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Reallocation and productivity during the Great Recession: evidence from French manufacturing firms

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Reallocation and productivity during the Great Recession: evidence from French manufacturing firms

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Abstract

According to the 'cleansing hypothesis', recessions are periods in which productivity-enhancing reallocation intensifies, shifting resources away from less efficient to more efficient firms at a greater pace. Does the Great Recession of 2008-2010 fit this view? We address this question, studying the case of the French manufacturing sector. Based on a panel of firms, built by matching data from several sources, we investigate the contribution of productivity to firm growth and survival over the period 2002-2013. Our results show that, during the recent global crisis, more productive firms decreased their advantage with respect to less productive firms, in terms of both employment growth and probability to survive, in disagreement with the cleansing hypothesis.

JEL classifications: D22, D24, L20, L25
Keywords: firm productivity, selection, employment growth, global crisis

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1 Introduction

Market economies are characterized by continuous reallocation of resources across producers: some firms grow, some others shrink and even disappear, while new firms come into the market. According to most theories of firm-industry evolution, from the Schumpeterian view of creative destruction to the equilibrium predictions of neoclassical models, this process is positively linked to heterogeneous firm-level productivities; hence, industry-level productivity, which can be conceived as the aggregation of idiosyncratic firm-level productivities, increases as the composition of the industry shifts in favor of more productive firms. Empirical evidence confirms the presence of such productivity-enhancing reallocation (Baily et al., 1992; Griliches and Regev, 1995; Baldwin and Gu, 2006; Foster et al., 2001; Hyytinen and Maliranta, 2013; Melitz and Polanec, 2015).

A more controversial issue is whether and how this process is altered during recessions. A popular view, labeled as the 'cleansing hypothesis', the roots of which can be traced back to the thought of Schumpeter (1934, 1942), claims that productivity-enhancing reallocation intensifies during economic downturns. Consensus regarding this hypothesis, however, is not established, either from a theoretical or an empirical point of view. The famous model by Caballero and Hammour (1994), postulating 'the cleansing effect of recessions', is countered by other models, stating that in the presence of distortions, for example in the credit market, reallocation might reverse (i.e. go from more efficient to less efficient firms) during recessions, and that the latter could also have 'sullying' or 'scarring' effects on the economy (Barlevy, 2002, 2003; Ouyang, 2009). On the empirical side, there is evidence of moderate cleansing effects during recessions (Baily et al., 2001; Foster et al., 2001) but also signs that productivity-enhancing reallocation may fail to intensify during severe crises (among others, Hallward-Driemeier and Rijkers, 2013).

What is the evidence from the Great Recession? This major, global crisis was a multifaceted event, having roots in finance, and effects spanning over finance itself (the credit crunch), the overall level of economic activity (the deepest recession since the 1930s), and international trade (the trade collapse; see Bems et al. 2013). Despite the relevance of the previous question, not many studies exist that address the cleansing effect of the recent global crisis. Among the few, Foster et al. (2016) show that reallocation occurring during the Great Recession in the US was in fact less productivity enhancing than in other recessions and that, overall, the intensity of reallocation fell rather than rose during that crisis.

In this paper, we investigate the validity of the cleansing hypothesis, studying the case of the French manufacturing sector. We contribute to the literature by providing evidence on a large European economy, and by accounting for different dimensions of firm heterogeneity, acknowledging the complex nature of the Great Recession and its consequences on international exchanges (the trade collapse) and financial markets (the credit crunch). To do so, we match data from several sources (worker-level, balance sheet, customs, patents), and employ the resulting dataset, covering the population of French firms with employees, to analyze the relationship between productivity and firm performance, in terms of employment growth and survival, over the period 2002-2013; and, in particular, to assess if and how it changed during the Great Recession.

Shedding new light on the relationship between reallocation and productivity during recessions is important, as it has implications on both economic theory and policy. Indeed, empirical evidence on this topic may help choosing among different models, as well as among related different policies. If the cleansing hypothesis holds, then counter-cyclical policies, aimed at reducing the short-term negative effects of recessions, might in fact hamper the bases for long-term growth; if the opposite is true, then they would contribute to an improvement of prospects in both the short and the long run.

Our results show that, during the recession, more productive firms did not increase their advantage with respect to less productive firms, in terms of both employment growth and probability to survive, in disagreement with the cleansing hypothesis. In fact, we find a slight weakening of productivity-enhancing reallocation, which seems mostly driven by firms belonging to more financially dependent sectors. We also find that the 'growth premium' enjoyed by exporting firms substantially decreased during the Great Recession—a clear consequence of the trade collapse. Overall, our evidence shows that Great Recession was not a phase of increased productivity-driven reallocation.

The paper is structured as follows. The next section reviews the theoretical and empirical literature on reallocation; and, in the light of this, describes the empirical exercises that are conducted in this study. Section 3 presents the data. Section 4 describes the macroeconomic context and firm dynamics over the observed period; and provides *prima facie* evidence on productivity-enhancing reallocation, based on productivity growth decomposition. Section 5 tests the cleansing hypothesis by econometric means, providing additional insights on the role of financial dependence in the reallocation process, and verifying the robustness of the analysis to using a different timing for the crisis. Section 6 concludes.

2 Related literature and analytical framework

2.1 Related literature

Joseph Schumpeter argued that, during economic downturns, an accelerated pace of creative destruction favors the emergence and the growth of more efficient firms; hence, 'depressions are not simply evils, which we might attempt to suppress, but [...] adjustment to previous economic change' (Schumpeter, 1934, 16). Consistently with such a view, Caballero and Hammour (1994) developed a model where recessions are shown to have a 'cleansing effect': reallocation intensifies, since opportunity cost is lower than in normal times, and aggregate productivity increases, as resources are shifted away from less efficient to more efficient firms. The validity of this mechanism is not uncontroversial: in fact, in a subsequent paper, Caballero and Hammour (1996) pointed out that, in the presence of incomplete contracting in the labor market, reallocation may fail to intensify during recessions. The cleansing effect can also be offset by a 'sullying effect', whereby, in the presence of on-the-job search, even if the least efficient jobs are destroyed, reallocation towards more productive jobs is hampered by fewer jobs being created (Barlevy, 2002).

Further criticisms to the cleansing hypothesis are based on distortions in the credit market. Barlevy (2003) contended that financial constraints may reverse the cleansing mechanism, in as much as the most efficient production arrangements are also those that mostly depend on external funding; hence, in the presence of credit constraints, reallocation may be directed from more efficient to less efficient firms. Finally, Ouyang (2009) posited that recessions may have an additional 'scarring effect', referring to the fact that potentially superior firms may be prevented from entering the market and growing, as learning mechanisms *à la* Jovanovic (1982) are obstructed by the generalized fall in profitability.

Several empirical studies have documented that reallocation increases during recessions (Davis and Haltiwanger, 1990, 1992) and that it is generally linked to industry-level productivity growth, using in particular productivity growth decomposition analyses (see, among others, Baily et al. 1992 and Foster et al. 2001 for the US; Griliches and Regev 1995 for Israel; Disney et al. 2003 for the UK; Baldwin and Gu 2006 for Canada; Hyytinen and Maliranta 2013 for Finland; Melitz and Polanec 2015 for Slovenia; Dosi et al. 2015 for comparative evidence across France, Germany, the UK, and the US. For surveys and discussions, see Bartelsman and Doms 2000; Dosi 2007; Syverson 2011). In such exercises, the growth of an industry's productivity between two time periods is conceived as the sum of various components, namely:

- the increases in the individual productivities of continuing firms, keeping their shares constant (the *within* component);
- the reallocation of shares between incumbent firms characterized by different productivity levels (the *between* component);
- the 'churning' associated with entry and exit dynamics, as the productivity of entering and exiting firms may be higher or lower than that of continuing firms (the *entry* and *exit* components).

Productivity growth decomposition exercises typically find that the components associated to firm shares' reallocation, i.e. *between*, *entry*, and *exit*, account for a significant but minor share of aggregate productivity growth, while the *within* component turns out to have a much larger effect; although findings tend to vary somehow across studies, depending on the country and time period analyzed, as well as on the methodologies employed.[1] reallocation appears to be steady, and to provide a positive contribution to productivity growth also during economic downturns, thus offsetting the fall entailed by the *within* component, which is typically highly pro-cyclical. In fact, some studies even observe that the *between* component is counter-cyclical (Baily et al., 2001; Foster et al., 2001): this means that productivity-enhancing reallocation increases in relevance during economic downturns, thus confirming the cleansing hypothesis.

