Productivity Growth and Resource Reallocation in France: The Process of Creative Destruction

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Abstract – Based on a large sample of French firms, this article examines the contribution of resource reallocation and of the learning effect to changes in total factor productivity (TFP) before (2000-2007) and after (2008/2009-2012) the 2008 crisis. First, we show that there was very little TFP growth before the crisis and that a fall occurred between 2008 and 2012. Second, we show that the evolution of TFP is highly dependent on the learning effect, as measured here by internal firm performance. Its negative contribution after the crisis is indicative of the difficulties experienced by firms in France in adjusting their production scale rapidly and effectively. However, this effect was reduced by 1) a process of resource reallocation towards the most productive continuing firms, which only really took hold from 2009 onwards, and 2) an earlier Schumpeterian process of creative destruction (cleansing effect), the first signs of which appeared in 2008.

JEL Classification: L2, L25, O4, C10
Keywords: total factor productivity, resource reallocation, learning, process of creative destruction, Schumpeter

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In 2009, the number of firms created in France, excluding the "*auto-entrepreneur*" status[1], fell by almost 21.5% compared to the previous year (Hagège & Clotilde, 2012). At the same time, 8,033 additional business failures were recorded, an increase of 14.5% compared to 2008. Failing firms exiting the market, but also the least productive continuing firms, serve to free up resources for the best performers. The transfer of resources to the most productive firms – a process known in the literature as "resource reallocation" – is not without consequences for aggregate productivity trends and, therefore, for employment and wealth creation.

In examining aggregate productivity trends, the literature has mainly focused on the role of resource reallocation and internal performance specific to firms (learning effects). In periods of crisis, the effects on their contributions can be ambiguous. On the one hand, a decline in demand leads to a decline in production and, consequently, a decrease in the productive performance of firms. On the other hand, the crisis served to "clean up" the various sectors by crowding out the worst performing companies, possibly reducing entry barriers for potential entrants and allowing survivors to restructure in order to return to their pre-crisis levels of growth. In this context, it is not inconceivable that the 2008 financial crisis played a major role in the process of creative destruction through the net flows of new business start-ups in France. The churn of firms, conducive to the process of resource reallocation, may lead to productivity gains, as suggested, for example, in a study by Foster *et al*. (2006) focusing on the US retail sector of the 1990s.

In this paper, we examine the process of resource reallocation between French firms and its contribution to sectoral and national productivity growth before (2000-2007) and after (2008-2012 and 2009-2012) the 2008 crisis with the twofold aim of 1) differentiating the contribution of learning to the evolution of sectoral productivity and the contribution due to resource reallocation with a view to understanding the mechanisms underlying the slowdown in productivity from the early 2000s onwards and 2) examining the evolution of these mechanisms following the 2008 crisis with a view to capturing a potential Schumpeterian process of creative destruction (cleansing effect).[2] To this end, several methods are used to decompose total productivity (Griliches & Regev, 1995; Foster *et al.*, 2015; Melitz & Polanec, 2015).

In this study, as in Carreira & Teixeira (2016) and Martin & Scarpetta (2012), among others, resource reallocation is measured based on changes in market shares. The aim is also to assess the learning capacity of firms and its effects on aggregate productivity growth. Learning capacity is measured by the evolution of the TFP of continuing firms. TFP is estimated per sector using the Levinsohn & Petrin (2003) method – abbreviated to "LP" in the remainder of the paper – based on a sample group of firms covering the period 2000-2012. The data are drawn from the Insee's complete and consolidated SUSE file[3] (FICUS[4]) before 2008 and Insee's annual statistics on companies (ESANE[5] and FARE[6]) from 2008 onwards.

To assess the effect of the 2008 crisis on both learning and resource reallocation mechanisms in France, we compare the results obtained with several decompositions. The results obtained show that aggregate productivity grew on average by 0.66% per year between 2000 and 2007. They also clearly highlight the effects of the 2008 crisis, which had a major impact on productivity across all sectors, with an average decline of 0.32% per year between 2008 and 2012. However, a slight rebound in productivity is observed from 2009 onwards, with an average annual growth rate of 0.36% between 2009 and 2012. Before the 2008 crisis, and depending on the decomposition method used, the learning effect and resource reallocation each contribute significantly to the evolution of aggregate productivity in France (one to two thirds). During the post-crisis period, the results obtained highlight a learning effect representing the main factor behind the decline in productivity in France, with a contribution ranging between 280% and 138% depending on the chosen method. However, two mechanisms played a key role in mitigating the decline: 1) a process of resource reallocation to continuing firms, the effect of which is positive and continues to grow after the crisis over the 2009-2012 period, and

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1. For further details on the "auto-entrepreneur" status, see: https://www.insee.fr/en/metadonnees/definition/c2066.

2. The Schumpeterian process of creative destruction refers here to the entry of new firms into a (competitive) market which, through innovation (whether product, process, organisational, marketing or other innovations) results in the disappearance and obsolescence of old firms and ensures the permanent renewal of production structures. For a formal theoretical framework relating to the Schumpeterian hypothesis, see Aghion & Howitt (1992).

3. Unified Corporate Statistics System (Insee).

4. Complete Consolidated SUSE file.

5. Elaboration of Annual Statistics of Companies.

6. File approaching the results of ESANE.

2) a Schumpeterian process of creative destruction, which contributed positively to aggregate TFP growth before the crisis and played a greater role in the post-crisis period, regardless of the post-crisis period chosen (2008-2012 or 2009-2012). However here, the Schumpeterian process should be seen above all as having a cleansing effect – a process mostly driven by the disappearance of the least productive firms.

The remainder of the paper is organised as follows: after a literature review, a section is devoted to presenting the different methods for decomposing aggregate productivity. We then present the data used and descriptive statistics, before examining the results obtained and discussing them. The paper ends with concluding remarks.

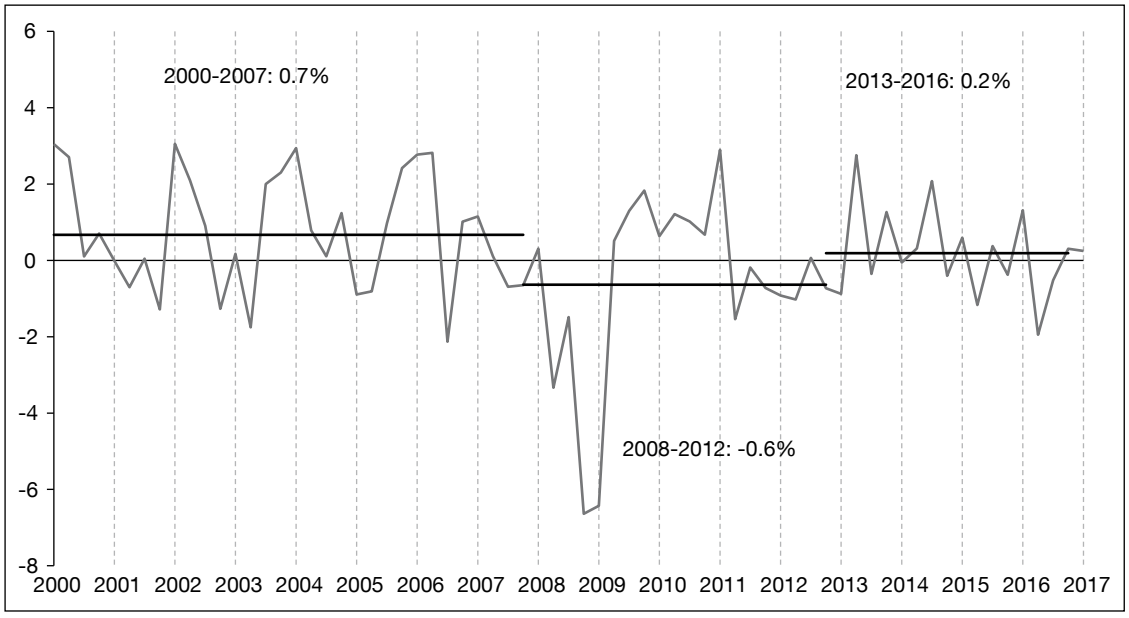
Literature Review

A recent literature on resource reallocation and the impact of the process of business renewal and growth on the slowdown in aggregate total factor productivity (TFP) has emerged (see, in particular, Berthou, 2016; Midrigan & Xu, 2014; Restuccia & Rogerson, 2013; Hsieh & Klenow, 2009). In evidence in France since the early 2000s, the decline increased after the 2008 crisis, as shown by an estimate of total factor productivity (Figure I).[7]

