003), this skill-bias technological change rose as the price of computer capital dramatically declined overt the last decades. The main driver of this skill-bias is the direct labour saving effect. However, there is also a small skill-bias from GFCF, in line with the development of ICT and R&D. Conversely to the US (Autor and Dorn, 2013; Michaels, Natraj, and van Reenen, 2014) and to some European countries (Goos and Manning, 2007; Goos, Manning, and Salomons, 2011, 2014), there is no evidence of employment polarisation because of technological change. The skill-bias seems monotonous in France and favours high-skilled workers the most (Maurin and Thesmar, 2004). Only by using a more detailed occupational level does Ast (2015) find a slight job polarization in some services, as employment of low-skilled workers (caregivers, home help, caretakers, nanny, salesclerk, employees in the accommodation and food industry...) has been particularly dynamic.

[17] The skill bias of trade is only driven by a composition effect. There is no information of the specific labour content of exported products compared to domestically consumed products, least about its change with time.

Average contribution (in % per year)	Total	Skill level				
		High	Middle higher	Middle lower	Low	Other
Jobs creation	0.6	3.4	1.4	0.4	0.1	-1.7
Final consumption	1.2	1.3	1.3	1.2	1.3	0.9
Trade	0.3	0.3	0.3	0.4	0.3	0.4
Technology	-0.9	1.7	-0.3	-1.2	-1.5	-3

Source: Insee, LFS and national accounts; authors' calculations.

Note: The first row of the table represents the average annual growth rate of total employment and employment by skill level. The remaining rows represent the average annual contributions that sum to the employment growth rate.

Table 2: Broad contributions to employment change by skill level. 1983-2010

Average contribution (in % per year)	Total	Skill level				
		High	Middle higher	Middle lower	Low	Other
Final consumption effects	1.2	1.3	1.3	1.2	1.3	0.9
Consumption structure	-0.1	0.1	0	-0.1	-0.2	-0.3
Purchasing power	0.4	0.4	0.4	0.4	0.5	0.6
Sociodemographic effects	0.3	0.2	0.2	0.3	0.3	0.4
Household saving	0	0	0	0	0	0.1
Gov. and NPISH consumption	0.5	0.6	0.7	0.5	0.6	0.2

Source: Insee, LFS and national accounts; authors' calculations.

Note: The first row represents the average annual contribution of final consumption to employment growth also displayed in Table 2. It is equal to the sum of the remaining rows.

Table 3: Breakdown of final consumption effects to employment change by skill level. 1983-2010

Average contribution (in % per year)	Total	Skill level				
		High	Middle higher	Middle lower	Low	Other
Trade effects	0.3	0.3	0.3	0.4	0.3	0.4
Exports	0.7	0.7	0.7	0.8	0.7	0.8
Offshore outsourcing	-0.3	-0.2	-0.2	-0.3	-0.3	-0.3
Home share in FC	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
Home share in GFCF	0	0	0	0	0	0

Note: See Table 3.

Table 4: Breakdown of trade effects on employment change by skill level. 1983-2010

Average contribution (in % per year)	Total	Skill level				
		High	Middle higher	Middle lower	Low	Other
Technology effects	-0.9	1.7	-0.3	-1.2	-1.5	-3
Direct labour saving	-1.2	1.4	-0.4	-1.5	-1.5	-3.2
IC effects	-0.1	-0.1	-0.1	0	-0.2	0
GFCF effects	0.3	0.5	0.3	0.3	0.2	0.2

Note: See Table 3.

Table 5: Breakdown of technology effects on employment change by skill level. 1983-2010

5.2 Are skill-bias changes a consequence of sectoral developments?

Autor, Katz, and Krueger (1998) underline the correlation between the skill-bias and computer-intensive industries. In France, services flourished over the last decades at the expense of industrial and agricultural sectors, and high-skilled workers are mainly gathered in services (more than 80% in 2010). The previously underlined skill-biased changes could in fact reflect sector-biased developments.

In order to assess the effect of sectoral development on skill-bias change, we focus on five broad groups of products:

(1) High technology manufacturing: chemicals, pharmaceutical, computer, electronic and optical products, electrical and machinery equipment (air and spacecraft, ships, boats...);

(2) Low technology manufacturing: other industrial products such as rubber, plastic, food, beverage, textile, etc.;

(3) Non-tradable services[18]: construction, accommodation and food services, finance and insurance, real estate, public and personal services;

(4) Tradable services: trade, transportation, information and communication, business services;

(5) Other: agriculture, energy and utilities.

Table 6 and tables 8, 9 and 11 break down the previous decompositions according to these five groups of products[19].

[18] These sectors are defined as non-tradable on the basis of an insignificant contribution of trade to the total changes in the jobs required to produce the final output. See Table C in Appendix C for more details

[19] These tables are also available for 17 products in a separate appendix.

Regardless of the skill level, development of services accounts for a substantial part of employment change[20] (+0.5 percentage point per year on average in both non-tradable and tradable services), while changes are negative in the other industries. The growth in the total labour content of services is mainly driven by consumption, especially purchasing power and population growth. As expected in the case of non-tradable services, public spending like public services is a more important determinant of the increase in total labour content (Table 8).

The skill-bias effect of changes in consumption structure reflects the shift in the consumption of services at the expense of agriculture and low-technology manufacturing products. As the latter require more low-skilled labour content (see Table 1), low-skilled workers suffer more from changes in consumption structure. However this negative contribution in the growth of low-skill is offset by income and population effects. More specifically, the income effect is stronger in the lowest skilled content of non-tradable services. This implies low-skilled workers benefit from richer workers greater demand for services replacing their household production, e.g. child care, domestic work, food service (Michaels, Natraj, and van Reenen, 2014).

On the trade side, the more favourable contribution of foreign demand to lower skilled workers is driven by low-technology manufacturing products and tradable services (mainly trade, transportation and business services). Nevertheless, offshore outsourcing (broad and narrow) weighs the most on lower skilled content of these goods and services. Focusing on manufacturing, importing finished goods (for final consumption and GFCF) is more detrimental to low-skilled workers in low-technology manufacturing (average annual contribution of -0.07 point against -0.02 in high-technology manufacturing).

Finally, the skill-bias effect of technological change is at play for all industries, manufacturing or services, although we note a small polarization effect from technology on tradable services. More precisely, the direct labour saving effect weighs more on lower skilled workers in low-technology manufacturing and tradable services (trade and transportation). In the framework of the labour-technology literature, these workers are more substitutable with capital. The skill-bias effect of GFCF can also be explained as a consequence of sectoral development, as it is more sizeable for tradable services, and more precisely for R&D, included in the business services, and for information and communication.