However, a number of recent firm-level studies, focusing on severe recessions, have provided evidence that is not supportive of the cleansing hypothesis. Hallward-Driemeier and Rijkers (2013), using manufacturing census data from Indonesia in the period 1991-2001, which encompasses the East Asian crisis of 1997, find that the productivity-reallocation relationship did not strengthen during that crisis, and the selection force represented by market exit was even attenuated, in a manner consistent with the 'scarring' effect. Carreira and Teixeira (2016), studying the case of the Portuguese manufacturing sector during the period 2004-2012, do observe the presence of a cleansing effect in the crisis years since 2008; but at the same time they find that financial constraints had a negative impact on reallocation and its productivity-enhancing effect, in line with Barlevy (2003).[2] Foster et al. (2016), using long-term data on US manufacturing from the mid-1970s to 2011, find that the relationship between productivity, on one side, and firm growth and exit, on the other, tended to strengthen during all crises, but the Great Recession, when it actually weakened. In the same spirit, Ikeuchi (2017) find increased productivity-enhancing reallocation, in both manufacturing and non-manufacturing sectors, during all crises in Japan between 1980 and 2012, but the Great Recession.

[1] Notably, some methods devise an additional *cross* or *covariance* component, given by the product of the variation of firm-level productivities times the variation of the shares. For a recent review of existing decompositions, see Melitz and Polanec (2015). Still,

[2] Similar empirical evidence is provided by Eslava et al. (2010), who, based on Colombian data from 1995-2004, show that highly-productive firms exited during the 1998-2001 recession because they were financially constrained.

2.2 Analytical framework

In line with the works just reviewed, this paper analyzes the link between productivity and reallocation, first at the aggregate level by means of productivity growth decompositions, then at the firm level by econometric analyses, where the outcome dependent variables (firm growth and exit) are regressed on productivity and a number of other independent variables.

In productivity growth decomposition, aggregate productivity (Π_t) is conceived as the weighted sum of firm-level productivities (π_{it}):

$$\Pi_t = \sum_i s_{it}\pi_{it}$$

where weights s_{it} are given by firms' shares, in terms of some measure (in our case, employment and number of hours). Aggregate productivity growth is decomposed into a number of components, reflecting firm-level productivity increases and the reallocation of shares among different firms. We follow the approach originally developed by Griliches and Regev (1995) and perform the following decomposition:

$$\Delta\Pi_t = \underbrace{\sum_{i\in C}\overline{s_{it}}\Delta\pi_{it}}_{within} + \underbrace{\sum_{i\in C}\Delta s_{it}(\overline{\pi_{it}} - \overline{\Pi_t})}_{between} + \underbrace{\sum_{i\in N}s_{it}(\pi_{it} - \overline{\Pi_t})}_{entry} + \underbrace{\sum_{i\in X}s_{it-1}(\pi_{it-1} - \overline{\Pi_t})}_{exit} \qquad (1)$$

where Δ stands for the first difference between two years, a bar over a variable indicates the average of that variable over those two years, and C, N, and X are the sets of continuing, entering, and exiting firms, respectively. As firm weights, we use employment shares.

The first term on the right-hand side represents the *within* component of aggregate productivity growth, capturing the effect of changes in incumbent firms' productivity (holding their employment shares constant), interpreted as the result of firm-level processes of learning, innovation, and imitation. Instead, the second term, known as the *between* component, reflects changes in the employment shares of firms characterized by different productivities (above or below the aggregate average). A positive (negative) *between* component denotes that market selection forces reallocate employment towards more (less) efficient firms, thus increasing (decreasing) aggregate productivity. Likewise, the third and fourth terms on the right-hand side respectively indicate the contribution to aggregate productivity growth by entering and exiting firms being more or less productive than the average.

The results of productivity growth decomposition, presented in Subsection 4.3, provide first evidence on the relevance of reallocation forces in driving aggregate productivity, and on their dynamics over the observed period. In Section 5, we investigate the cleansing hypothesis by means of a more specific firm-level econometric test. This also allows us to account for a number of factors which may affect the productivity-reallocation nexus.

Following similar studies (Hallward-Driemeier and Rijkers, 2013; Carreira and Teixeira, 2016; Foster et al., 2016), we perform two separate exercises. First, we regress employment growth (g_{it}) on lagged firm productivity (π_{it-1}) and a vector of firm characteristics ($\mathbf{x_{it-1}}$), as well as on the interaction of those right-hand side variables with a temporal dummy denoting crisis years ($Crisis$):

$$g_{it} = \beta_0 + \beta_\pi\pi_{it-1} + \beta_x\mathbf{x_{it-1}} + \beta_{\pi C}\pi_{it-1}Crisis + \beta_{xC}\mathbf{x_{it-1}}Crisis + \delta_s + \delta_t + \epsilon_{it} \qquad (2)$$

The presence in Equation 2 of interacted terms allows evaluating how the relationships between the dependent and the independent variables changed during the crisis. Of particular interest to us, in order to test the cleansing hypothesis, is the coefficient on productivity and its interaction with the crisis dummy: $\beta_\pi > 0$ would denote that a positive relationship generally holds between employment growth and productivity, in other words that reallocation is productivity-enhancing; while a positive coefficient on the productivity-crisis interaction ($\beta_{\pi C}$) would denote that this relationship strengthens during the crisis, thus supporting the cleansing hypothesis.

In a second econometric exercise, we study the determinants of firm survival by means of a Cox proportional hazards model in which firm-specific, time-variant hazard rates ($h_{it}(t)$) depend on the same set of variables as above. The model reads:

$$h_{it}(t) = h_0(t)exp(\beta_0 + \beta_\pi \pi_{it-1} + \beta_x \mathbf{x_{it-1}} + \beta_{\pi C}\pi_{it-1}Crisis + \beta_{xC}\mathbf{x_{it-1}}Crisis + \delta_s + \delta_t + \epsilon_{it}) \quad (3)$$

where $h_0(t)$ is the baseline hazard function. In this case, a main (exponentiated) coefficient larger than unity ($exp(\beta_\pi) > 1$) would denote that productivity is positively related to firm exit (hence, negatively related to survival); while $exp(\beta_{\pi C}) > 1$ would denote that this relationship strengthens during the crisis. The cleansing hypothesis therefore holds if $exp(\beta_\pi) < 1$ and $exp(\beta_{\pi C}) < 1$.

In both exercises, δ_s and δ_t denote industry and year dummies, controlling for time-invariant industry characteristics and macro time trends, whereas the vector $\mathbf{x_{it-1}}$ includes a set of additional covariates, namely size, age, as well as dummies denoting firms' involvement in export and innovative activity. The literature provides many reasons for the inclusion of these variables. Size and age are usually found to be negatively associated to firm growth and positively related to firm survival (see on US and Italy, Haltiwanger et al., 2013; Grazzi and Moschella, 2018), and they are also likely to affect firms' reaction to economic downturns: recent evidence from the US firms shows that small and young firms experienced larger declines in net employment growth during the Great Recession (Fort et al., 2013).

As mentioned in the introduction, the Great Recession was associated to a severe trade collapse: from the last quarter of 2008 to the middle of 2009, world trade contracted by around 20%. Though less intense overall, this fall was much sharper than the 1929-1933 trade collapse (O'Rourke, 2017). Empirical evidence, in particular Levchenko et al. (2010) on the US and Bricongne et al. (2012) on France, showed that the 2008-2009 trade collapse hit mainly at the intensive margin, i.e. by reducing export values rather than participation into exporting. Contraction along the intensive margin may in turn affect employment growth and survival of exporting firms, which are on average more productive than non exporting firms (see, among the many, Bernard et al., 2012).

The Great Recession also impacted on innovative activity. Paunov (2012) found that, during the 2008-2009 crisis, firms reduced their investments on innovation projects across Latin America. Argente et al. (2018) pointed out that product reallocation, which is connected with innovative activity, fell by one-fourth during the Great Recession.

Finally, the Great Recession was also the 'most severe financial crisis since the Great Depression' (Brunnermeier, 2009), hitting the entire economy with heavy consequences on employment (on the US, see Chodorow-Reich, 2014; Haltenhof et al., 2014). The credit crunch was particularly prolonged in the Eurozone, where, after a first decline in 2008-09, lending to non-financial firms was exacerbated by the sovereign debt crisis (Bundesbank, 2015). In order to account for the effects of the credit crunch, in Subsection 5.1 we replicate both econometric exercises, splitting the sample into two groups of industries, based on a sectoral measure of dependence on external finance (see Subsection 3.2 for definitions).[3] Finally, in Subsection 5.2 we verify the robustness of our findings to using a broader timing of the crisis, accounting for its particularly long duration in France, as in the rest of the Eurozone (cf. Subsection 4.1.)