A first explanation for the slowdown may be found in the difficulty of reallocating resources to the most productive firms (Cette *et al.*, 2017). When not prevented by labour market rigidities or by frictions in the credit market (Musso & Schiavo, 2008), resource reallocation reflects market share gains for successful firms benefiting from production factors adapted to their activity. Another explanation for the slowdown in productivity growth is the inability of firms to adapt to an increasingly changing and highly competitive environment. Some studies have emphasised this explanation, arguing that the internal performance specific to firms (learning effect, to use the terminology of Baldwin & Rafiquzzaman, 1995), is the main source

7. Here, TFP growth is estimated by adjusting the growth in value added of market sectors with two terms: the growth rate of capital services, estimated as the growth in the net capital stock of financial and non-financial firms and the growth rate of labour services, estimated as the growth rate of hours worked in the market sector. Each of these terms is weighted by the share of each factor (labour or capital) in value added. The weighting coefficient takes a fixed value equal to 35% for the capital factor and to 65% for the labour factor.

Figure I
Estimation of Total Factor Productivity (TFP) Growth in France (Annualised Quarterly Growth Rate, 2000-2016)



Reading Note: The annualised quarterly growth rate of TFP corresponds to the growth rate of TFP over a year if it were to vary over the year at the same rate as during the quarter considered.
Coverage: All market sectors
Sources: Insee; author's calculations.

of aggregate productivity growth and decline (Foster *et al.*, 2015; Hallward-Driemeier & Rijkers, 2013; Griffin & Odaki, 2009). The theoretical literature distinguishes between active learning (Ericson & Pakes, 1995) and passive learning (Jovanovic, 1982). In the active learning model of Ericson & Pakes, firms are able to develop their productivity through investments (in R&D, physical capital, etc.), in the knowledge that the investments made do not have an immediate effect, that they have uncertain returns and that the economic environment may result in increased competitive pressures in the markets. In this analytical framework, firms that are unable to adapt to changes in the environment by making sufficient investment compared to their competitors or by increasing their productivity will collapse and disappear from the market. Others will be able to increase their level of productivity and, consequently, the productivity of their sector.

The passive learning model assumes that firms face uncertainty in terms of their level of productivity/performance. For Jovanovic (1982), potential market entrants cannot know their level of productivity in advance and only discover their chances of survival and their level of growth after they have entered the market. However, what they can know is the distribution of the sector's performance. Their presence in the market will enable them to discover their level of productivity gradually, given their a priori performance. Once this level is known, firms may either remain in the industry or leave if their productivity level is too low. This type of learning may result in a Schumpeterian process of creative destruction with a net entry effect (entries minus exits), the level of which will depend on the learning capability of firms once they entered the market.

Many studies have shown that the potential productivity gains associated with a better allocation of resources are significant. Hsieh & Klenow (2009) estimate them at between 30% and 50% in the case of China between 1998 and 2005 and between 40% and 60% in the case of India between 1987 and 1994 if both countries had an economic efficiency level equivalent to that of the United States. In their general equilibrium model, which takes into account the diversity of firms and market distortions, they measure resource misallocation[8] (sub-optimal allocation) in both countries based on the gap with the productivity of U.S. firms (as a benchmark). Petrin & Sivadasan (2011) , for their part, contend that a better allocation of resources, measured by reducing the gap between the marginal productivity of Chilean firms and the cost of their production factors by one unit, could have led to an increase in their aggregate value added of 0.5% on average between 1982 and 1994. Foster *et al*. (2001) use techniques to decompose the evolution of aggregate productivity. They estimate that the reallocation of labour input between firms entering and exiting the same sector accounts for more than 25% of U.S. industrial productivity growth between 1977 and 1987. Lentz & Mortensen (2008) show that the reallocation of labour in Denmark over the period 1992-1997 contributed more than 50%.

In the case of France, Cette *et al*. (2017) posit, based on an analysis of the dispersion of firm productivity, that resource reallocation has deteriorated since the early 2000s. The study by Fontagné & Santoni (2015) takes a similar position, showing that misallocation applies particularly to small and old firms. Osotimehin (2016) considers, on the one hand, the significance of reallocation towards the most productive continuing firms and, on the other, the process of creative destruction. The author shows that, over the period 1989-2007, the contribution of reallocation towards the most productive continuing firms to the evolution of French sectoral total factor productivity (TFP) is greater than that resulting from a Schumpeterian process of creative destruction.

Different methods of decomposing the evolution of productivity have been proposed to quantify the effect of reallocation on sectoral productivity change. The results vary according to the period studied and, above all, according to the decomposition method used. The first decomposition was proposed by Baily *et al*. (1992) – hereinafter abbreviated to BHC. With this method, the effect of the creative destruction process is highly sensitive to the number of firm entries and exits: if, at a given level of productivity, there are more entries than exits, the net effect (entries minus exits) will invariably be negative (Haltiwanger, 1997). Foster *et al*. (2001) – hereinafter abbreviated as FHK – and Griliches & Regev (1995)

8. In this study, the term "misallocation" refers to the misallocation of resources between companies due to market imperfections. A recent literature has emerged that examines various channels of misallocation such as constraints on access to credit (Midrigan & Xu, 2014), the survival of "zombie" firms (McGowan et al.*, 2017) and regulatory distortions (Ordonez, 2014).*

– hereinafter abbreviated as GR – propose two decomposition methods that correct this bias by taking into account a "size" effect. The FHK decomposition calculates the contribution of entries and exits as a deviation from average sectoral productivity at the beginning of the period, while GR calculates their contribution relative to the average aggregate productivity between two years (*t* and *t–k*). According to GR, the FHK method is sensitive to measurement errors. For its part, the GR method poses a problem related to the interpretation of learning and reallocation effects. Melitz & Polanec (2015) – hereinafter abbreviated as MP – show, with reference to the 1995-2000 period of strong growth in Slovenia, that all these methods suffer from a bias related to the overestimation of the contribution of entering firms, thereby underestimating the contribution of reallocation to the most productive continuing firms, which is two to three times greater than with the GR and FHK methods. The results obtained in this study do not support this claim and the PM method appears to be equally sensitive, at least for the period studied.[9]

Methodology

Aggregate productivity for the entire economy or sector P_t at time *t* is defined as a weighted average of the productivity of each firm:

$$P_t = \sum_i \theta_{it} p_{it}$$

Where θ_{it} represents the share of the value added of firm *i* at time *t* and p_{it} measures the log of TFP. Although other performance measures have been used in the literature, this study focuses on TFP, estimated by the Levisohn & Petrin (2003) method (see Box).

The first decomposition proposed by Baily *et al*. (1992) shows four components of the change in aggregate productivity:

$$\Delta P_t = \underbrace{\sum_{i\in C} \theta_{it-k} \Delta p_{it}}_{\textit{Within effect}} + \underbrace{\sum_{i\in C} \Delta\theta_{it}\ p_{it}}_{\textit{Between effect}} + \underbrace{\sum_{i\in N} \theta_{it}\ p_{it} - \sum_{i\in X} \theta_{it-k}\ p_{it-k}}_{\textit{Net Entry effect}}$$

where Δ is the rate of change (TFP being expressed in logarithms) over a period of *k* years between the first year $t - k$ and the last year *t*; *C*, *N* and *X* are categories of continuing, entering and exiting firms[10], respectively.