[20]Sectoral employment is measured in terms of jobs required to produce its final output, and does not represent the employment within the sector.

Average contribution (in % per year)	Total	Products in: Manufacturing high-tech	Manufacturing low-tech	Services non-tradable	Services tradable	Agr. and energy
				Total		
Jobs creation	0.61	-0.08	-0.2	0.52	0.48	-0.12
Final consumption	1.21	0.02	0.05	0.7	0.4	0.04
Trade	0.34	0.05	0.01	0.03	0.23	0.03
Technology	-0.95	-0.15	-0.25	-0.21	-0.15	-0.19
				High skill		
Jobs creation	3.37	0.12	0.08	1.47	1.63	0.07
Final consumption	1.32	0.04	0.02	0.81	0.42	0.02
Trade	0.32	0.06	0.01	0.05	0.2	0.01
Technology	1.73	0.02	0.05	0.61	1	0.04
				Middle skill (higher)		
Jobs creation	1.38	-0.05	0.01	0.75	0.62	0.04
Final consumption	1.34	0.03	0.03	0.86	0.38	0.03
Trade	0.32	0.06	0.01	0.04	0.2	0.01
Technology	-0.28	-0.14	-0.03	-0.15	0.04	0
				Middle skill (lower)		
Jobs creation	0.38	-0.13	-0.17	0.38	0.28	0.01
Final consumption	1.18	0.02	0.05	0.63	0.45	0.02
Trade	0.37	0.06	0.01	0.03	0.26	0.01
Technology	-1.17	-0.21	-0.23	-0.28	-0.43	-0.02
				Low skill		
Jobs creation	0.11	-0.18	-0.54	0.49	0.34	0
Final consumption	1.27	0.02	0.06	0.8	0.37	0.03
Trade	0.3	0.04	-0.01	0.02	0.23	0.01
Technology	-1.46	-0.23	-0.6	-0.33	-0.26	-0.05
				Other skill		
Jobs creation	-1.7	-0.02	-0.31	-0.24	-0.07	-1.06
Final consumption	0.94	0	0.07	0.36	0.35	0.16
Trade	0.38	0.01	0.01	0.03	0.21	0.12
Technology	-3.02	-0.04	-0.39	-0.62	-0.63	-1.35

Source: Insee, LFS and national accounts; authors' calculations.

Note: Column "Total" is equal to the sum of the remaining columns by products and displays the same figures as Table 2. In each panel, the first row is equal to the sum of the remaining rows.

Table 6: Broad contributions to employment change by skill and product. 1983-2010

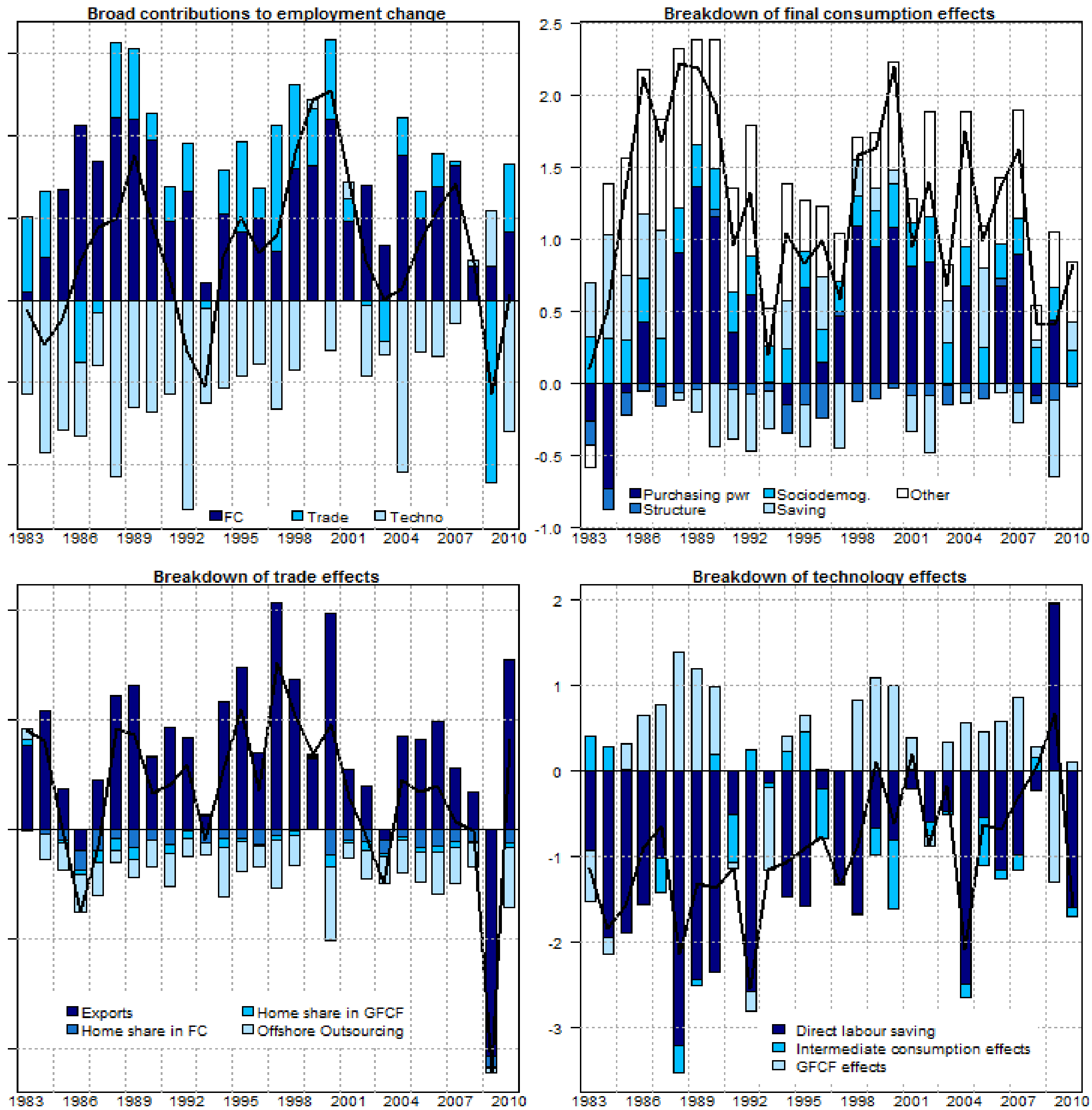
5.3 Are skill-bias changes driven by external shocks?