3 Data and variables

3.1 Data

The present work employs data concerning all French manufacturing firms with employees over the period 2002-2013. To construct our dataset, we merge different sources, using the unique identification number of French firms (SIREN). The starting point is the *Déclaration Annuelle de Donnés Sociales* (DADS), a confidential database provided by the French national statistical office (INSEE) and based on the mandatory forms that all establishments with employees must hand in to the Social Security authorities. In particular, we use the DADS *postes* dataset, in which the unit of observation is the 'job' (*poste*), defined as a worker-establishment pair.[4] From this dataset, we collect firm-level information on the number of employees (defined as the headcount at December 31) and the number of worked hours. We restrict our attention to manufacturing firms, identified as those whose reported main activity code (*Activité Principale Exercée*, APE) belongs to divisions 10 to 33 of the NAF rev. 2 classification (corresponding to the European NACE rev. 2).[5] As a firm's APE may vary across years, we assign each firm a permanent 2-digit sector based on the most frequent occurrence.[6]

DADS is matched to FICUS and FARE, two confidential datasets, also provided by INSEE, based on the fiscal statements that all French firms must make to the tax authorities, which contain detailed balance-sheet and revenue-account data. FARE is the successor of FICUS since 2008 and collects data from a larger set of tax regimes than FICUS. To ensure consistency, we restrict our analysis to two tax regimes that are present in both FICUS and FARE, and that jointly account for the vast majority of manufacturing firms, namely the BRN (*Bénéfice Réel Normal*) and the RSI (*Régime Social des Indépendants*).[7] The former is the standard tax regime, whereas the latter is a simplified regime that small firms can opt for. In matching DADS to FICUS and FARE we lose 4.9% of the observations originally retrieved from DADS.

In our analysis, we also need information on the exporting and innovative activity of the

[3] We do not have a direct measurement of the financial constraints faced by individual firms. Notice however that firm size and age are considered as proxies of financial constraints by the literature (Hadlock and Pierce, 2010). For a review, see Carreira and Silva (2010); Silva and Carreira (2012).

[4] Establishments can be easily aggregated at the firm-level using their SIRET identification number, whose first nine digits correspond to the SIREN code.

[5] In the data, the APE code is expressed in terms of the NAF rev. 1 classification from 2002 to 2008, and in terms of the NAF rev. 2 classification since 2008. To ensure consistency over the observed time span, we establish a one-to-one mapping between the 4-digit classes of the NAF rev. 1 classification and those of the NAF rev. 2. To do this, we use the following criterion: if the majority of firms active in sector A (NAF rev. 1) in 2007 is active in sector B (NAF rev. 2) in 2008, then we map sector A into sector B. The few remaining ambiguous cases have been solved manually.

[6] In case more than one mode is present, we assign the code referring to the latest available year.

[7] As a matter of fact, also the BNC (*Bénéfices Non-Commerciaux*) regime is present in both FICUS and FARE; however, it is negligible in the case of the manufacturing sector, as it only accounts for 0.06% of manufacturing firms.

firms. To capture the first dimension, we match our dataset to French customs data, containing transaction-level information on the universe of French exporters. To capture the second, we use Amadeus, a commercial dataset provided by Bureau Van Dijk, which integrates patent data from PATSTAT. Notice that, by identifying innovative firms through patenting firms in Amadeus, we may actually underestimate the true percentage of innovative firms in the population. First, we do not consider innovative firms that do not patent; second, the coverage of French firms in Amadeus may not be complete in all years and sectors.[8]

3.2 Definitions

As stated in Subsection 2.2, our firm-level analysis of the relationship between productivity and employment reallocation will be divided into two exercises: the first will investigate the determinants of employment growth of continuing firms (Equation 2); the second will take into account firm exit, by estimating the determinants of hazard rates (Equation 3).

The employment growth rate of a firm is computed as the logarithmic difference between its employment in two consecutive years:

$$g_{it} = ln(Emp_{it}) - ln(Emp_{it-1})$$

where *Emp* denotes the headcount at December 31.[9] Notice that this rate of growth is only defined for firms having positive employment at both t and t-1, i.e. for *continuing* firms.[10]

Instead, a firm is *entering* when it first appears in our integrated dataset of manufacturing firms with employees, and *exiting* in the last year in which the firm is observed (with positive employment).

Our preferred measure of productivity is real value-added per worked hour. In formula, hourly labor productivity (HLP) is defined as

$$HLP_{it} = \frac{VA_{it}}{Hours_{it}}$$

where VA denotes valued-added at constant prices and $Hours$ the total number of worked hours. As an alternative measure, we also use total factor productivity (TFP). This is computed using the methodology by Levinsohn and Petrin 2003 (building on Olley and Pakes 1996), whereby a Cobb-Douglas production function is estimated, proxying unobservable productivity shocks by intermediate inputs, and TFP is then then computed as that function's 'residual', i.e. the difference between output and inputs.[11]

[8] Although it is fairly high, between 75% and 100%.

[9] In fact, we only count jobs labeled as *non-annexes* by the INSEE, which exceed some duration, working-time, and/or salary thresholds (the job should last more than 30 days and involve more than 120 worked hours, with more than 1.5 hours worked per day; or the net salary should be more than three times the monthly minimum salary; else, it is classified as *annexe*). These can be seen as the 'true' jobs that contribute to the production process (see e.g. INSEE 2010, 17), and account for the large majority (three-fourths) of total jobs.

[10] Our analysis is robust to using the rate of growth *à la* Davis et al. (1996), which is also defined for entering and exiting firms, and is a second-order approximation of the log-difference growth rate around 0.

[11] We measure output by value added, capital by physical assets, labor by total wages and social contributions, and intermediate inputs by the cost of raw materials.

Based on export and patent data, we construct two binary dummy variables, *Exp* and *Pat*. The former denotes whether a firm exports in a given year (in formula, $Exports_{it} > 0$);[12] the latter equals unity in the case a firm has been granted at least one patent over the current and the previous four years (in formula: $\sum_{j=0}^{4} Patents_{it-j} > 0$).

In order to control for the financial context in which firms operate, we introduce an industry-level measure of dependence on external finance *à la* Rajan and Zingales (1998). Following Bricongne et al. (2012), we first compute, for each firm in the dataset:

$$ExtFin_{it} = 1 - \frac{\sum_{t=2002}^{2007} Internal\ financing_{it}}{\sum_{t=2002}^{2007} Gross\ fixed\ capital\ formation_{it}}$$

where *Internal financing* is proxied by the operating result. To obtain an industry-level measure, we then assign to each 2-digit division the median value of the index across firms. *ExtFin* indicates what share of investment is covered by internally-generated funds: positive (negative) values imply that internal financing falls short of (exceeds) investment, hence an industry does (not) depend on external finance. Notice that *ExtFin* is based on pre-crisis averages of *Internal financing* and *Gross fixed capital formation*, so that it is not affected by the financial upheaval associated with the Great Recession.

Finally, firm age (Age) is computed using information on firm's foundation year.

4 Macro and micro trends

4.1 The Great Recession in France

The period observed in the present paper (2002-2013) extends before, during, and after the Great Recession of 2008-2010. Figure 1 presents four charts, conveying an idea of the entity of the crisis.

The top charts display how France performed, in terms of GDP growth and unemployment rate, compared to the Eurozone and the OECD averages. In these advanced economies, the GDP growth rate (Figure 1a) was nil in 2008, and deeply negative in 2009: in the latter year, France's economy, though performing better than others, contracted by almost 3%. At the same time the unemployment rate (Figure 1b), which had decreased in all the considered economies until 2007, soared during the Great Recession, peaking at 9.5% in France. After a recovery of production in 2010 and 2011, in the last two years of our observation period France and Europe experienced another downturn, connected to the Eurozone 'sovereign debt' crisis.[13] During those two years, growth was almost nil in France, and the unemployment rate rose considerably, exceeding 10% in 2013.

The bottom charts compare the performance of France's manufacturing sector, which is the focus of the present work, to the country's overall economic activity. Over the observed period, value added in manufacturing (Figure 1c) was subject to wide swings. Before the crisis it enjoyed a continuous and sustained growth, such that, at the 2007 peak, it was almost one-third higher than in 2002; but most of this gain was wiped out by the Great Recession, during which

[12] We have also elaborated an index of country-diversification, corresponding to the number of countries where a firm exports, plus one (for the domestic market). The results based on this index do not substantially differ from those based on the binary variable *Exp*, and are available upon request.

[13] The regional, rather than global character of this second crisis is apparent from the GDP of the Eurozone shrinking, while that of the OECD as a whole grew.