Productivity growth is divided into two distinct effects: the learning effect (or learning process)

9. See the section on "The Scale of the Schumpeterian Process" for a comparative analysis of the results using the MP decomposition on the one hand and using the FHK and GR decompositions on the other.

10. A firm is deemed to be "continuing" if it was trading in t – k *and in* t. *A firm is deemed to be "exiting" if it was trading in* t – k *and non-existent in* t. *If it was trading in* t *and non-existent in* t – k, *it has the status of an "entering" firm.*

Box – **TFP Estimated by the Levinsohn & Petrin Method (2003)**

To calculate TFP, we estimate a Cobb-Douglas production function with two production factors (capital and labour) without imposing the nature of returns to scale:

$$y_{ijt} = ptf_{ijt} + \beta_{lj} l_{ijt} + \beta_{kj} k_{ijt} + \varepsilon_{ijt}$$

where y_{ijt} is the value added of firm *i* in sector *j* in year *t*, deflated by its annual price index; Parameter ptf_{ijt} is total factor productivity; l_{ijt} the number of employees at year end and k_{ijt} physical capital stock, deflated by the annual investment price index. All variables are expressed in logarithms and the price indices used are at the sector level. The estimates are conducted on a sector-specific basis according to the ten-sector aggregated classification of the NAF rev 2 over the period 2000-2012. The statistical unit is the firm (*l'entreprise*) within the meaning of the LME. Parameter ε_{ijt} is the idiosyncratic error term measuring potential productivity shocks.

Among the recent methods for estimating production functions, this study uses the method developed by Levinsohn & Petrin (2003). One of the main advantages of this semi-parametric method is that unobserved productivity shocks can be controlled for. Olley & Pakes (1996) use investment as a proxy to approximate this shock. To reduce attrition bias, we follow Levinsohn & Petrin (2003) in using intermediate consumption, which is less likely to have a null value compared to investment.

The results show significant differences in the elasticity of estimated production factors between sectors (see Appendix 2). These differences reflect the heterogeneity of production technologies used and the difference in capital intensity.[(a)]

(a) Based on firm data (FICUS) for France, Blanchard & Mathieu (2016) show that the elasticity of production factors (capital and labour) estimated using the methods of Levinsohn & Petrin (2003), Olley & Pakes (1996) and Ackerberg et al. (2015) yield very similar results.

of firms and a resource reallocation effect. Here, the first term is considered to represent the share of productivity due to learning that results from the evolution of productivity in continuing firms, corresponding to the *within effect*. The second term is the *between effect* of continuing firms, which measures the variation of productivity following a change in the composition of market shares. Finally, the last two terms measure the *net entry effect* of the creative destruction process.

Unlike those that follow, this decomposition is not calculated relative to a reference productivity level, which means that the contribution of entering firms is invariably positive and the contribution of exiting firms is invariably negative regardless of their level of productivity.

To mitigate this problem related to the contribution of entries-exits, FHK, but also GR, propose a method of decomposition in which the contribution of entries-exits is calculated relative to a reference level of aggregate productivity.

The FHK Method (Foster, Haltiwanger & Krisan, 2001)

For FHK, the reference productivity level is the average productivity at the beginning of the period. A distinction is drawn between five effects commonly referred to as the *within effect*, the *between effect*, the *cross effect*, the *entry effect* and the *exit effect*, presented in that order below:

$$\Delta P_t = \underbrace{\sum_{i\in C}\theta_{it-k}\Delta p_{it}}_{\text{Within effect}} + \underbrace{\sum_{i\in C}\Delta\theta_{it}\left(p_{it-k}-P_{t-k}\right)}_{\text{Between effect}} + \underbrace{\sum_{i\in C}\Delta\theta_{it}\Delta p_{it}}_{\text{Cross effect}} + \underbrace{\sum_{i\in N}\theta_{it}\left(p_{it}-P_{t-k}\right)-\sum_{i\in X}\theta_{it-k}\left(p_{it-k}-P_{t-k}\right)}_{\text{Net Entry effect}}$$

The first term – the *within effect* – represents the share of the evolution of productivity due to learning; the second term is a *between effect* measuring the contribution of resource reallocation to continuing firms. An increase in market share leads to a positive *between effect* if the firm's productivity is higher than the average productivity of the sector at the beginning of the period. The third term – the covariance (cross effect) between productivity and firm size – is positive when the firm's productivity and market shares vary in the same direction. This term shows that in order for a firm to contribute to TFP growth it must be increasingly efficient and gain market shares even if its productivity is lower than the average productivity of its sector. Therefore, the cross term reflects a reallocation process, albeit not necessarily towards the most productive firms. Finally, the last two terms measure the effect of market entries and exits. Taking into account the net effect of entries, it is possible to assess the effect of the creative destruction process on aggregate productivity.

The FHK decomposition method raises measurement issues acknowledged by the authors themselves. The calculation of the various contributions relative to average productivity at the beginning of the period may overestimate the contribution of the entry effect and therefore underestimate the contribution of continuing firms. Entering firms are not, by construction, included in the calculation of average productivity at the beginning of the period, which appears in the between and net entry effect terms. By not taking into account entering firms in the calculation of the reference productivity level, their contribution will be overestimated while the contribution of continuing firms will be underestimated.

The GR decomposition can be used to control these measurement errors since the reference productivity level is calculated using a time average including entering and continuing firms.

The GR Method (Griliches & Regey, 1995)

GR measures reference productivity as the average aggregate productivity between two periods ($\bar{P}$):

$$\Delta P_t = \underbrace{\sum_{i\in C}\bar{\theta}_i\Delta p_{it}}_{\text{Within effect}} + \underbrace{\sum_{i\in C}\Delta\theta_{it}\left(\bar{p}_i-\bar{P}\right)}_{\text{Between effect}} + \underbrace{\sum_{i\in N}\theta_{it}\left(p_{it}-\bar{P}\right)-\sum_{i\in X}\theta_{it-k}\left(p_{it-k}-\bar{P}\right)}_{\text{Net Entry effect}}$$

The first term always represents the *within effect* but now weighted by the time average of the market shares of firm *i*. The *between effect* and the *net entry effect* are calculated relative to temporal average productivity. The advantage of this decomposition is that it is less sensitive to measurements errors. However, it may pose a problem when interpreting contributions. The within and between effects are interdependent since, in the first case, the weighting used is the average of the market shares while, in the

second case, the weighting is their difference (Duhautois *et al*., 2008). Moreover, the decomposition does not show a cross term that might reflect a possible mechanism for reallocating to firms that become more productive over the period studied, regardless of their initial level of productivity.

Decomposition Based on the MP Method (Melitz & Polanec, 2015).