Apart from sectoral development, skill-bias changes can also result from external determinants, such as crises, labour policies, international environment... Depending on these external shocks, the average annual effects of final consumption, trade and technology on employment changes could be driven by a single year or a specific period. For instance, as displayed in Figure 9, final consumption effects are closely related to the business cycle, with a decreasing impact during years of crises (1993, 2003 and 2009). Trade and technology effects have particularly irregular profile in 2009 and 2010, as direct consequence of the 2008-2009 economic and financial crisis.

More specifically in the case of trade, the period of the 90's is of great interest since it is linked to the rise of globalization. Hence the effect of both exports and imports on employment changes dramatically increased during this period. Exports effects for tradable services are almost twice as important in the period 1994-2000 than in 1987-1992 and in 2001-2008[21]In addition, with the development of high-technology manufacturing over the same period, exports also benefit to higher skilled workers required for this kind of products. Over these three periods, the effect of offshore outsourcing remains relatively similar.

Finally in the case of technology, its decreasing effect on employment changes over time is related to fading productivity gains, as underlined by Schreiber and Vicard (2011). This concerns more specifically low-skilled workers in manufacturing in the period 1998-2008, in line with the negative impact in this sector of the switch to the 35-hour working week (Biscourp and Kramarz, 2007; Schreiber and Vicard, 2011).

[21] 1986, 1993 and 2009-2010 are excluded from the following estimates, as they represent years of crisis. Tables are made available in a separate appendix.



Source: Insee, LFS and national accounts; authors' calculations.

Figure 9: Contributions to total employment changes (in %). 1983-2010

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A The retropolation of Input Output Tables

National accounts and in particular the Supply and Use Table (SUT) are produced in compliance with ESA2010 and Naf Rev2 since 2013. From the 2010 accounts, the SUT is converted by the national accountants into a symmetric Input Output Table (IOT) based on detailed information (138 products and industries) (Rodriguez, 2014). From 1980 to the reference year (2010), we have replicated the methodology of the national accounts at a less detailed level based on the available information in order to produce IOT with the same concepts and nomenclature as the current national accounts. *This is the first advantage of our dataset: covering 30 years in compliance with the most up to date official accounts.* In particular, two consecutive changes in the reference year (2005 and 2010) have introduced important changes in nomenclature and concepts which have markedly impacted the frontier between goods and services, the definition of investment and intermediate consumption and the measure of foreign exchanges.

The IOT differs from the standard SUT (Eurostat, 2008, Chapter 11). First in the IOT, uses are valued at basic prices, that is excluding trade and transportation margins as well as taxes and subsidies on products (first of which VAT). Second, the computation of the IOT requires a treatment for CIF-FOB (cost insurance freight-free on board) of imports to value them at the frontier of the exporting country (FOB) to match the concept for exports. Third, the concept of industry is converted to a concept of product[22] consistent with the rows of the SUT. This is done through the matrix of transfers, recording the production of each industry (mainly non market and agricultural) in secondary products. With this conversion for instance, the intermediate input table records the consumption of intermediate inputs for the production of each output rather than each industry. Fourth, uses must be split between those addressed by domestic production and by imports. In the absence of additional information, this division is based on hypothesis (both in our retropolation and the official compilation of the IOT). Note that in theory there are no imports re-exported recorded in the national accounts and in practice very few.

An analysis on the year 2010, for which data at the detailed level (138 products) are also available, shows that transposing the *symmetrisation* methodology to a SUT with only 48 products and industries generates only small discrepancies (Poissonnier, 2015b). Some adjustments were made to correct the largest discrepancies, steaming from the ventilation of taxes and subsidies on products other than VAT. In retropolation, missing information on VAT on intermediate consumption by industry and transportation margin by uses where built from the ventilation structure in 2010 and adjusted to match the totals known for each year. As for the partition between imported and domestic demands, an analysis with even more detailed information (332 products) in 2010 showed that there is a 10% uncertainty on this partition for each component of demand (excluding exports) but the official IOT and ours concur at 2% for 2010.

[22] A symetric choice can also be made for instance in the World Input-Output Database (Dietzenbacher, Los, Stehrer, Timmer, and de Vries, 2013).

Compared to other datasets, we have benefited from detailed information allowing us to conduct the first three operations with greater precision than done for instance in the WIOD (Dietzenbacher, Los, Stehrer, Timmer, and de Vries, 2013) or by the OECD (Yamano and Ahmad, 2006). Our dataset is nevertheless limited to France. As for the separation between imported and domestic uses, we replicate the methodology from the official IOT while the WIOD in particular use a bilateral trade database to refine this last step.

To be cleared from price effects, decomposition (4.9) must be computed between an IOT in volume (previous year prices) and the IOT of the previous year in value. To do so we have extended the compilation of IOT in values developed by the national accountants to IOT in previous year prices. *This is second advantage of our dataset: estimates in previous year prices based on detailed price information.* For the most part prices and volumes are inherited from the SUT. However, for some treatments (CIF-FOB, transportation margins by uses) the same weights are used in previous year prices and values which maintains prices specific to the operation and not affected by the price of use. For other specific operations (VAT on intermediate consumption by industry, other taxes and subsidies), as much as possible the volume growth is based on that of the use, to be in line with national accounting concepts. For domestic and imported demands (excluding exports), prices are such that the relative price index of an imported and domestic use is the relative price index of imports and production while the relative price of two imported (resp. domestically produced) uses is the relative price of these uses. As for exports, the small share of re-exported imports are assumed to follow the same prices as imports.

B Employment by skill level

How skill is measured Several indicators provide information about the skill level of workers. The main indicators found in the literature are the average hourly wage, the educational attainment and the occupation. Measuring skill level according to the average hourly wage is rather simple to implement. But it leaves out self-employed workers and does not control for structural determinants (age, gender, experience, seniority...). Education level – either defined as the highest level of diploma or the years of studying – is an alternative used in some papers (Los, Timmer, and De Vries, 2014; Ludwig and Brautzsch, 2014; Michaels, Natraj, and van Reenen, 2014). But it can also bias our analysis. While the level of diploma can be a hiring condition, training and experience make it possible for workers to get more skilled jobs. Further, educational attainment has increased within jobs over the last decades (Goos and Manning, 2007).

The French occupational classification (PCS) classifies workers (employees and self-employed) based on the job they do. As such, it takes into account educational attainment, as well as experience and other specific features related to a given job (e.g. supervising other workers). Therefore, like Gregory, Zissimos, and Greenhalgh (2001), we consider the occupational classification as a relevant measure of skill level. The PCS classifies workers into nine major groups:

- Group 1: Farmers
- Group 2: Craft and related trades workers and chief executives
- Group 3: Managers (includes liberal professions)
- Group 4: Intermediate occupations (professionals and technicians)
- Group 5: Skilled service and sales workers
- Group 6: Unskilled service and sales workers [23]
- Group 7: Skilled machine operators and elementary occupations
- Group 8: Unskilled machine operators and elementary occupations
- Group 9: Other (Military contingents, unknown)

We then aggregate these nine groups into five broad skill levels. The "high-skill" group comprises Group 3 and the "low-skill" group comprises Groups 6 and 8. The "intermediate-skill" level is divided into a higher part (Groups 4) and a lower part (Groups 5 and 7). Groups 1, 2 and 9 are aggregated into "other".