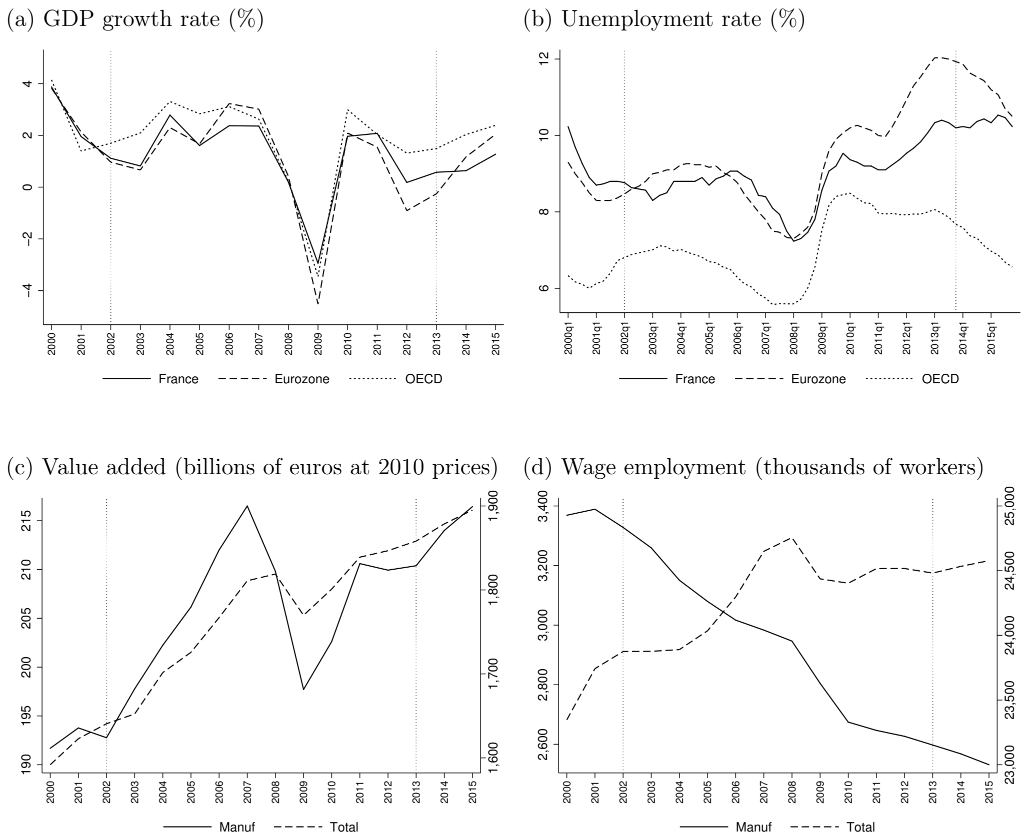

Figure 1: Macroeconomic figures, 2000-2015. Sources: (a, b) OECD; (c, d) INSEE. Notes: (i) vertical dotted lines delimit the time span of our data; (ii) in Figures 1c and 1d, *Total* is measured the left axis, *Manuf* is measured the right axis.

the manufacturing sector was hit harder, and longer, than the rest of the economy. Indeed, value added in manufacturing fell in both 2008 (by -3.1%) and 2009 (by -5.8%); then, after the partial recovery of 2010-2011, it stagnated during the Eurozone crisis. Finally, Figure 1d displays the evolution of wage employment. Employment in the manufacturing sector had been steadily declining since the early 2000s;[14] still, the impact of the Great Recession is apparent from the decline being particularly marked in 2009 and 2010. Indeed, in those two years manufacturing employment contracted by 4.8% and 4.6% (much more than any other sector), and 252,000 manufacturing jobs were lost, overall.

4.2 Entry, exit, and employment growth: firm-level evidence

The macro trends in employment briefly described in the previous section are driven by the dynamics of firm entry, exit, and employment growth. Table 1 reports the entry and exit rates (respectively defined as the ratio between the number of entering and exiting firms in year t and total firms in the same year) during the observed period, as well as summary statistics

[14] In fact, manufacturing employment had been on a negative trend since the mid-1970s, both in absolute terms (declining from more than 5 millions in the 1970s to less than 3 millions nowadays) and as a share of total employment (from 23% to 10%), with the only exception of the mid- and late-1990s, when it was substantially stable (source: INSEE).

Table 1: Entry, exit, and growth rates (%), 2002-2013.

	Entry	Exit	Growth (g)				N
			mean	sd	p25	p75	
2003	8.1	8.0	-0.5	35.8	-7.4	5.7	143,945
2004	6.7	8.3	-0.3	35.6	-7.4	6.1	142,467
2005	6.4	8.3	0.3	36.3	-6.4	6.8	138,876
2006	6.1	8.1	0.4	35.3	-6.1	7.6	137,918
2007	6.1	8.1	0.3	34.2	-5.4	8.0	135,710
2008	5.6	8.2	-1.0	34.2	-7.2	5.4	133,252
2009	5.1	6.3	-3.7	34.6	-10.5	0.0	128,645
2010	5.3	9.4	-1.0	33.0	-6.3	4.3	128,316
2011	5.3	8.1	0.1	32.3	-3.6	6.9	123,804
2012	5.2	7.6	-1.0	32.1	-5.7	3.8	120,831
2013	4.7	8.2	-1.1	31.6	-5.7	3.2	118,303

Source: our elaborations on DADS. Notes: (i) the first year of the data (2002) is lost in the computation of growth rates; (ii) the number of observations (N) refers to all firms that are active at any point during a certain year, i.e. continuing, entering, and exiting firms (see Subsection 3.2).

about the distribution of the firm employment growth rate (see definition in Section 3.2).

The entry rate tended to decrease over the period, which is in line with emerging evidence on the decline of business dynamism in advanced economies (Decker et al., 2016; Criscuolo et al., 2014). Instead, the exit rate was rather stable, slightly above 8%, with the notable exception of 2009 and 2010, when it first sharply dropped, then bounced back, before reverting to the period mean. The exit rate's trough in 2009 appears paradoxical, in the light of that year's recession; yet, it is paralleled by a slighter decline in 2012, itself a year of stagnation. Tentative justifications for this behavior can be based on the particularly sizable decrease in the entry rate from 2007 to 2009; on a possible determination to 'hold on' during the crisis; and on the lagged timing of employment dynamics with respect to the business cycle, meaning that many exits at the beginning of a certain year do in fact refer to firms that were already disarray in the previous year(s). The latter argument also helps interpreting the 2010 peak in the exit rate, as it rather reflects the previous year's recession, than the ongoing recovery.

The average employment growth of continuing firms was negative in most years, with the exception of 2005-2007 and 2011. On a closer inspection, average employment changes were small (no more than 0.5%, in absolute value) in the pre-crisis period; then, the crisis brought about substantial negative rates, dipping to -3.7% in 2009, of which the positive but negligible growth of 2011 only represented a temporary interruption. This pattern is homogeneous over the growth rate distribution, as shown by the figures of the 25th and the 75th percentiles. Notably, the latter fell to zero in 2009 and, after the 2010-2011 recovery, it halved in 2012-2013, i.e. the years of the Eurozone crisis. If connected to the dynamics of the exit rate, these may provide an interpretation for the 2009-2010 fall in manufacturing employment: while the 2009-2010 decrease in manufacturing employment was evenly spread over those two years (as shown in Figure 1d), its main drivers were different in each of them, namely firm downsizing in 2009, and firm exit in 2010. In other words, during the Great Recession, employment first fell via the intensive margin, then via the extensive one.

Finally, the number of manufacturing firms, reported in the last column, monotonically decreased over the period, which can be seen as reflecting the secular decline in manufacturing employment, displayed in Figure 1a above.

Table 2: Descriptive statistics about the main variables, 2002-2013.

	HLP		TFP		Emp		Age		Exp		Pat	
	mean	p50	mean	p50	mean	p50	mean	p50	mean	p50	mean	p50
2002	30.2	21.2	49.6	37.1	26.1	5.0	14.8	11.0	22.7	0.0	1.4	0.0
2003	31.9	22.4	52.2	38.5	25.1	5.0	14.8	11.0	20.7	0.0	1.3	0.0
2004	34.1	23.8	54.4	40.7	24.8	5.0	15.2	12.0	20.4	0.0	1.5	0.0
2005	34.3	24.3	56.3	41.6	25.1	5.0	15.6	12.0	20.6	0.0	1.6	0.0
2006	36.8	25.1	58.2	43.5	24.7	5.0	15.8	13.0	20.3	0.0	1.7	0.0
2007	36.2	25.9	59.7	44.9	24.9	5.0	15.9	13.0	20.2	0.0	1.8	0.0
2008	34.3	25.6	57.7	44.6	24.9	5.0	16.2	13.0	20.1	0.0	1.9	0.0
2009	32.7	24.4	58.4	42.4	24.1	5.0	16.5	13.0	20.0	0.0	1.9	0.0
2010	37.4	26.4	62.9	45.2	24.3	5.0	16.8	14.0	20.1	0.0	1.8	0.0
2011	36.9	27.3	63.2	46.5	24.6	5.0	17.1	14.0	19.3	0.0	1.7	0.0
2012	35.1	26.8	63.0	46.5	24.8	5.0	17.4	14.0	19.6	0.0	1.6	0.0
2013	34.6	26.4	61.3	45.9	24.9	5.0	17.8	14.0	19.8	0.0	1.5	0.0

Source: our elaborations on DADS, FICUS/FARE, customs data, and patent data (see Section 2.1). Note: HLP is expressed in in euros per worked hour, while TFP does not have a meaningful unit of measure.