Based on the static decomposition by Olley & Pakes (1996):

$$P_t = \sum_i \theta_{it} p_{it} = \bar{p}_t + \sum_i \left(\theta_{it} - \bar{\theta}_t\right)\left(p_{it} - \bar{p}_t\right)$$
$$= \bar{p}_t + cov\left(\theta_{it}, p_{it}\right)$$

MP propose a dynamic decomposition that takes into account the entry-exit movements of firms:

$$\Delta P_t = \underbrace{\Delta \bar{p}_t}_{Within\ effect} + \underbrace{\Delta cov\left(\theta_{it}, p_{it}\right)}_{Cross\ effect}$$
$$+ \underbrace{\sum_{i \in N} \theta_{it} \left[\sum_{i \in N} \frac{\theta_{it}}{\sum_{i \in N} \theta_{it}} p_{it} - \sum_{i \in C} \frac{\theta_{it}}{\sum_{i \in C} \theta_{it}} p_{it} \right]}_{Net\ Entry}$$
$$\underbrace{- \sum_{i \in X} \theta_{it-k} \left[\sum_{i \in X} \frac{\theta_{it-k}}{\sum_{i \in X} \theta_{it-k}} p_{it-k} - \sum_{i \in C} \frac{\theta_{it-k}}{\sum_{i \in C} \theta_{it-k}} p_{it-k} \right]}_{effect}$$

With: $\Delta \bar{p}_t = \frac{1}{n_t} \sum_{i \in C} p_{it} - \frac{1}{n_{t-k}} \sum_{i \in C} p_{it-k}$ and $cov\left(\theta_{it}, p_{it}\right)$
$$= \sum_{i=C} \left(\theta_{it} - \bar{\theta}_t\right)\left(p_{it} - \bar{p}_t\right)$$

The first term represents the *within effect*. It differs from the within effect obtained with the BHC, FHK and GR methods. The focus is on a non-weighted average of the productivity of continuing firms. It is based on the first term of the decomposition of Olley & Pakes (1996) by taking the difference of this average between year t and year $t - k$. The second term – *cross effect* – also corresponds to the cross term of the Olley & Pakes decomposition in variation. Therefore, it cannot be compared to the FHK method (calculated as a deviation from the productivity of continuing firms over the initial period).

In what follows, we present and compare the results of the different decomposition methods applied to French data. Since no one method prevails over the others, a comparative analysis of the results obtained with the three decomposition methods – FHK (2001), GR (1995) and MP (2015) – remains pertinent.

Data

The data used are drawn from the FICUS file for the period 2000-2007 and from the ESANE file for the period 2008-2012. Both databases cover all firms subject to corporate income tax. They contain information on, among other things, value added, investment and fixed assets. The employment variables are taken from the Annual Declarations of Social Data (*Déclarations annuelles de données sociales*, or DADS).

Estimates of labour and capital elasticities by sector are carried out using the notion of "*entreprise*" ("firm") as defined in Law No. 2008-1354 on the Modernisation of the Economy (*Loi de modernisation de l'économie*, LME), which takes into account the "group" dimension (see Appendix 2).[11] The Financial Links Between Enterprises Survey (LIFI) was therefore used. Insee data by sector of activity are also used to obtain deflators of value added, capital, intermediate consumption and investment.

Firms with more than 9 employees are selected to ensure the estimates are not sensitive to measurement errors with a significant impact on very small firms. As in Guillou & Nesta (2015), ten sectors were selected, representing nearly 90% of market value added: five manufacturing sectors (Food, beverages and tobacco products, Coke and refined petroleum products, Equipment and machinery, Transport equipment, Other industrial products), the construction sector and four main categories within the service sector ("Low- and medium-" technology business services including "Transport and storage" and "Administrative and support services"; High-technology business services including "Information and communication" and "Scientific and technical services"; Financial and real estate activities; Other services including "Sale and repair" and "Accommodation and food services").

*11. All the variables used in this study are aggregated (unconsolidated) to characterise the new statistical unit: "*entreprise*" ("firm") within the meaning of the LME. The aggregation only concerns legal entities with an ownership percentage greater than or equal to 50% and whose group head is a resident. The sector of the firm corresponds to the sector of the legal entities with the greatest weight of value added in the firm, provided such weight exceeds 50%. Where no sector exceeds the 50% threshold, the weight is measured by the number of employees. If neither of the two criteria verifies this condition, a classification based on value added is used (Cahn* et al.*, 2016). In this context, the notion of continuance (or survival) is linked to the continuance (survival) of the group's leadership. For a comparison of the results obtained for firms as legal units or in the meaning of the LME, see Online complement C2. A link to Online complements is provided at the end of the article.*

The period studied (2000-2012) is of particular interest because it is marked by the 2008 crisis and the beginning of the recovery from 2009 onwards. A relatively significant number of firm entry/exit movements occurred during the period. Table 1 shows the average number of entering, exiting and continuing firms associated with each sub-period. The number of entering and exiting firms[12] is higher over the period 2000-2007 (8,615 and 5,118 firms on average, respectively) compared to the period 2008-2012 (2,883 and 6,361 firms on average, respectively) and the period 2009-2012 (2,219 and 6,648 firms on average, respectively). Given the counting method used, this difference is explained by the fact that the first period is longer than the second.[13]

The opposite is true of continuing firms since, by construction, the four-year survival rate is higher than the eight-year survival rate. However, continuing firms over the 2000-2007 period are not significantly different from those of the 2008-2012 period, at least in terms of productive performance. The average TFP of continuing firms over the periods 2000-2007 and 2008-2012 is 3.98 and 4.02, respectively (see Table in Appendix 1).

Figure II shows the trends in the average TFP of all the firms included in the sample as well as the average TFP of continuing, entering and exiting firms.[14] The TFP of all firms shows an upward trend until 2008 before reaching its post-crisis low point in 2009. The average productivity of entering and continuing firms is higher than that of exiting firms over the entire study period. In addition, the productivity gap between entering and exiting firms appears to increase over the years, especially in the post-crisis period. From this point of view, the market selection process appears to play a key role in the evolution of aggregate TFP by replacing the least productive firms with more productive firms. These trends conceal very different realities depending on the sector.

While the average productivity of entering and continuing manufacturing firms decreased between the sub-periods 2000-2007 and 2008-2012 (see table in Appendix 1), the business services sector, where the average productivity of entering and exiting firms continued to grow after 2008, may have benefited from a better allocation of available resources. However, a simple descriptive analysis is not sufficient to determine the various mechanisms for reallocating resources between firms and their contribution to productivity growth. Therefore, in what follows, we propose to conduct an analysis aimed at understanding the different elements of TFP growth and decline and at identifying the sectors most likely to experience a process of firm churn and resource reallocation.

12. We checked that entries (exits) actually correspond to entries (exits) in (from) the base and that a given entry (exit) was not related to an increase (decrease) in the number of employees above (below) the chosen threshold of 10 employees. However, exits related to merger and acquisition transactions cannot be controlled for.

13. Accounting for entries (exits) each year from 2001 to 2007 (2000 to 2006) requires combining the number of entering (exiting) firms over seven years, which automatically gives a higher number than if the counting is conducted over four years, for example from 2009 to 2012.

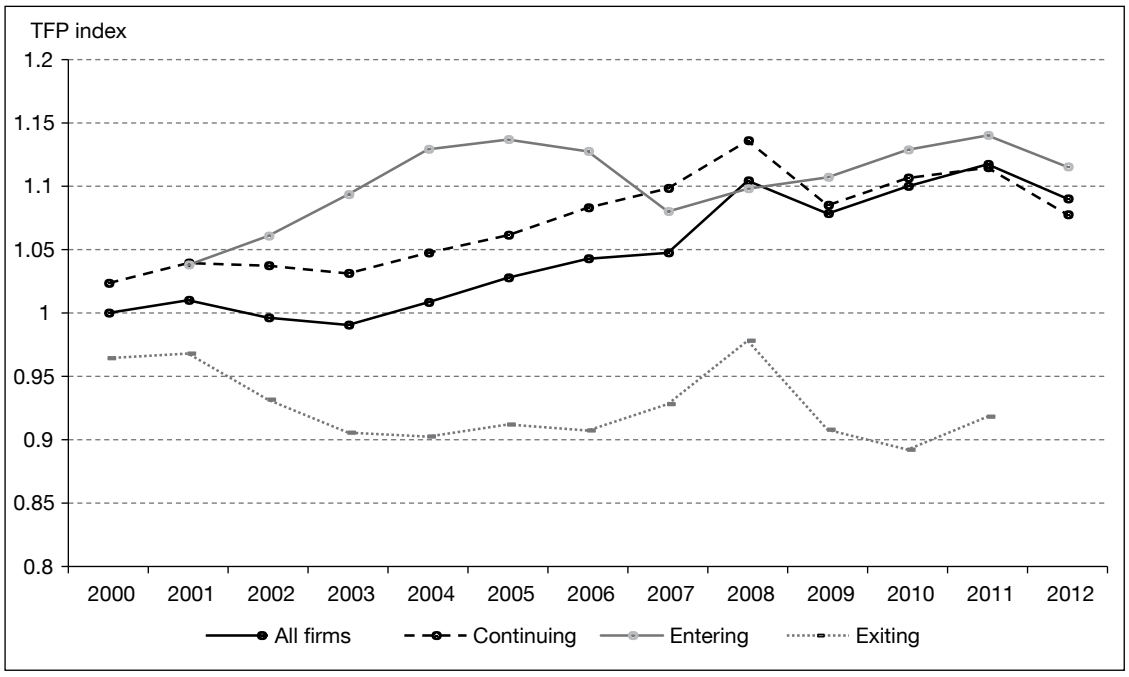
14. The method of counting by firm type is the same as above but over the entire study period: a firm is deemed to be "continuing" if it was trading in 2000 and in 2012. It is deemed to be an "exiting" firm if it was trading in 2000 and non-existent in 2012 and "entering" if it was trading in 2012 and non-existent in 2000.