Autor and Dorn (2013) propose another classification to focus on technology effects on employment. It also relies on the occupational classification but takes into account the tasks associated to each job. Three levels are then identified: abstract, routine and manual tasks. Blinder (2009) suggests another classification specifically designed to measure *offshorability*, based on an index he builds. However, these classifications require a more detailed occupational classification, which is not available over a long period in the PCS classification[24].

Using French Labour Force Survey Employment data by skill level and activity are taken from the Labour Force Survey (LFS) over the period 1982-2010. The main advantage of this data is its exhaustive coverage: both employees and self-employed are surveyed, regardless of the activity they are working in. However, some caveats need to be addressed to combine the LFS with national accounts data. First, from 1982 to 2010 LFS underwent several breaks:

[23] Groups 5 and 6 are based on (Amossé and Chardon, 2006) classification. Group 6 includes home help, caretakers, salesclerk...

[24] These nine groups are built up from more detailed sub-groups. We stick to these nine groups, since we need long series for our analysis and long series are not available for a more detailed level over the period 1982-2010.

- transition to the new occupational classification in 2003 (PCS-1982 to PCS-2003);
- transitions to different activity classifications (NAP to NAF in 1993, NAF to NAF Rev.1 in 2003, and NAF Rev.1 to NAF Rev.2 in 2008);
- changes in the survey questionnaire and in data collection, especially in 2003 (transition from annual to continuous survey)

Second, active workers as defined by the International Labour Office (ILO) with LFS data slightly differ from those as defined in the national accounts. As the LFS cover households living in France, foreigners who live abroad but work in France are excluded from the active workers, while people living in France but working abroad are included. It is the opposite with the national accounts: only domestic employment is estimated. Another explanation for the discrepancies relies on the estimation of small part-time jobs and borderline jobs (partial or gradual retirement, students, limited activity...). Since estimations from LFS rely on spontaneous answers of the respondent, this kind of small jobs could be under-reported. In the case of limited activity, if respondents are unemployed the week they are surveyed but worked several hours during the previous months, they will be counted as active workers in the national accounts, but not in the LFS estimates.

To correct the former issues, we first address changes in the activity classifications by building transition matrices. In the case of the NAP-NAF transition in 1993 and the NAF Rev.1-NAF Rev.2 transition in 2008, we use the LFS dual coding available at the most highly disaggregated level (650 in NAP, 696 in NAF, 712 in NAF Rev.1, and 732 in NAF Rev.2). There is no dual coding in the LFS for the transition from NAF to NAF Rev. 1 in 2003 but, since very little changes were made between these classifications, we use a theoretical transition matrix. We also use a transition matrix to convert activities (in NAF Rev.2) into industries (national accounts classification at the level A38).

In a second step, we correct remaining breaks by benchmarking our employment matrices of active workers according to their skill levels and industries on two sets of series published by Insee: long series by occupation based on LFS data and long series by industries estimated by the national accounts.[25] Finally, we convert industries into products to fit the IOT concept.

The following figure illustrates the case involving the most numerous steps to correct LFS data, i.e. for activities defined in the NAP classification.

$$N^{activity}_{NAP,650} \Rightarrow N^{activity}_{NAF,696} \Rightarrow N^{activity}_{NAFrev1,712} \Rightarrow N^{activity}_{NAFrev2,732} \Rightarrow N^{activity}_{NAFrev2,129} \Rightarrow$$
$$N^{industry}_{NAFrev2,129} \Rightarrow N^{industry}_{NAFrev2,38} \xrightarrow{benchmarking} N^{industry}_{NAFrev2,38} \Rightarrow N^{product}_{NAFrev2,38}$$

[25]This benchmarking is based on a minimisation framework exposed in (Poissonnier, 2015a)

C Sectoral aggregation

Aggregated sector	Description	Average contribution (in % per year)			
		FC	Exports	Imports	Tech.
Manuf. High Tech.	CE - Chemicals	0.4	2.8	-2.1	-3.2
	CF - Pharmaceuticals	3.3	4.0	-2.5	-4.5
	C3- Electrical equip.	2.4	8.2	-6.1	-9.8
	CL - Transport equip.	-0.1	2.2	-1.2	-3.3
Manuf. Low Tech.	C1 - Food & drink	0.9	0.7	-0.5	-1.5
	CB - Textile & leather	-0.3	0.7	-4	-2.5
	CC - Wood & paper	0.8	1.2	-0.8	-2.8
	C2 - Coke & refined petroleum	0.7	1.0	-1.2	-2.8
	CG - Rubber & plastic	0.5	1.6	-1.3	-2.2
	CH - Metals	0	1.4	-1.3	-1.8
	CM - Other manuf.	0.1	1.4	-0.9	-1.8
Serv. non Tradable	FZ - Construction	0.2	0.1	0.0	-0.2
	IZ - Accomodation & food serv.	1.2	0.2	-0.1	0.6
	KZ - Finance	2.2	0.5	-0.1	-2.1
	LZ - Real estate	2.0	0.2	-0.1	-0.7
	OQ - Public adm.	7.1	0.1	-0.1	-1.7
	RU - Other serv.	6.0	0.7	-0.2	2.2
Serv. Tradable	GZ - Trade	1.4	1.0	-0.2	-1.5
	HZ - Transportation	1.1	1.1	-0.4	-1.2
	JZ - Info. & comm.	6.4	1.9	-0.8	-2.3
	MN - Business serv.	3.5	3.7	-1.7	3.8
Other	AZ - Agriculture	0.9	0.9	-0.6	-4.3
	DE - Energy & utilities	3.3	2.7	-3.7	-4.7

Source: Insee, national accounts; authors' calculations.

Note: For each row of the table, the contributions of final consumption, exports, imports and technology sum to the total change in the jobs required to produce each kind of product. The sectoral employment is measured in terms of jobs required to produce its final output, and does not represent the employment within the sector.