Table 2 provides summary statistics about the firm-level variables that will be employed in the following analysis, defined in Section 3.2. Labor productivity increased before the global crisis, and fell in 2008 and 2009 (actually, some decline had already occurred in 2007). It strongly recovered in 2010, as a result of the diverging trends experienced by manufacturing value added and employment in that year (see Figure 2); then it declined again, especially in 2012. TFP followed a broadly similar pattern: it steadily grew until 2007, fell relatively less than HLP did in 2008, started recovering already in 2009, peaked from 2010 to 2012, and decreased in 2013.

Firm size was broadly stable over the period, around 25 employees on average, and 5 at the median. Average size fell to 24 in 2009, and recovered subsequently, in line with evidence regarding the growth rate. Firm age, instead, grew monotonically over the observed period, by 3 years overall. The share of exporting firms over total manufacturing firms was about one-fifth, though slightly decreasing throughout the period, and did not show any significant slump during the Great Recession. This comes as no surprise, in the light of the empirical evidence that the 2008-2009 trade collapse mostly hit at the intensive margin (on France, see Bricongne et al., 2012).A sizable drop in *Exp* only occurred in 2011, which was partially recovered in the following years. Finally, the share of patenting firms was quite small (always below 2%) throughout the period.

4.3 Productivity growth decomposition

Aggregate evidence on the relevance of reallocation in driving productivity, and on its dynamics over the Great Recession can be obtained by means of productivity growth decomposition. Figure 2 graphically represents the results of the application to the entire French manufacturing sector of the decomposition as per Equation 1. Four charts are displayed, each representing one combination of the two different productivity measures considered in this paper (HLP and TFP) with two different types of weights, respectively based on the headcount of employees (Emp) and the number of worked hours ($Hours$).

In line with the existing literature (see Subsection 2.1), the *within* component is, gener-

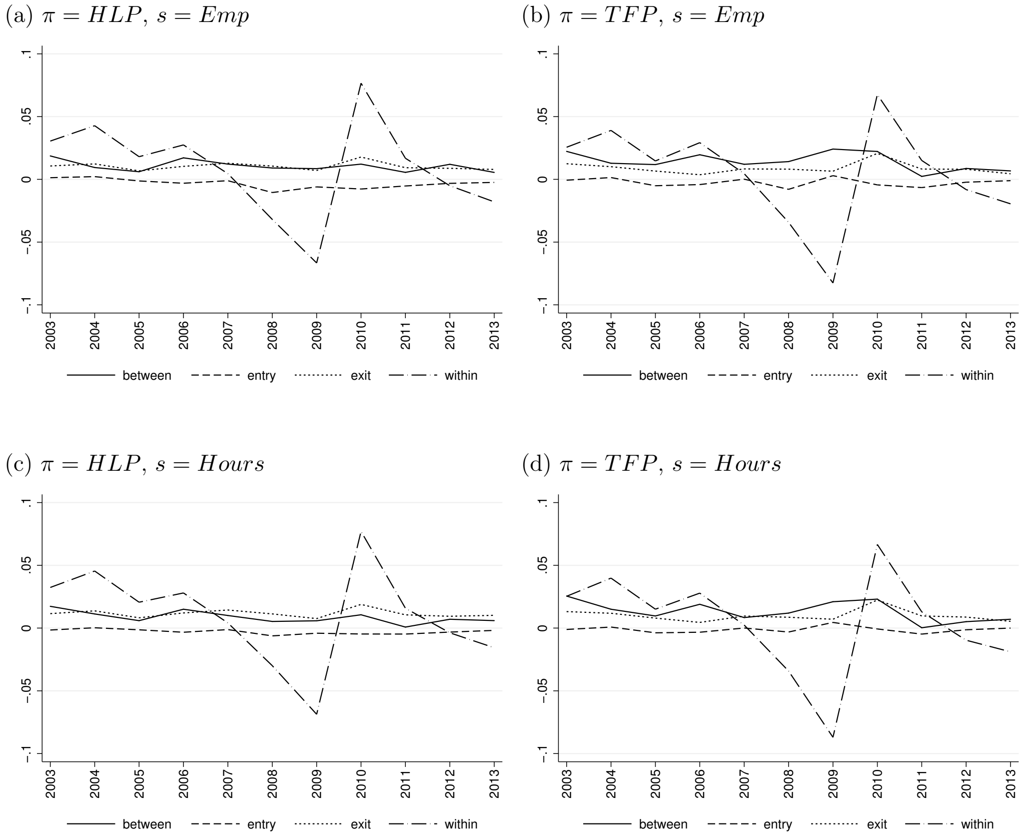

Figure 2: Productivity growth decomposition.

ally, the most sizable contributor to productivity growth. This holds particularly true during the Great Recession (2008-2010), when massive swings (first negative, then positive; see the previous subsection) in that component largely drove the aggregate productivity dynamics. The *between* and *exit* components are lower in magnitude (the latter's being equal to or below the former's); but they are more stable over the business cycle, and always characterized by positive sign. These two components indicate that selection forces were permanently at work, also during the crisis, when they partially offset the fall in productivity brought about by the *within* component. However their dynamics, especially over the crisis, are somewhat sensitive to the employed productivity variables and weights: the *exit* component peaks in 2010 in all four charts; but only in Figures 2b and 2d, referring to TFP, does the *between* component also peak, and does so in the previous year as well. Finally, *entry* tends to have negative sign, denoting that entering firms are typically less productive than incumbent ones, and to be the least sizable component: indeed, in most years it appears negligible. This motivates our decision not to dedicate, in what follows, a separate, detailed analysis to entering firms.

5 Did the Great Recession have a cleansing effect?

The productivity growth decomposition, presented in the last subsection, has provided *prima facie* evidence that selection forces, reallocating employment shares towards more productive firms, were at work during the whole period observed, even if the intensity of these forces was not particularly higher during the Great Recession. In this section, the latter claim is more accurately investigated with a firm-level econometric analysis. We analyze the two most important reallocation factors, i.e., in the previous section's terminology, the 'between' and the 'exit' components, controlling for different dimensions of firm heterogeneity. As anticipated in Section 2.2, we follow the methodology used, among others, in Hallward-Driemeier and Rijkers (2013) and Carreira and Teixeira (2016) and perform, first, pooled OLS and fixed-effects (FE) estimations of Equation 2, where the the dependent variable is employment growth; then, we estimate a Cox proportional hazards model, as per Equation 3, investigating the determinants of firm exit.

In both exercises, we regress the dependent variable on productivity and a number of other firm characteristics, as well as on the interactions between each of the independent variables and a temporal dummy (*Crisis*), denoting the crisis years 2008-2010.[15] The inclusion of interacted terms is aimed at analyzing whether and how the relationships between the dependent and the independent variables changed during the crisis.

For each exercise, we present estimates employing, as a measure of productivity, both HLP and TFP; and for each of these we present the outputs of three regressions, in which the number of independent variables is progressively extended:

1. in the most basic specification, only productivity, computed in deviations from sector-year mean, is included (in other words, the vector $\mathbf{x_{it-1}}$ in Equations 2 and 3 is empty);
2. then size (*Emp*), its squared term (to allow for a non-linear relationship), and *Age* are included, as basic controls;
3. finally, dummies denoting export and patenting activity (*Exp* and *Pat*, respectively) are added to the framework.

Independent variables are lagged (see Equations 2 and 3); productivity, size, and age are taken in logarithmic form. In the following regression outputs, we report the estimated coefficients and robust standard errors clustered at the firm level.

Table 3 presents the results of the estimation of Equation 2 by pooled OLS. Labor productivity (HLP) displays a significant positive coefficient, indicating the presence of reallocation of employment towards more productive firms: indeed, a unit increase in demeaned log-productivity is associated with an increase in the average firm growth rate by around 8.5 percent points (Column 1).[16] The significant negative interaction $HLP * Crisis$, however, implies that this advantage decreases during the Great Recession, although it remains positive (8 percent points, computed as the sum of the non-interacted and interacted coefficients). This attenuation of productivity-enhancing reallocation contrasts with the cleansing hypothesis.