Table 1
Number of Firms by Type

Type of firm	Average annual number		
	2000-2007	2008-2012	2009-2012
Entering	8,615	2,883	2,219
Exiting	5,118	6,361	6,648
Continuing	19,111	32,296	41,589

Reading Note: The average annual number corresponds to the number of firms in the sub-period considered divided by the number of years of observation of the same sub-period, i.e. seven years (four years, respectively) for entering and exiting firms and eight years (five years, respectively) for continuing firms over the period 2000-2007 (2008-2012, respectively). The same principle is used to count the number of firms over the period 2009-2012. Here, this is used to control for selection bias due to the implementation of Insee's new system for the production of structural business statistics (transition from FICUS to ESANE (from 2008).
Coverage: All firms (within the meaning of the LME) with more than 9 employees subject to corporate income tax (excluding public and agricultural sectors).
Sources: Insee, FICUS-FARE-DADS; Insee and DGFiP, LIFI.

Figure II
Average TFP of all Firms and by Type



Notes: Average TFP – normalised by the average TFP of firms across the entire sample, weighted by the weight of value added as a proportion of total value added. The TFP index is normalised to 1 in 2000 for all firms.
Coverage: All firms (within the meaning of the LME) with more than 9 employees subject to corporate income tax (excluding public and agricultural sectors).
Sources: Insee, FICUS-FARE-DADS; Insee and DGFiP, LIFI.

Sources of Sectoral Productivity Growth and Decline: Reallocation or Learning?

First Lessons from a Global Analysis

Table 2 shows that between 2000 and 2007 aggregate TFP in France increased at an average rate of 0.66% per year while it fell by 0.32% per year on average between 2008 and 2012. In other words, the crisis led to a decline in aggregate productivity in France over the period 2008-2012.[15]

The first lesson from the different decomposition methods is that, depending on the method used, total resource reallocation (*Between* + *Cross* + *Net Entry*) accounts for between one and two thirds of the change in aggregate productivity between 2000 and 2007 (Figure III). Over the period, firm-specific performance (learning effect) also contributes significantly to the change in aggregate productivity (one to two thirds). Given the absence of objective indicators demonstrating the superiority of one method over another, this interval may be interpreted as an interval giving the boundaries of the contribution of each component to the evolution of aggregate TFP.[16] Figure III highlights the significance of the process of total resource reallocation, which served to offset the negative impact of the learning effect, thereby limiting the decline in aggregate productivity after the 2008 crisis. Therefore, France appears not to suffer from a problem of resource misallocation (sum of the reallocation of resources to continuing firms and between entering and exiting firms). On the contrary, resource reallocation even appears to have acted as a shock absorber against the decline in aggregate productivity during the post-crisis period.

The Learning Effect: Main Factor of the Decrease in Productivity in France Between 2008 and 2012

The relatively significant decline in TFP (-0.32%) after the crisis is the result of a

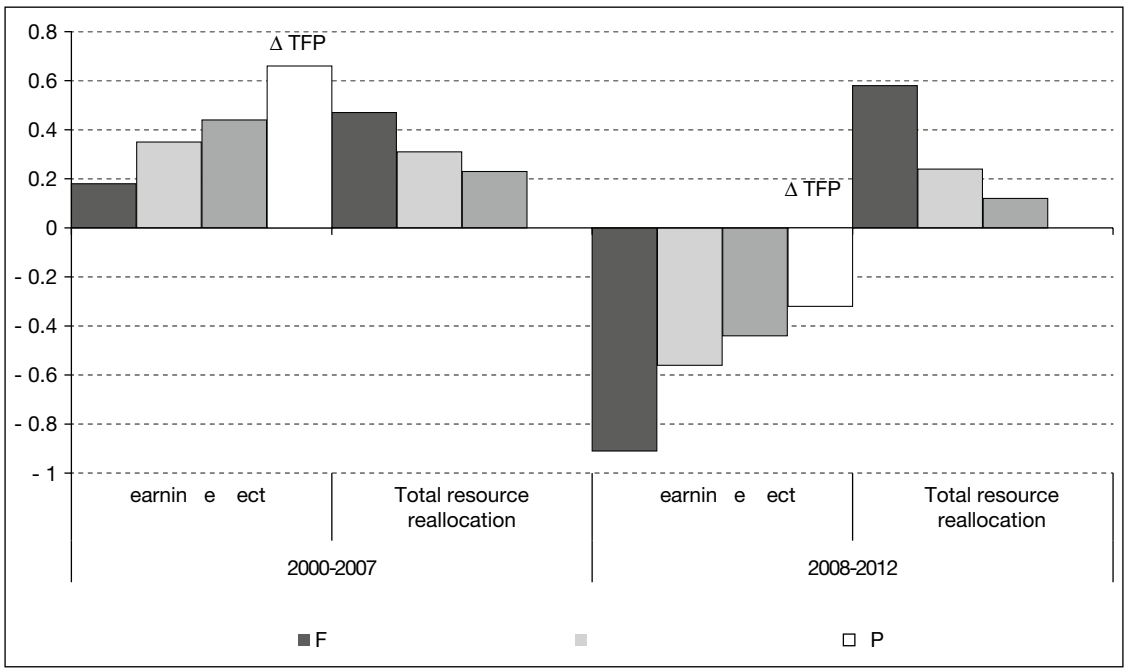
15. The changes in TFP estimated using the LP method (2003) are consistent with those obtained from Insee's quarterly national accounts data (cf. Figure I).
16. The results obtained do not corroborate MP's claim that FHK and GR overestimate the contribution of entering firms (Melitz & Polanec, 2015) since the contribution of such firms, according to the MP method, is greater than that of the FHK method during the post-crisis period.

Table 2
Decomposition of the Average Annual Growth Rate of TFP Using FHK, GR and MP (All Sectors of Activity)

Period	ΔP_t (%)	Learning	Reallocation toward continuing firms	Entry	Exit	Net entry
FHK						
2000-2007	0.66	0.18 (28)	0.18 (27)	0.18 (28)	-0.11 (-17)	0.29 (44)
2008-2012	-0.32	-0.91 (281)	0.28 (-87.5)	0.02 (-6)	-0.28 (-88)	0.30 (-94)
GR						
2000-2007	0.66	0.35 (54)	0.04 (6)	0.10 (15)	-0.17 (-26)	0.27 (41)
2008-2012	-0.32	-0.56 (175)	-0.04 (13)	0.04 (-13)	-0.24 (75)	0.28 (-88)
MP						
2000-2007	0.66	0.44 (66)	0.10 (15)	0.01 (2)	-0.12 (-19)	0.13 (20)
2008-2012	-0.32	-0.44 (138)	-0.24 (75)	0.04 (-13)	-0.32 (100)	0.36 (-113)

Reading Note: The aggregate TFP of French sectors increased on average by 0.66% per year between 2000 and 2007. According to the FHK decomposition, the learning process (Within) contributes 0.18 pp while resource reallocation towards continuing firms contributes 0.18 pp (Reallocation towards continuing firms = Between + Cross). The process of reallocation of firm entry-exits contributes 0.29 pp (Entry – Exit). The values in brackets are in percentage and represent the share of each component in the aggregate TFP growth rate.
Coverage: All firms (within the meaning of the LME) with more than 9 employees subject to corporate income tax (excluding public and agricultural sectors).
Sources: Insee, FICUS-FARE-DADS; Insee and DGFiP, LIFI.