Table 7: Sectoral aggregation into 5 broad categories

D Breakdown of final consumption, trade and technology effects on employment changes by skill and product

Average contribution (in % per year)	**Total**	**Products in:** Manufacturing high-tech	Manufacturing low-tech	Services non-tradable	Services tradable	Agr. and energy
				Total		
Final consumption effects	1.21	0.02	0.05	0.7	0.4	0.04
Consumption structure	-0.08	0	-0.06	-0.02	0.02	-0.03
Purchasing power	0.44	0.01	0.05	0.16	0.18	0.04
Sociodemographic effects	0.27	0.01	0.04	0.09	0.11	0.03
Household saving	0.04	0	0.01	0.01	0.01	0.01
Gov. and NPISH consumption	0.55	0	0.01	0.46	0.08	0
				High skill		
Final Consumption effects	1.32	0.04	0.02	0.81	0.42	0.02
Consumption structure	0.07	0.01	-0.04	0.05	0.04	0
Purchasing power	0.38	0.01	0.03	0.15	0.18	0.01
Sociodemographic effects	0.23	0.01	0.02	0.09	0.11	0.01
Household saving	0.03	0	0	0.01	0.01	0
Gov. and NPISH Consumption	0.61	0.01	0.01	0.5	0.08	0
				Middle skill (higher)		
Final Consumption effects	1.34	0.03	0.03	0.86	0.38	0.03
Consumption structure	0.01	0.01	-0.04	0.01	0.03	0
Purchasing power	0.38	0.01	0.03	0.15	0.17	0.02
Sociodemographic effects	0.23	0.01	0.02	0.09	0.1	0.01
Household saving	0.03	0	0	0.01	0.01	0
Gov. and NPISH Consumption	0.69	0.01	0.01	0.6	0.07	0.01
				Middle skill (lower)		
Final Consumption effects	1.18	0.02	0.05	0.63	0.45	0.02
Consumption structure	-0.05	0	-0.07	0	0.01	0
Purchasing power	0.42	0.01	0.06	0.13	0.21	0.01
Sociodemographic effects	0.25	0.01	0.04	0.08	0.12	0.01
Household saving	0.04	0	0.01	0.01	0.02	0
Gov. and NPISH Consumption	0.53	0	0.02	0.42	0.09	0
				Low skill		
Final Consumption effects	1.27	0.02	0.06	0.8	0.37	0.03
Consumption structure	-0.19	0	-0.09	-0.07	0	-0.02
Purchasing power	0.5	0.01	0.07	0.21	0.18	0.03
Sociodemographic effects	0.3	0.01	0.05	0.12	0.1	0.02
Household saving	0.04	0	0.01	0.01	0.01	0
Gov. and NPISH Consumption	0.62	0	0.02	0.53	0.08	0
				Other skill		
Final Consumption effects	0.94	0	0.07	0.36	0.35	0.16
Consumption structure	-0.29	0	-0.06	-0.07	-0.01	-0.15
Purchasing power	0.59	0	0.07	0.15	0.18	0.18
Sociodemographic effects	0.36	0	0.05	0.09	0.11	0.12
Household saving	0.06	0	0.01	0.01	0.01	0.03
Gov. and NPISH Consumption	0.22	0	0	0.18	0.07	-0.02

Source: Insee, LFS and national accounts; authors' calculations.

Note: Column "Total" is equal to the sum of the remaining columns by product and displays the same figures as Table 3. In each panel, the first row is equal to the sum of the remaining rows.

Table 8: Breakdown of final consumption effects to employment change by skill and product. 1983-2010

Average contribution (in % per year)	**Total**	**Products in:**				
		Manufacturing		Services		Agr. and
		high-tech	low-tech	non-tradable	tradable	energy
				Total		
Trade effects	0.34	0.05	0.01	0.03	0.23	0.03
Exports	0.74	0.12	0.15	0.05	0.36	0.06
Offshore outsourcing	-0.26	-0.05	-0.09	-0.01	-0.09	-0.02
Home share in FC	-0.1	-0.02	-0.04	-0.01	-0.03	-0.01
Home share in GFCF	-0.04	-0.01	-0.01	0	-0.01	0
				High skill		
Trade effects	0.32	0.06	0.01	0.05	0.2	0.01
Exports	0.67	0.15	0.08	0.08	0.34	0.02
Offshore outsourcing	-0.22	-0.06	-0.05	-0.02	-0.08	-0.01
Home share in FC	-0.08	-0.02	-0.02	-0.01	-0.03	0
Home share in GFCF	-0.04	-0.01	-0.01	0	-0.02	0
				Middle skill (higher)		
Trade effects	0.32	0.06	0.01	0.04	0.2	0.01
Exports	0.67	0.16	0.12	0.06	0.32	0.02
Offshore outsourcing	-0.23	-0.06	-0.07	-0.01	-0.08	-0.01
Home share in FC	-0.09	-0.02	-0.03	-0.01	-0.03	0
Home share in GFCF	-0.04	-0.01	-0.01	0	-0.01	0
				Middle skill (lower)		
Trade effects	0.37	0.06	0.01	0.03	0.26	0.01
Exports	0.81	0.14	0.18	0.05	0.42	0.02
Offshore outsourcing	-0.29	-0.05	-0.11	-0.01	-0.11	-0.01
Home share in FC	-0.11	-0.02	-0.05	0	-0.04	0
Home share in GFCF	-0.05	-0.01	-0.01	0	-0.01	0
				Low skill		
Trade effects	0.3	0.04	-0.01	0.02	0.23	0.01
Exports	0.72	0.1	0.18	0.04	0.37	0.04
Offshore outsourcing	-0.27	-0.04	-0.11	-0.01	-0.1	-0.02
Home share in FC	-0.11	-0.01	-0.06	0	-0.03	-0.01
Home share in GFCF	-0.03	-0.01	-0.01	0	-0.01	0
				Other skill		
Trade effects	0.38	0.01	0.01	0.03	0.21	0.12
Exports	0.78	0.02	0.11	0.05	0.31	0.28
Offshore outsourcing	-0.25	-0.01	-0.06	-0.01	-0.07	-0.11
Home share in FC	-0.12	0	-0.04	-0.01	-0.02	-0.05
Home share in GFCF	-0.02	0	-0.01	0	-0.01	0

Source: Insee, LFS and national accounts; authors' calculations.

Note: Column "Total" is equal to the sum of the remaining columns by product and displays the same figures as Table 4. In each panel, the first row is equal to the sum of the remaining rows.