Adding covariates does not change the main message: in Columns 2 and 3, the coefficient on HLP is still positive and significant, even though with a lower value, and the interaction $HLP * Crisis$ is negative and significant, although the overall effect of productivity on employment growth during the crisis remains positive. This result confirms the attenuation of productivity-enhancing reallocation during the Great Recession.

[15] This timing of the crisis has been chosen because 2008-2010 are the years in which the Great Recession impacted on GDP and employment (see Figure 2); and it is consistent with that identified by the the World Bank's Global Financial Development Database (Cihak et al., 2012). We also present, in Section 5.2, a more comprehensive definition, as the whole post-2008 period (2008-2013).

[16] Notice that a unit increase in demeaned log-productivity is equivalent to an increase by 1.6 standard deviations.

Table 3: Estimation of Equation 2 by pooled OLS.

	(1)	(2)	(3)	(4)	(5)	(6)
HLP	0.085***	0.067***	0.066***			
	0.001	0.001	0.001			
HLP*Crisis	-0.005***	-0.006***	-0.005***			
	0.002	0.002	0.002			
TFP				0.047***	0.076***	0.074***
				0.001	0.001	0.001
TFP*Crisis				-0.004**	-0.005***	-0.005***
				0.002	0.002	0.002
Emp		-0.069***	-0.071***		-0.094***	-0.095***
		0.001	0.001		0.001	0.001
Emp^2		0.009***	0.009***		0.011***	0.010***
		0.000	0.000		0.000	0.000
Emp*Crisis		-0.003**	-0.002		-0.001	-0.000
		0.001	0.001		0.001	0.001
Emp^2*Crisis		0.000	0.001		0.000	0.000
		0.000	0.000		0.000	0.000
Age		-0.020***	-0.021***		-0.015***	-0.016***
		0.000	0.000		0.000	0.000
Age*Crisis		0.002***	0.003***		0.002**	0.002***
		0.001	0.001		0.001	0.001
Exp			0.024***			0.028***
			0.001			0.001
Exp*Crisis			-0.010***			-0.010***
			0.002			0.002
Pat			0.023***			0.029***
			0.003			0.003
Pat*Crisis			-0.004			-0.004
		0.005	0.005		0.005	0.005
Crisis	-0.005***	-0.006**	-0.007**	-0.006***	-0.009***	-0.010***
	0.001	0.003	0.003	0.001	0.003	0.003
Const.	-0.001	0.114***	0.118***	-0.004***	0.131***	0.135***
	0.001	0.002	0.002	0.001	0.002	0.002
N. obs.	1,161,932	1,161,740	1,161,740	1,147,408	1,147,217	1,147,217
N. firms	186,291	186,204	186,204	184,202	184,115	184,115
Adj. R^2	0.022	0.041	0.042	0.008	0.043	0.043

Notes: year and industry dummies are included; *, **, and *** denote $p<0.10$, $p<0.05$ and $p<0.01$, respectively (based on robust standard errors, clustered at the firm level).

A significant non-linear negative relationship between firm size and growth is implied by the coefficients on Emp and its squared term, respectively negative and positive. This relationship does not change during the Great Recession, as the interaction terms $Emp*Crisis$ and $Emp^2*Crisis$ are not significant. Likewise, firm age is negatively related to growth, while the positive but small $Age*Crisis$ interaction denotes a slight attenuation of this relationship during the Great Recession (Columns 2 and 3). Together, these results are in agreement with the empirical literature on the relationship between firm size and age, on the one side, and growth, on the other, reviewed in Subsection 2.2.

Exporting firms enjoy larger growth rates than non-exporting firms; but their growth premium (+2.4 percent points in 'normal' times) considerably drops, though not vanishing, during the Great Recession—a clear consequence of the trade collapse. A similar premium is also enjoyed by patenting firms; but this does not significantly change during the crisis.

All these results are largely confirmed when we use the TFP measure of firm productivity (columns 4 to 6). The main differences concern the coefficient on TFP, which is smaller than the coefficient on HLP in the first specification, but larger in the specifications with covariates, and the growth premia of exporters and patentees, which are somewhat larger.

Heterogeneous firms' reaction to the crisis may be driven by factors that are not fully captured by our variables. In particular, unobservable characteristics, relatively invariant over time but affected by the unexpected shock, may bias the estimation of coefficients. In order to account for these, we estimate Equation 2 by interacting firm-specific fixed effects with the $Crisis$ dummy.[17] The results of these fixed-effects estimations are reported in Table 4.

The main result from Table 3 is confirmed: productivity-enhancing reallocation is at work, but it weakens during the crisis. However, in this case, there is an apparent difference between HLP and TFP: the interaction coefficient is significantly larger (in absolute value) when we use the latter measure.

A similar pattern is observed for the other variables: the main effect is similar to the OLS estimation (with the exception of Age), whereas the interaction effect tends to be larger in absolute value. In particular, the growth advantage of small firms now appears to be magnified during the crisis. A puzzling significant positive coefficient is estimated for Age, implying that older firms should grow more, conditional on firm-specific fixed effects. However, fixed-effects estimation should be interpreted cautiously in the case of this variable which, by construction, has limited within-firm variability (as it is incremental over time), hence it is not precisely estimated by means of a 'within' regression. The same line of reasoning may also explain the negative sign on the the interaction $Pat*Crisis$, which is however barely significant at the 10% level: indeed, the Pat variable has quite a stable value over the observed period, implying little within-firm variability.

Let us now turn to the second econometric exercise, i.e. the Cox proportional hazards model (Equation 3), which estimates the determinants of time-variant hazard rates. Results are presented in Table 5. Notice that coefficients are exponentiated: larger values (smaller) than unity imply a positive (negative) relationship between the dependent and the independent variables. Based on this interpretation, the lower-than-one coefficient attached to HLP indicates that higher productivity is associated with a lower hazard rate, i.e. a higher probability to survive. This relationship, however, weakens during the Great Recession, as the coefficient on the interaction $HLP*Crisis$ is larger than one, in line with evidence from the previous

[17] This methodology is inspired by the general models with individual-specific slopes, presented by Wooldridge (2010, 377-381). Notice that industry dummies are omitted from Equation 2 in FE regressions.

Table 4: Estimation of Equation 2 by FE.

	(1)	(2)	(3)	(4)	(5)	(6)
HLP	0.174***	0.063***	0.062***			
	0.003	0.002	0.002			
HLP*Crisis	-0.002	-0.009**	-0.009**			
	0.006	0.004	0.004			
TFP				0.095***	0.089***	0.088***
				0.003	0.002	0.002
TFP*Crisis				-0.014**	-0.027***	-0.027***
				0.006	0.004	0.004
Emp		-0.623***	-0.624***		-0.640***	-0.640***
		0.005	0.005		0.005	0.005
Emp^2		0.049***	0.049***		0.049***	0.049***
		0.002	0.002		0.002	0.002
Emp*Crisis		-0.447***	-0.447***		-0.438***	-0.438***
		0.009	0.009		0.009	0.009
Emp^2*Crisis		-0.001	-0.001		-0.002	-0.002
		0.003	0.003		0.003	0.003
Age		0.023***	0.023***		0.022***	0.022***
		0.002	0.002		0.003	0.003
Age*Crisis		0.062***	0.062***		0.055***	0.055***
		0.008	0.008		0.008	0.008
Exp			0.024***			0.022***
			0.002			0.002
Exp*Crisis			-0.020***			-0.019***
			0.004			0.004
Pat			0.017***			0.017***
			0.006			0.006
Pat*Crisis			-0.018*			-0.017*
			0.011			0.011
Const.	0.010***	1.041***	1.038***	0.008***	1.075***	1.073***
	0.001	0.008	0.008	0.001	0.008	0.008
N. obs.	1,161,932	1,161,740	1,161,740	1,147,408	1,147,217	1,147,217
N. firms	186,291	186,204	186,204	184,202	184,115	184,115
Adj. R^2	0.063	0.307	0.308	0.040	0.309	0.309

Notes: year dummies and firm fixed effects are included; *, **, and *** denote $p<0.10$, $p<0.05$ and $p<0.01$, respectively (based on robust standard errors, clustered at the firm level).

Table 5: Estimation of Equation 3 by a Cox proportional-hazards model.