Figure III
Evolution of the Average Annual TFP Growth Rate (Δ TFP) and Contribution of the Learning Effect and Total Resource Reallocation



Notes: Total resource reallocation = Reallocation towards continuing firms + Net entry.
Coverage: All firms (within the meaning of the LME) with more than 9 employees subject to corporate income tax (excluding public and agricultural sectors).
Sources: Insee, FICUS-FARE-DADS; Insee and DGFiP, LIFI.

relatively significant decrease in the learning effect (*within effect*). The (negative) predominance of this component during the period 2008-2012 is robust to the different decomposition methods, with its share in the decrease in productivity amounting to approximately 280% with the FHK method, 175% with GR and 138% with MP. In the pre-crisis period, the learning effect contributes positively to TFP growth, accounting for nearly a third with FHK, more than a half with GR and more than two thirds with MP. These results confirm those previously reported by Carreira & Teixeira (2016) for Portugal, where the learning effect accounts for the most significant contribution of the decline in productivity during the post-crisis period (2008-2012). This effect, which measures internal productivity gains in firms, depends on the ability of firms to optimise their own production processes by permanently adjusting their production factors in order to respond to potential adverse shocks. The 2008 shock – initially a financial shock before spreading to the real economy – revealed the difficulties faced by French firms in responding to a negative demand shock, a process that requires a rapid and effective adjustment of production scale. The pro-cyclical nature of productivity (Basu & Fernald, 2000; Cette *et al*., 2015) in the case of France, appears to transit via the *within* component, which represents the main factor behind the decline in aggregate productivity in France between 2008 and 2012.

The Scale of the Schumpeterian Process of Creative Destruction Before and After the Crisis

The three decomposition methods used in this study show that the Schumpeterian process of creative destruction contributes positively to the evolution of TFP both before and after the 2008 crisis. The *net entry effect* is positive and increased between the two periods. Before the crisis, it made a significant and increasing contribution of nearly 0.3 pp according to the FHK and GR methods, with exiting firms having a greater impact. These contributed -0.28 pp (-0.24 pp and -0.32 pp, respectively) between 2008 and 2012, while entering firms contributed just +0.02 pp (+0.04 pp and +0.04 pp, respectively), using the FHK (GR, MP, respectively) method. The positive contribution of exiting firms is mainly due to a "cleansing effect" given their low productivity compared to the average sectoral productivity level (cf. Figure II). Therefore, the process of creative destruction after the crisis appears to find expression mainly in the destruction dimension.

Moreover, we find that the FHK and GR methods overestimate the contribution of entries but only during the period 2000-2007. However, in the post-crisis period, they no longer show the significant contribution of entering firms. Moreover, the contribution decreased to such an extent that a very similar result is now obtained with the MP decomposition. The contribution of entering firms with the MP method is even greater than with the FHK method (+0.02 pp compared to +0.04 with MP). The weak positive contribution of entering firms, combined with a relatively significant contribution from the exit of the least productive firms after the crisis, helped to mitigate the decline in TFP through a greater cleansing effect in the post-crisis period. The idea that the crisis enabled firms to restructure, a process involving a better allocation of resources, is also found in Gamberoni *et al*. (2016). Based on firm data covering the period 2002-2012 from five major euro area countries (Belgium, France, Germany, Italy and Spain), the authors show that the crisis resulted in a better allocation of labour in 2008, 2009 and 2012.

Resource Reallocation to Continuing Firms: a Positive Contribution Before the Crisis but a Mixed Contribution in the Post-Crisis Period

The intuitive notion that an effective market selection process should allow resources to be reallocated to the best performing firms is confirmed by the results obtained with the three decomposition methods for the period 2000-2007. Resource reallocation towards continuing firms contributed positively to aggregate TFP growth between 2000 and 2007 (+0.18 pp according to FHK, +0.04 according to GR and +0.10 according to MP). Using the GR and MP methods, the association between firms' market share growth and their relative efficiency decreased significantly between 2008 and 2012 compared to the pre-crisis period, reflecting a poor allocation of resources to the most productive continuing firms in France after the crisis. By contrast, the results obtained with the FHK method (*Between effect* + *Cross effect*)[17] over the period 2008-2012 suggest an improvement in the reallocation of resources (0.28 pp). The difference between the results obtained with the

17. *The contribution of each of these components is detailed in the Online complement C1.*

FHK method and the other two methods is due to the cross term of the FHK decomposition, which measures the simultaneous variation in productivity and market share of continuing firms, regardless of their level of performance and/or market share at the beginning of the period. It does not necessarily measure a reallocation to the most productive firms since it is not calculated as a deviation from an average. In other words, it measures market share gains achieved by the most dynamic firms – i.e. those that are simultaneously increasing their productive performance.

The 2009-2012 Period: Signs of Recovery due to Resource Reallocation and Persistent Difficulties with the Learning Effect

The period of instability that began in the first quarter of 2008 and continued until the third quarter of 2009 before signs of recovery were observed (Cabannes *et al*., 2010 ; Bricongne *et al*., 2010) raises questions about the speed of adjustment of business activity in France. This section examines the role of learning and resource reallocation in the recovery observed from the end of 2009 onwards. The hypothesis adopted here suggests that the entry-exit movements observed up to the end of 2008 result from a selection process independent of the impact of the crisis and that if there was a cleansing effect associated with the financial crisis, it should be measured from 2009 onwards.[18]

Table 3 shows the decompositions of the 2000-2007 and 2008-2012 periods, completed with the decomposition of the evolution of aggregate TFP over the period 2009-2012. The results show that aggregate productivity increased between 2009 and 2012 (by 0.36% per year on average) but declined between 2008 and 2012 (-0.32% per year on average). However, the growth rate did not return to the level of the pre-crisis period (0.66% per year on average between 2000 and 2007). These results confirm the findings of Cette *et al*. (2017), who report a "drop in productivity, with an average annual growth from 2008 onwards […] lower than or equal to that observed in previous sub-periods".

The three decomposition methods used here provide some explanations for the slight return to aggregate TFP growth between 2009 and 2012. Despite the slightly greater contribution of the learning effect compared to the 2008-2012 period, the difficulties experienced by continuing firms in adjusting their production scale rapidly and effectively (learning effect) continue to drive aggregate productivity growth down. On the other hand, the mechanisms for reallocating resources to the most productive continuing firms appear to play an increasingly significant role in adjusting activity (positive TFP growth). The FHK method highlights a significant improvement in this effect, which increased by +0.10 points, from +0.28 pp per year on average over the 2008-2012 period to +0.38 pp per year on average over the 2009-2012 period. The GR and MP methods also show an improvement in the reallocation of resources towards the most productive continuing firms over the 2009-2012 period, although its contribution remains moderate (19% of aggregate TFP growth with GR and 38% with MP). Above all, it is the combination of this effect with the net entry effect that enabled a return to a low rate of aggregate productivity growth from 2009 onwards. Not only is this contribution persistent, but it also increased, with a weight of more than 120% over the 2009-2012 period, compared to less than 95% over the 2000-2007 and 2008-2012 periods, regardless of the decomposition method used.