Table 9: Breakdown of trade effects to employment change by skill and product. 1983-2010

Average contribution (in % per year)	Total	Products in: Manufacturing high-tech	Manufacturing low-tech	Services non-tradable	Services tradable	Agr. and energy
				Total		
Offshore outsourcing	-0.26	-0.05	-0.09	-0.01	-0.09	-0.02
Narrow offshore outsourcing	-0.12	-0.01	-0.03	-0.01	-0.06	-0.01
				High skill		
Offshore outsourcing	-0.22	-0.06	-0.05	-0.02	-0.08	-0.01
Narrow offshore outsourcing	-0.09	-0.01	-0.02	-0.01	-0.05	0
				Middle skill (higher)		
Offshore outsourcing	-0.23	-0.06	-0.07	-0.01	-0.08	-0.01
Narrow offshore outsourcing	-0.1	-0.01	-0.02	-0.01	-0.05	0
				Middle skill (lower)		
Offshore outsourcing	-0.29	-0.05	-0.11	-0.01	-0.11	-0.01
Narrow offshore outsourcing	-0.13	-0.01	-0.04	-0.01	-0.07	0
				Low skill		
Offshore outsourcing	-0.27	-0.04	-0.11	-0.01	-0.1	-0.02
Narrow offshore outsourcing	-0.13	-0.01	-0.04	0	-0.07	0
				Other skill		
Offshore outsourcing	-0.25	-0.01	-0.06	-0.01	-0.07	-0.11
Narrow offshore outsourcing	-0.13	0	-0.02	-0.01	-0.07	-0.03

Source: Insee, LFS and national accounts; authors' calculations.

Note: Column "Total" is equal to the sum of the remaining columns by product.
Offshore outsourcing in the broad sense is defined as imported intermediate inputs from all productions, while narrow offshore outsourcing is restricted to those from the same product.

Table 10: Breakdown of trade effects to employment change by skill and product (focus on offshore outsourcing effects. 1983-2010

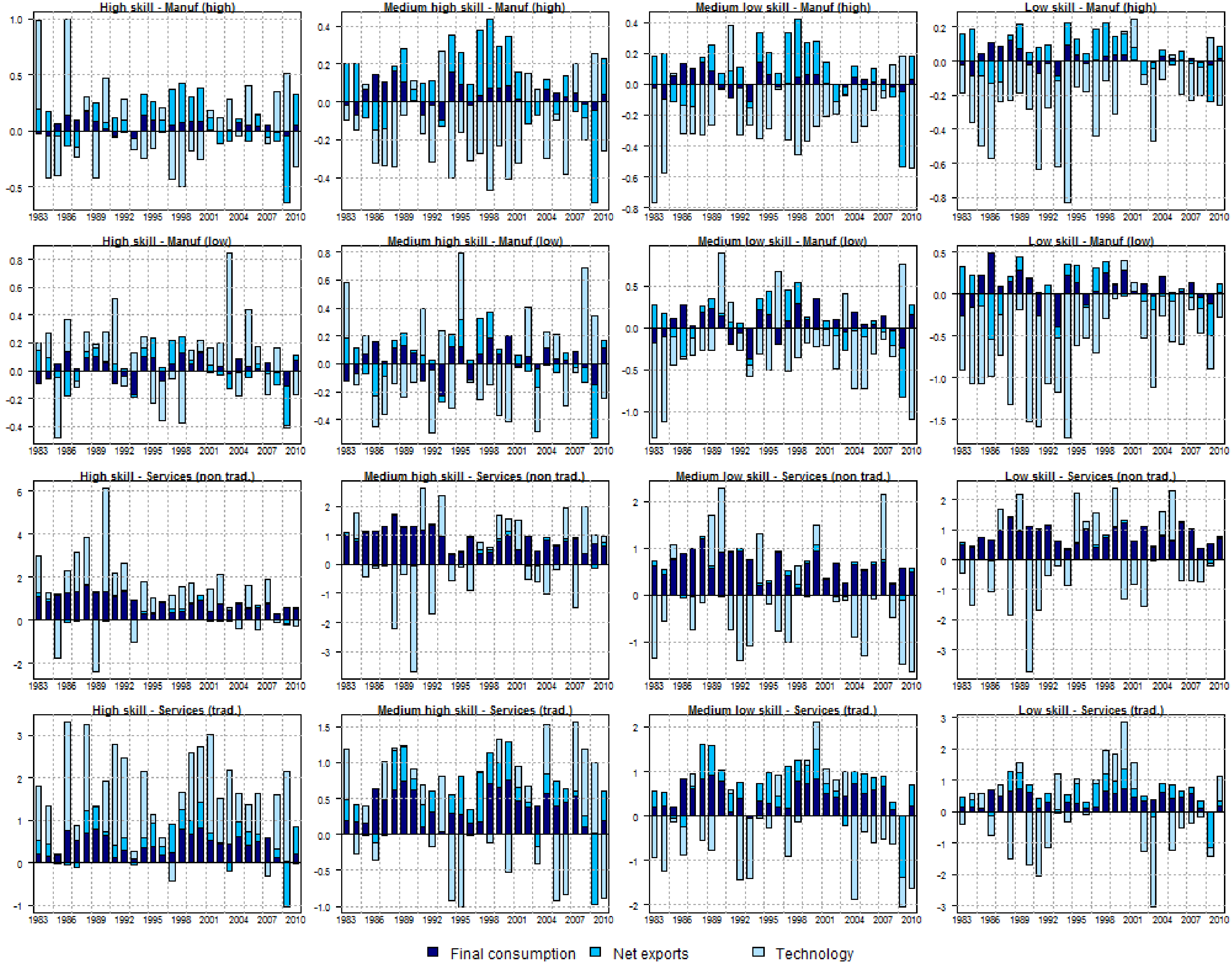
Average contribution (in % per year)	Total	Products in: Manufacturing high-tech	Manufacturing low-tech	Services non-tradable	Services tradable	Agr. and energy
				Total		
Technology effects	-0.95	-0.15	-0.25	-0.21	-0.15	-0.19
Direct labour saving	-1.16	-0.18	-0.3	-0.1	-0.38	-0.21
IC effects	-0.08	0.01	0.01	-0.18	0.06	0.02
GFCF effects	0.3	0.02	0.04	0.06	0.18	0
				High skill		
Technology effects	1.73	0.02	0.05	0.61	1	0.04
Direct labour saving	1.35	-0.02	0.01	0.73	0.58	0.04
IC effects	-0.07	0.02	0.01	-0.17	0.07	0
GFCF effects	0.45	0.02	0.03	0.04	0.36	0
				Middle skill (higher)		
Technology effects	-0.28	-0.14	-0.03	-0.15	0.04	0
Direct labour saving	-0.44	-0.18	-0.08	0.03	-0.21	0
IC effects	-0.13	0.01	0.02	-0.22	0.07	0
GFCF effects	0.29	0.02	0.04	0.04	0.18	0
				Middle skill (lower)		
Technology effects	-1.17	-0.21	-0.23	-0.28	-0.43	-0.02
Direct labour saving	-1.49	-0.23	-0.3	-0.2	-0.73	-0.03
IC effects	0.01	0.01	0.02	-0.16	0.13	0.01
GFCF effects	0.32	0.02	0.05	0.08	0.16	0
				Low skill		
Technology effects	-1.46	-0.23	-0.6	-0.33	-0.26	-0.05
Direct labour saving	-1.46	-0.25	-0.63	-0.17	-0.34	-0.07
IC effects	-0.24	0.01	-0.01	-0.21	-0.04	0.02
GFCF effects	0.23	0.01	0.04	0.05	0.13	0
				Other skill		
Technology effects	-3.02	-0.04	-0.39	-0.62	-0.63	-1.35
Direct labour saving	-3.23	-0.04	-0.41	-0.61	-0.73	-1.44
IC effects	-0.03	0	-0.01	-0.12	-0.01	0.09
GFCF effects	0.24	0	0.03	0.1	0.11	0

Source: Insee, LFS and national accounts; authors' calculations.