	(1)	(2)	(3)	(4)	(5)	(6)
HLP	0.814***	0.692***	0.693***			
	0.006	0.004	0.004			
HLP*Crisis	1.005	1.020**	1.021**			
	0.013	0.010	0.010			
TFP				0.593***	0.686***	0.686***
				0.003	0.004	0.004
TFP*Crisis				1.051***	1.023**	1.023**
				0.012	0.011	0.011
Emp		0.415***	0.408***		0.478***	0.470***
		0.003	0.003		0.003	0.003
Emp^2		1.093***	1.104***		1.078***	1.090***
		0.002	0.002		0.002	0.002
Emp*Crisis		0.987	0.986		0.977*	0.974**
		0.012	0.012		0.012	0.012
Emp^2*Crisis		1.002	1.004		1.005**	1.007***
		0.002	0.003		0.003	0.003
Age		1.012***	1.012***		0.982***	0.983***
		0.005	0.005		0.005	0.005
Age*Crisis		1.094***	1.095***		1.089***	1.089***
		0.009	0.009		0.010	0.010
Exp			0.952***			0.918***
			0.013			0.013
Exp*Crisis			0.965			0.995
			0.024			0.026
Pat			0.134***			0.130***
			0.017			0.017
Pat*Crisis			0.768			0.789
			0.185			0.192
Crisis	2.149***	1.161***	1.159***	1.853***	1.114***	1.114***
	0.042	0.031	0.031	0.039	0.031	0.031
N. obs.	1,294,253	1,287,215	1,287,215	1,270,218	1,264,213	1,264,213
N. firms	207,519	207,345	207,345	204,128	203,960	203,960
Pseudo R^2	0.004	0.020	0.020	0.009	0.020	0.020

Notes: year and industry dummies are included; coefficients are exponentiated; *, **, and *** denote $p<0.10$, $p<0.05$ and $p<0.01$, respectively (based on robust standard errors, clustered at the firm level).

econometric exercise. Indeed, based on column 3 of Table 5, a unit increase in demeaned log-productivity entails a decrease in the probability of exit by 30.7% ($0.693 - 1 = -0.307$) in 'normal' times, and by 29.2% during the Great Recession (obtained as the product of the non-interacted and interacted coefficients, minus one: $0.693 * 1.021 - 1 = -0.292$). Column 6 shows that using the TFP measure of productivity does not change substantially these results.

As for the other variables, the coefficients on *Emp* and its squared term indicate a non-linear positive relationship between firm size and survival. Larger firms have lower probability of exit, and this advantage slightly increases during the Great Recession.[18] The coefficient on *Age*, though significant, is close to unity in all specifications, suggesting that, *ceteris paribus*, age affects little the probability of exit in normal times. However, during the crisis, the product of the non-interacted and of the interacted coefficients is above one, implying a higher likelihood to exit for older firms.

Exporting and patenting firms are more likely to survive than those which do not perform these activities, respectively by 5% (using HLP; 8%, using TFP) and by as much as 87%. Neither of these relationships significantly varied during the Great Recession.

5.1 The role of financial dependence

The estimation results of Equation 2 and Equation 3 have shown that the employment growth premium of more productive firms did not increase during the Great Recession, in disagreement with the cleansing hypothesis. If anything, we have detected signs of a weakening of the productivity-growth relationship, as well as of the productivity-survival nexus. One possible explanation for the failing of the cleansing effect could be the presence of financial constraints (see Section 2).

We do not have a direct measurement of the financial constraints faced by individual firms. However, following Rajan and Zingales (1998), we exploit the sectoral dimension of financial dependence. In particular, we investigate how sectoral financial dependence impacted on productivity-enhancing reallocation during the 2008-2010 recession. Using the variable *ExtFin* (introduced in Subsection 3.2), we split the sample into two sets of (2-digits) industries: those with positive *ExtFin* are assumed to be dependent on external finance, whereas those with negative *ExtFin* are not. Tables 6 and 7 respectively present the estimates of Equations 2 and 3 on these two subsamples. Notice that the former displays both pooled OLS (columns 1 to 4) and FE estimates (columns 5 to 8); and that only the most complete specification is displayed.[19]

Productivity is positively related to employment growth in both financially independent sectors ($ExtFin < 0$, Columns 1, 3, 5, and 7) and financially dependent sectors ($ExtFin > 0$, Columns 2, 4, 6, and 8). Moreover, the sign of the coefficients on $HLP * Crisis$ and $TFP * Crisis$ is negative in both subsamples: even controlling for the role of financial dependence, productivity-enhancing reallocation is slightly attenuated during the crisis, contrary to the cleansing hypothesis. The attenuation seems to be stronger in financially dependent sectors, where the coefficient on the interacted term is significant and larger in absolute value in all specifications. Yet, the difference between the interacted coefficients in the two subsamples

[18] In fact, the coefficients on $Emp * Crisis$ and $Emp^2 * Crisis$ are only significant when the TFP measure is used.

[19] Similar to the results on the whole sample, there are no significant differences between the most complete specification (equivalent to Columns 3 and 6 of Tables 3, 4, and 5) and the more basic specifications. These additional results are available upon request.

Table 6: Estimation of Equation 2 by pooled OLS (columns 1 to 4) and FE (columns 5 to8) on subsamples based on *ExtFin*

.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ExtFin	≤ 0	> 0	≤ 0	> 0	≤ 0	> 0	≤ 0	> 0
HLP	0.061***	0.071***			0.054***	0.075***		
	0.001	0.002			0.003	0.004		
HLP*Crisis	-0.002	-0.009***			-0.004	-0.017**		
	0.002	0.003			0.005	0.006		
TFP			0.077***	0.071***			0.087***	0.091***
			0.001	0.002			0.003	0.004
TFP*Crisis			-0.004*	-0.008***			-0.026***	-0.027***
			0.002	0.003			0.005	0.007
Emp	-0.083***	-0.055***	-0.109***	-0.074***	-0.652***	-0.571***	-0.664***	-0.592***
	0.001	0.001	0.001	0.001	0.007	0.008	0.006	0.008
Emp^2	0.011***	0.006***	0.013***	0.007***	0.055***	0.040***	0.054***	0.040***
	0.000	0.000	0.000	0.000	0.002	0.002	0.002	0.002
Emp*Crisis	0.002	-0.005**	0.003*	-0.003	-0.431***	-0.467***	-0.425***	-0.457***
	0.002	0.002	0.002	0.002	0.011	0.017	0.011	0.017
Emp^2*Crisis	-0.000	0.001**	-0.000	0.001*	-0.005	0.002	-0.005	0.002
	0.000	0.000	0.000	0.000	0.004	0.005	0.004	0.005
Age	-0.021***	-0.021***	-0.018***	-0.015***	0.021***	0.026***	0.016***	0.030***
	0.001	0.001	0.001	0.001	0.003	0.004	0.003	0.004
Age*Crisis	0.003***	0.005***	0.002**	0.004***	0.050***	0.068***	0.045***	0.058***
	0.001	0.001	0.001	0.001	0.009	0.015	0.010	0.015
Exp	0.030***	0.015***	0.033***	0.020***	0.027***	0.021***	0.025***	0.020***
	0.002	0.002	0.002	0.002	0.003	0.003	0.003	0.003
Exp*Crisis	-0.011***	-0.006**	-0.011***	-0.006**	-0.019***	-0.020***	-0.017**	-0.020***
	0.003	0.003	0.003	0.003	0.007	0.006	0.007	0.006
Pat	0.025***	0.023***	0.037***	0.024***	0.022**	0.013*	0.023***	0.012*
	0.004	0.004	0.004	0.004	0.009	0.007	0.008	0.007
Pat*Crisis	-0.014**	0.004	-0.013**	0.004	-0.007	-0.029**	-0.007	-0.028*
	0.007	0.007	0.007	0.007	0.015	0.015	0.014	0.015
Crisis	-0.016***	-0.001	-0.017***	-0.006				
	0.004	0.005	0.004	0.005				
Const.	0.132***	0.128***	0.154***	0.140***	0.971***	1.148***	1.003***	1.184***
	0.002	0.005	0.002	0.005	0.009	0.016	0.009	0.016
N. obs.	727,848	433,892	718,135	429,082	727,848	433,892	718,135	429,082
N. firms	123,062	63,142	121,619	62,496	123,062	63,142	121,619	62,496
Adj. R^2	0.044	0.040	0.047	0.039	0.310	0.304	0.312	0.305

Notes: year dummies, industry dummies (columns 1 to 4), and firm fixed effects (columns 5 to 8) are included; *, **, and *** denote $p<0.10$, $p<0.05$ and $p<0.01$, respectively (based on robust standard errors, clustered at the firm level).

is not statistically significant at conventional levels.[20] As for the other variables, the growth premium of smaller firms seems to be larger in less dependent sectors; and the same is true of the growth premia of exporters and patentees.

Table 7: Estimation of Equation 3 by a Cox proportional-hazards model on subsamples based on *ExtFin*.