These results represent one of the main contributions of this study since they shed new light on the efficiency of the selection process of the French market, which is often considered to be rigid, with significant frictions in terms of the adjustment of production factors (Calavrezo & Zilloniz, 2016 ; Dhyne *et al*., 2015). These results confirm, to a certain extent and without loss of generality, those reported by Cochard *et al*. (2010) highlighting the responsiveness of the French labour market.

Confirmation of the General Trend at the Sectoral Level

Table 4 shows the results of the different decompositions of TFP growth by sector according to the three methods. The findings show that the effects at the sector level deviate only slightly from the general trend. All sectors were affected by the crisis except the "Manufacture of food, beverages and tobacco products" sector, which recorded a higher growth rate after the crisis

18. By starting the post-crisis period in 2007, there is an increased risk of the results being biased, potentially, by the introduction of the Insee's new system for the production of structural business statistics (transition from FICUS to ESANE from 2008). Since the crisis coincides with this change, the choice of sub-periods – 2000-2007 on the one hand and 2008-2012 and 2009-2012 on the other – means that the results may be deemed to be independent from this development.

Table 3
Decomposition of the Average Annual Growth Rate of TFP Using FHK, GR and MP (All Sectors of Activity)

Period	ΔP_t (%)	Learning	Reallocation towards continuing firms	Entry	Exit	Net entry
FHK						
2000-2007	0.66	0.18 (28)	0.18 (27)	0.18 (28)	-0.11 (-17)	0.29 (44)
2008-2012	-0.32	-0.91 (281)	0.28 (-87.5)	0.02 (-6)	-0.28 (-88)	0.30 (-94)
2009-2012	0.36	-0.45 (-125)	0.38 (105)	0.08 (22)	-0.36 (-100)	0.44 (122)
GR						
2000-2007	0.66	0.35 (54)	0.04 (6)	0.10 (15)	-0.17 (-26)	0.27 (41)
2008-2012	-0.32	-0.56 (175)	-0.04 (13)	0.04 (-13)	-0.24 (75)	0.28 (-88)
2009-2012	0.36	-0.16 (-44)	0.07 (19)	0.07 (19)	-0.37 (-103)	0.44 (122)
MP						
2000-2007	0.66	0.44 (66)	0.10 (15)	0.01 (2)	-0.12 (-19)	0.13 (20)
2008-2012	-0.32	-0.44 (138)	-0.24 (75)	0.04 (-13)	-0.32 (100)	0.36 (-113)
2009-2012	0.36	-0.24 (-67)	0.14 (39)	0.07 (19)	-0.40 (-111)	0.47 (131)

Reading Note: The aggregate TFP of French sectors increased on average by 0.36% per year between 2009 and 2012. According to the FHK decomposition, the learning process (Within) contributes -0.45 pp while resource reallocation towards continuing firms contributes +0.38 pp (Between + Cross). The process of reallocation of firm entries-exits contributes 0.44 pp (Entry – Exit). The values in brackets are in percentage terms and represent the share of each component in the aggregate TFP growth rate.
Coverage: All firms (within the meaning of the LME) with more than 9 employees subject to corporate income tax (excluding public and agricultural sectors).
Sources: Insee, FICUS-FARE-DADS; Insee and DGFiP, LIFI.

Table 4
Decomposition of the Average Annual Growth Rate of TFP Using the FHK, GR and MP Methods

Sector	2000-2007										2008-2012									
	ΔP_t (%)	Learning			Reallocation towards continuing firm			Net entry effect			ΔP_t (%)	Learning			Reallocation towards continuing firm			Net entry effect		
		FHK	GR	MP	FHK	GR	MP	FHK	GR	MP		FHK	GR	MP	FHK	GR	MP	FHK	GR	MP
Manufacture of food, beverages and tobacco products	0.73	0.56	0.73	0.88	0.15	0.01	0.09	0.02	-0.01	-0.23	1.17	0.70	1.15	1.64	0.29	-0.21	-0.61	0.18	0.23	0.14
Manufacture of coke and refined petroleum products	1.78	2.32	3.22	4.58	0.69	-0.42	-0.33	-1.23	-1.01	-2.48	-7.67	-6.29	-6.83	-7.44	-1.24	0.35	-0.05	-0.14	-1.19	-0.19
Manufacture of equipment and machinery	4.13	3.01	3.33	4.32	0.31	-0.09	-0.19	0.80	0.89	-0.01	-2.24	-1.61	-1.51	-1.72	-0.17	-0.04	0.04	-0.46	-0.69	-0.56
Manufacture of transport equipment	1.47	0.51	0.69	0.82	0.26	0.11	0.19	0.70	0.69	0.46	-3.29	-3.37	-3.20	-3.40	-0.09	-0.06	-0.26	0.17	-0.02	0.36
Manufacture of other industrial products	1.83	0.88	1.07	1.29	0.27	0.06	0.14	0.68	0.72	0.41	0.12	-0.56	-0.30	-0.28	0.30	0.04	-0.02	0.38	0.38	0.42
Construction	-0.85	-0.88	-0.68	-0.90	0.27	0.04	0.09	-0.24	-0.21	-0.04	-2.55	-3.07	-2.84	-2.90	0.13	-0.06	-0.23	0.40	0.36	0.59
Services to low- and medium-technology firms	0.54	0.22	0.32	0.43	0.06	0.00	0.04	0.26	0.22	0.07	0.24	-0.32	-0.02	0.24	0.20	-0.10	-0.36	0.36	0.36	0.36

➔

Table 4 (contd.)

Sector	2000-2007										2008-2012									
	ΔP_t (%)	Learning			Reallocation towards continuing firm			Net entry effect			ΔP_t (%)	Learning			Reallocation towards continuing firm			Net entry effect		
		FHK	GR	MP	FHK	GR	MP	FHK	GR	MP		FHK	GR	MP	FHK	GR	MP	FHK	GR	MP
Services to high-technology firms	0.99	0.45	0.60	0.91	0.12	0.00	-0.01	0.42	0.37	0.10	0.42	-0.14	0.28	0.54	0.30	-0.12	-0.36	0.26	0.26	0.24
Financial and real estate activities	1.08	0.30	0.54	0.65	0.23	0.06	0.18	0.55	0.48	0.25	1.81	0.48	0.83	1.08	0.44	0.04	-0.08	0.89	0.95	0.81
Other services	0.21	0.01	0.21	0.21	0.26	0.06	0.17	-0.06	-0.06	-0.17	0.08	-0.52	-0.14	0.06	0.32	-0.06	-0.28	0.28	0.28	0.30
All	0.66	0.18	0.35	0.43	0.18	0.04	0.10	0.29	0.27	0.13	-0.32	-0.91	-0.56	-0.44	0.28	-0.04	-0.24	0.30	0.28	0.36

Note: 'Learning' = Within effect; 'Reallocation towards continuing firms' = Between effect + Cross effect for FHK, Between effect for GR, Cross effect for MP; 'Net entries' = Entry – Exit. The results of this table are obtained by using the formulas described in the methodology section by aggregating the TFP of firms at a sector level. The results of the "All" line are obtained by aggregating TFP at a national level. The decomposition of the average annual growth rate of sectoral TFP does not take into account reallocations between sectors. Osotimehin (2016) shows that cross-sectoral reallocations play a limited role in aggregate productivity trends.
Coverage: All firms (within the meaning of the LME) with more than 9 employees subject to corporate income tax (excluding public and agricultural sectors).
Sources: Insee, FICUS-FARE-DADS; Insee and DGFiP, LIFI.