Note: Column "Total" is equal to the sum of the remaining columns by product and displays the same figures as Table 5. In each panel, the first row is equal to the sum of the remaining rows.

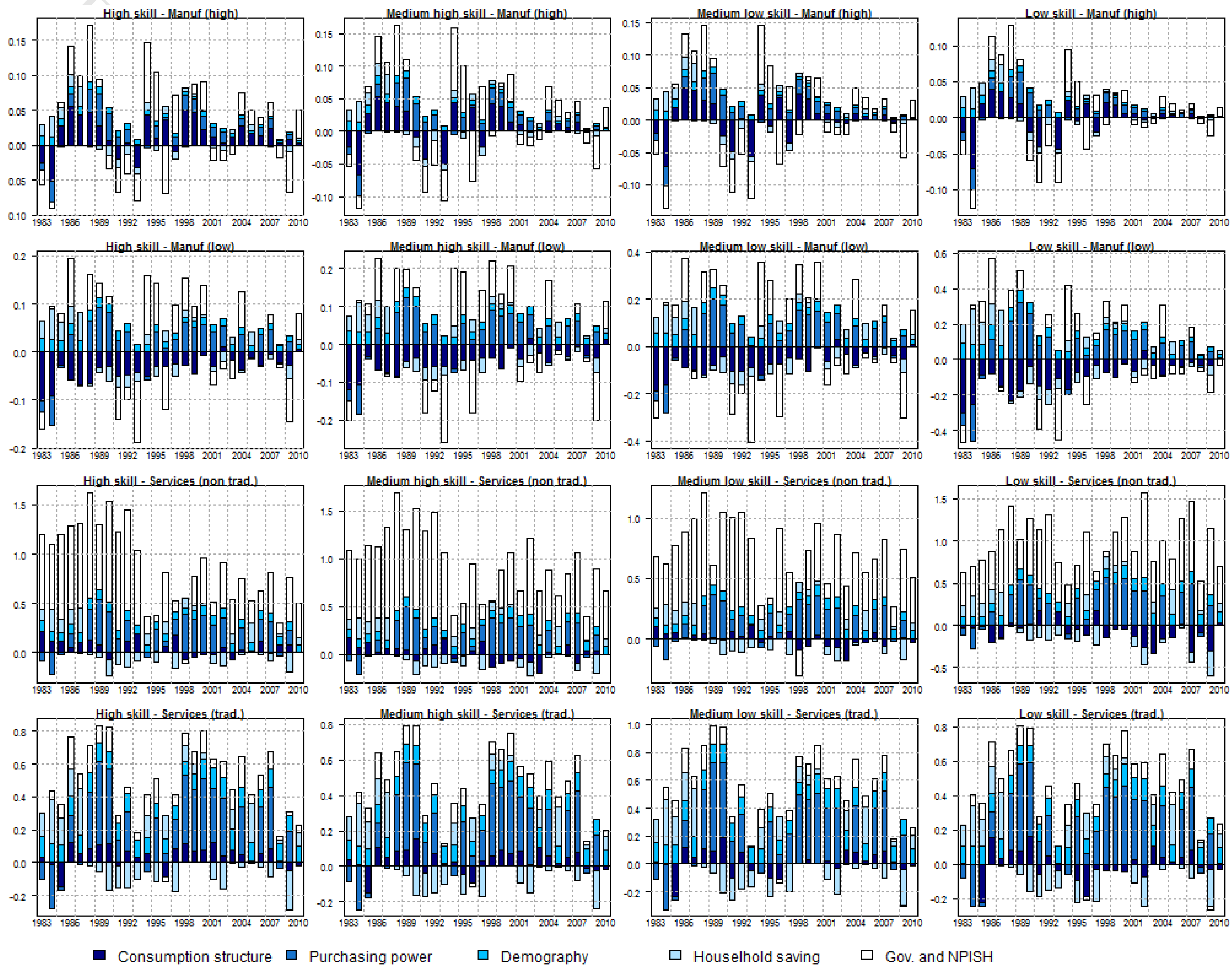
Table 11: Breakdown of technology effects to employment change by skill and product. 1983-2010