(1.17%) compared to the pre-crisis period (0.73%), thanks to a significant learning effect. In the manufacturing industry, the "Manufacture of coke and refined petroleum products", "Manufacture of equipment and machinery" and "Manufacture of transport equipment" sectors were particularly affected by the crisis. Reallocations to continuing firms and entry-exit movements contributed almost nothing, if not negatively, to TFP growth in these sectors. More generally, in manufacturing sectors, it was essentially the negative effect of learning that contributed to the decline in their productivity. Once again, neither the creative destruction mechanism nor the mechanism of resource reallocation towards the most productive continuing firms acted as a shock absorber in reducing the decline in aggregate TFP.

In the business services sectors, entry-exit movements clearly contributed to maintaining growth over the 2008-2012 period at a level lower than that of the pre-crisis period (but nonetheless positive), regardless of the decomposition method used. The contribution of resource reallocation is more mixed in the case of the business services sectors ("low- and medium-technology" and "high-technology" sectors). The FHK method is alone in producing a positive effect. The GR and MP methods yield generally negative reallocation effects after the 2008 crisis.

In financial and real estate activities, the Schumpeterian creative destruction effect played a significant role in the evolution of TFP both before and after the crisis. This result is consistent with the findings of Guillou & Nesta (2015) and may be explained by the early and immediate effect of the crisis on this sector (as early as 2008). In other sectors, transmission mechanisms are thought to have delayed the effects of the crisis.

* *
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This study examined the contributions of resource reallocation towards the most productive firms and of firm performance (learning effect) to the evolution of aggregate TFP in France before and after the 2008 crisis.

The results obtained show that the 2009 crisis had a negative impact on aggregate TFP. The learning effect, as measured here by the *within* component, was found to be the main factor behind the decline in aggregate TFP after the crisis. The total effect of resource reallocation (reallocation towards continuing firms + *net entry effect*) was found to act as a shock absorber against the decline in aggregate productivity during the post-crisis period. The three decomposition methods (FHK, GR and MP) show that the process of resource reallocation towards the most productive continuing firms was underway before the crisis. After the

crisis, over the period 2008-2012, only the FHK method shows a positive effect of reallocation towards the most productive continuing firms. By contrast, the GR and MP decomposition methods highlight a misallocation of resources to the detriment of the most productive firms during the same period. The period 2009-2012 saw a slight return to aggregate TFP growth, a trend driven by the mechanisms of resource reallocation towards the most productive continuing firms. These mechanisms indicate a moderate but positive and robust contribution to the different decomposition methods.

The results for the post-crisis period also point to a cleansing effect through a Schumpeterian process of creative destruction. However, the effect of this mechanism was more destructive than creative, a result confirmed by the main decompositions and periods used. At least two explanations can be put forward. First, in absolute terms, the contribution of entering firms after the crisis is very limited compared to the contribution of exiting firms. This implies a relatively significant contribution of the net entry effect (the balance of entries minus exits), which was almost equivalent to the contribution of exiting firms. Second, the post-crisis period is too short to capture the long-term effects of the crisis, a key assumption in the Schumpeterian approach according to which the renewal of production structures represents a relatively long-term process. Overall, the market selection process appears to have played a key role in the evolution of aggregate TFP in the post-crisis period since it eliminated the worst performing firms while entering firms played a more limited role.

These average trends conceal sectoral disparities. The results show that the crisis did not affect all sectors of the French economy to the same extent. The manufacturing sectors suffered the most from the 2008 crisis. This may be explained at least in part by their limited ability to adjust their production scale compared to the service sectors and by poorer resource allocation. The "business services" sector experienced a less pronounced decline in productivity growth than the manufacturing sector. In the service sector, the reallocation of resources to continuing firms and the creative destruction process may have offset the negative contribution of the learning effect.

This study assessed the contribution of the learning capacity of firms and of resource reallocation on productivity growth in France. However, we have yet to understand the reasons for the very low level of productivity growth we are currently seeing (0.2% per year on average between 2013 and 2016; cf. Figure I). The results presented suggest that the causes of the slowdown in aggregate productivity growth are to be found in the inability of entering firms to maintain a higher level of productivity over a sufficiently long period of time compared to continuing firms. Indeed, the replacement of exiting firms by entering firms whose productivity gains increase rapidly in the first few years and fade after four years (see Figure II) raises questions about the "impoverishing" effect of the creative destruction process, a problem representing a first avenue for future research. The second avenue concerns the impact of so-called "zombie" firms, which manage to remain in business for several years despite the persistent economic and financial difficulties they experience, on the learning effect and, consequently, on the slowdown in productivity gains. Such firms, which should have disappeared, tend to distort competition, to prevent the proper allocation of resources and to put "healthy" firms at risk. □

Link to the Online complements:

https://www.insee.fr/fr/statistiques/fichier/4173177/507-508_Ben-Hassine_complement.pdf

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APPENDIX 1

EVOLUTION OF AVERAGE TFP

Table A1
Average of TFP by Sector and by Type of Firm Before and After the Crisis

Sectors	Before (2000-2007)			After (2008-2012)		
	Continuing	Entering	Exiting	Continuing	Entering	Exiting
Manufacturing	3.84	3.74	3.74	3.79	3.69	3.70
Construction	4.13	4.16	3.95	3.99	3.98	3.78
Services to "low- and medium-technology" firms	3.85	3.86	3.72	3.93	3.90	3.67
Services to "high-technology" firms	4.30	4.37	4.17	4.42	4.50	4.30
Financial and real estate activities	4.29	4.34	4.32	4.31	4.35	4.00
Other services	4.02	3.98	3.80	4.08	3.99	3.81
Average (all sectors of activity)	3.98	4.02	3.81	4.02	4.02	3.79

Notes: The weighted average by value added is calculated for the entire sample for each sub-period by sector and type of firm. For entering firms, the first year of each sub-period is not taken into account in calculating the average. For exiting firms, the last year of each sub-period is not taken into account in calculating the average.
Coverage: All firms (within the meaning of the LME) with more than 9 employees subject to corporate income tax (excluding public and agricultural sectors).
Sources: Insee, FICUS-FARE-DADS; Insee and DGFiP, LIFI.

APPENDIX 2

ECONOMETRIC RESULTS

Table A2-I
Estimation of Production Factors by Sector Using the LP Method (10-Sector Aggregated Classification)

	Manufacture of food, beverages and tobacco products	Manufacture of coke and refined petroleum products	Manufacture of equipment and machinery	Manufacture of transport equipment	Manufacture of other industrial products
Log L	0.533*** (0.007)	0.496*** (0.087)	0.463*** (0.010)	0.590*** (0.019)	0.591*** (0.004)
Log K	0.195*** (0.008)	0.316* (0.184)	0.231*** (0.012)	0.231*** (0.035)	0.217*** (0.008)
Number of observations	124,392	987	69,818	12,331	319,875
Number of firms	13,048	113	7,421	1,289	33,339

Table A2-II
Estimation of Production Factors by Sector Using the LP Method (10-Sector Aggregated Classification)

	Construction	Services to low- and medium-technology firms	Services to high-technology firms	Financial and real estate activities	Other services
Log L	0.570*** (0.003)	0.726*** (0.003)	0.641*** (0.004)	0.627*** (0.010)	0.589*** (0.003)
Log K	0.197*** (0.003)	0.133*** (0.005)	0.151*** (0.004)	0.159*** (0.008)	0.162*** (0.003)
Number of observations	503,541	271,480	261,601	94,557	937,728
Number of firms	51,344	30,326	29,632	11,415	96,260

Significant coefficients at the 10% * threshold, 5% ** threshold, 1% *** threshold.
Notes: LP is a two-step estimation method (see box). Since the elasticity of labour is estimated in the second step, the standard deviations are biased. To correct this bias, we estimate robust standard deviations using a bootstrap with 250 replications. The standard deviations are shown in brackets.
Coverage: All firms (within the meaning of the LME) with more than 9 employees subject to corporate income tax (excluding public and agricultural sectors).
Sources: Insee, FICUS-FARE-DADS; Insee and DGFiP, LIFI.