E Evolution of contribution to jobs creation by skill and sector



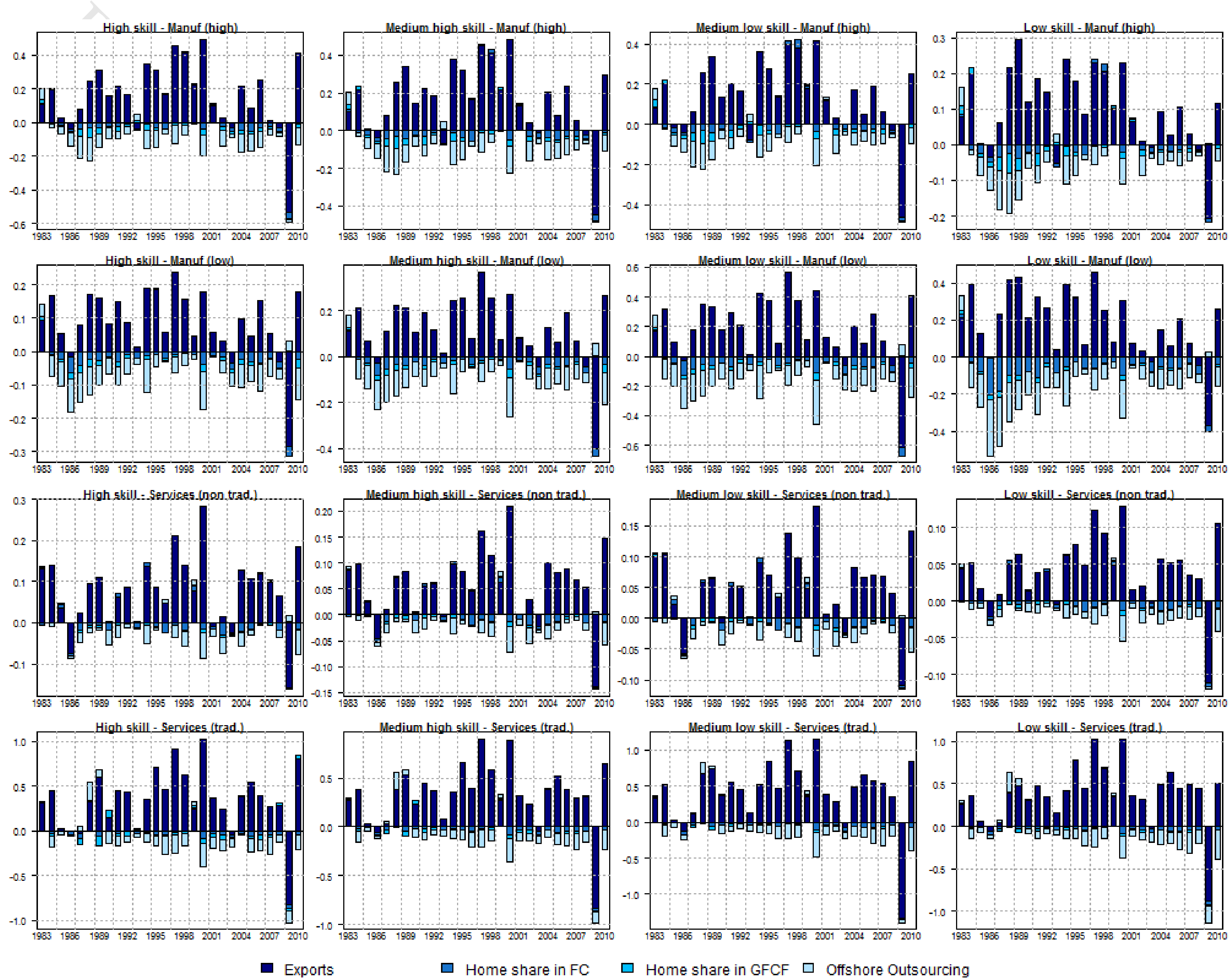
Source: Insee, LFS and national accounts; authors' calculations.

Figure 10: Final consumption, trade, and technology effects on employment change, by skill level and product (in %). 1983-2010



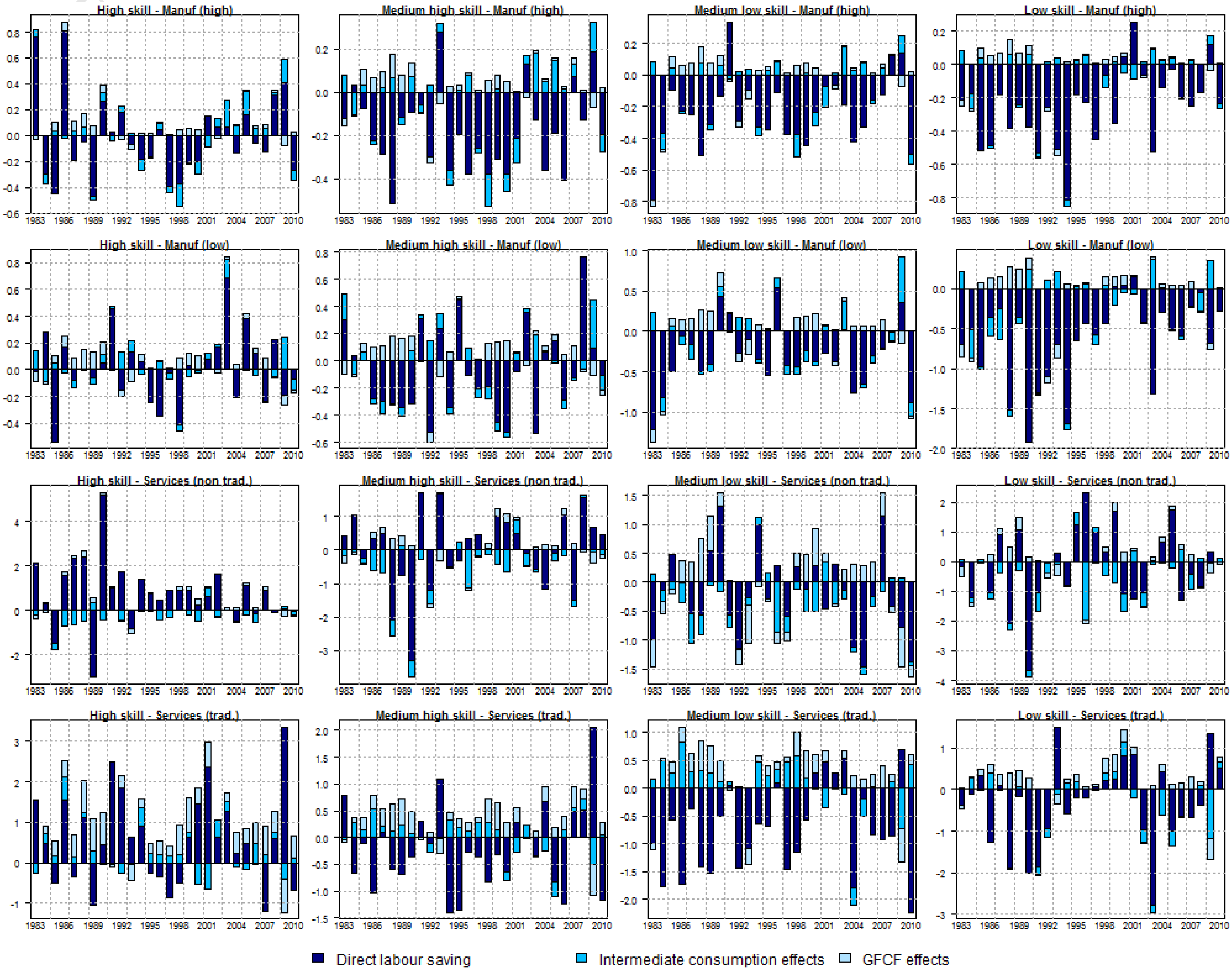
Source: Insee, LFS and national accounts; authors' calculations.

Figure 11: Breakdown of final consumption effects on employment change, by skill level and product (in %). 1983-2010



Source: Insee, LFS and national accounts; authors' calculations.

Figure 12: Breakdown of trade effects on employment change, by skill level and product (in %). 1983-2010



Source: Insee, LFS and national accounts; authors' calculations.

Figure 13: Breakdown of technology effects on employment change, by skill level and product (in %). 1983-2010