	(1)	(2)	(3)	(4)
ExtFin	≤ 0	> 0	≤ 0	> 0
HLP	0.726***	0.635***		
	0.005	0.006		
HLP*Crisis	1.008	1.053***		
	0.013	0.016		
TFP			0.708***	0.642***
			0.005	0.006
TFP*Crisis			1.013	1.050***
			0.014	0.017
Emp	0.413***	0.407***	0.471***	0.468***
	0.003	0.005	0.004	0.006
Emp^2	1.104***	1.103***	1.093***	1.088***
	0.002	0.003	0.002	0.003
Emp*Crisis	0.980	0.987	0.969**	0.976
	0.015	0.020	0.015	0.022
Emp^2*Crisis	1.006*	1.002	1.009**	1.005
	0.003	0.004	0.004	0.004
Age	1.036***	0.954***	1.014**	0.910***
	0.006	0.008	0.006	0.008
Age*Crisis	1.079***	1.136***	1.072***	1.134***
	0.011	0.018	0.011	0.019
Exp	0.897***	1.026	0.871***	0.991
	0.017	0.020	0.017	0.021
Exp*Crisis	0.952	0.956	0.982	0.979
	0.033	0.035	0.036	0.038
Pat	0.136***	0.135***	0.124***	0.138***
	0.023	0.024	0.022	0.025
Pat*Crisis	0.750	0.789	0.788	0.789
	0.252	0.272	0.296	0.275
Crisis	1.182***	1.144***	1.130***	1.144***
	0.037	0.056	0.038	0.059
N. obs.	816,308	470,907	800,452	463,761
N. firms	138,029	69,316	135,671	68,289
Pseudo R^2	0.018	0.028	0.018	0.027

Notes: year and industry dummies are included; coefficients are exponentiated; *, **, and *** denote $p<0.10$, $p<0.05$ and $p<0.01$, respectively (based on robust standard errors, clustered at the firm level).

Table 7 presents the split-sample results of the Cox survival analysis. As in Table 6, the attenuation of productivity-enhancing reallocation via firm exit during the Great Recession is detected in both subsamples, even if it is statistically significant only in more dependent

[20] Apart from the OLS specification with HLP, where the difference is barely significant at 10%. To test the significance of the difference between the estimated coefficients in the two subsamples, additional regressions have been run on the whole sample, adding interaction terms between all right-hand side variables and a dummy for financially dependent sectors. Results from these regressions are available upon request.

sectors. However, also in this case, the difference between the interacted coefficients in the two subsamples is not statistically significant.[21]

A noticeable difference concerns *Age*, whose coefficient is above unity in less dependent sectors, and below unity in more dependent ones: in other words, age threatens survival in the former, and favors it in the latter, possibly because established firms have better access to credit. In the crisis years, however, the effect of age on survival becomes negative also in more dependent sectors. Finally, the growth premium of exporters is only significant in less dependent sectors, while that of patentees is also significant in more dependent ones.

5.2 Robustness check: employing a broader definition of crisis

In the previous regressions, we have defined *Crisis* as the years 2008-2010, which Figure 2 shows being those when the Great Recession impacted on GDP and employment. However, it is clear from that figure that the following recovery was limited in size and time: in fact, in 2012-2013, France, like the rest of the Eurozone, experienced a new downturn, connected to the so-called 'sovereign debt' crisis. In this subsection we verify the robustness of our findings to employing a broader definition of the crisis dummy, as the years 2008-2013, accounting for the fact that growth was sluggish and unemployment was rising in the whole period since 2008.[22] This also allows improving the accuracy of FE estimates, as the fixed effects interacted with the crisis dummy can be identified over a larger number of years. The following tables present the results of regressions using the alternative crisis dummy, which, for the sake of clarity, we label *Post*. Each table is made of six columns, reporting the estimates on the whole sample and on the two subsamples based on *ExtFin*, measuring productivity by HLP and TFP. Notice that only the fullest specification is displayed.

Tables 8 and 9 present pooled OLS and FE estimates, respectively, of Equation 2. The main results observed in the previous subsection are confirmed: reallocation is productivity-enhancing, but it loses strength during the (broadly defined) crisis. This attenuation is driven by the sectors that are more dependent on external finance (i.e. for which $ExtFin > 0$), which are also those where, in 'normal' times, productivity-enhancing reallocation is stronger. In this case, the difference between the interacted coefficients in the two subsamples is statistically significant at 1% level. *Emp* has a significant non-linear negative relationship with firm growth, which is stronger in less dependent sectors, and which attenuates during the crisis. The coefficients attached to *Age* are estimated with different sign by pooled OLS and FE, but in both cases the age-growth relationship significantly weakens during the crisis. Exporters enjoy a significant growth premium, which is larger in sectors for which $ExtFin \leq 0$, but also significantly drops in the same sectors. Similarly, patentees' growth premium is larger in less financially dependent sectors (employing TFP), but in those sectors it also drops more (and more significantly) during the crisis.

Results from the survival analysis using the broader definition of crisis are presented in Table 10. The main result is again confirmed: reallocation via firm exit is productivity-enhancing, but it attenuates with the crisis. The attenuation is larger in more financially dependent sectors, as already observed in Table 7, but the differences are not statistically significant at conventional levels. The advantage of bigger firms in terms of lower probability

[21] In fact, it is only significant at 5% when HLP is used.

[22] The same timing of the crisis in the Eurozone has been adopted in the study on Portugal by Carreira and Teixeira (2016). In fact, they only identify 2008-2012 as the crisis years, since 2013 is not covered by their data; but they acknowledge that the crisis persisted until 2013 (Carreira and Teixeira, 2016, 594-595).

Table 8: Estimation of Equation 2 by pooled OLS.

	(1)	(2)	(3)	(4)	(5)	(6)
ExtFin		≤ 0	> 0		≤ 0	> 0
HLP	0.068***	0.061***	0.077***			
	0.001	0.002	0.002			
HLP*Post	-0.007***	-0.001	-0.016***			
	0.002	0.002	0.003			
TFP				0.081***	0.081***	0.082***
				0.001	0.002	0.002
TFP*Post				-0.014***	-0.009***	-0.023***
				0.002	0.002	0.003
Emp	-0.076***	-0.089***	-0.059***	-0.101***	-0.115***	-0.080***
	0.001	0.002	0.002	0.001	0.001	0.002
Emp^2	0.009***	0.012***	0.006***	0.011***	0.013***	0.008***
	0.000	0.000	0.000	0.000	0.000	0.000
Emp*Post	0.008***	0.012***	0.005**	0.012***	0.014***	0.010***
	0.001	0.002	0.002	0.001	0.002	0.002
Emp^2*Post	-0.000	-0.001*	-0.000	-0.001***	-0.001**	-0.001
	0.000	0.000	0.000	0.000	0.000	0.000
Age	-0.022***	-0.023***	-0.023***	-0.018***	-0.019***	-0.017***
	0.001	0.001	0.001	0.001	0.001	0.001
Age*Post	0.005***	0.004***	0.005***	0.004***	0.004***	0.004***
	0.001	0.001	0.001	0.001	0.001	0.001
Exp	0.024***	0.032***	0.014***	0.029***	0.035***	0.019***
	0.001	0.002	0.002	0.001	0.002	0.002
Exp*Post	-0.005***	-0.008***	-0.000	-0.006***	-0.008***	-0.001
	0.002	0.002	0.002	0.002	0.002	0.002
Pat	0.031***	0.033***	0.031***	0.036***	0.044***	0.031***
	0.004	0.005	0.005	0.004	0.005	0.005
Pat*Post	-0.018***	-0.024***	-0.012*	-0.016***	-0.021***	-0.011
	0.005	0.006	0.007	0.005	0.006	0.007
Post	-0.026***	-0.032***	-0.019***	-0.029***	-0.033***	-0.027***
	0.003	0.003	0.005	0.003	0.003	0.005
Const.	0.133***	0.143***	0.139***	0.147***	0.165***	0.154***
	0.002	0.002	0.005	0.002	0.002	0.005
N. obs.	1,161,740	727,848	433,892	1,147,217	718,135	429,082
N. firms	186,204	123,062	63,142	184,115	121,619	62,496
Adj. R^2	0.042	0.044	0.040	0.044	0.048	0.039

Notes: year and industry dummies are included; *, **, and *** denote $p<0.10$, $p<0.05$ and $p<0.01$, respectively (based on robust standard errors, clustered at the firm level).

Table 9: Estimation of Equation 2 by FE.

	(1)	(2)	(3)	(4)	(5)	(6)
ExtFin		≤ 0	> 0		≤ 0	> 0
HLP	0.062***	0.051***	0.079***			
	0.003	0.004	0.005			
HLP*Post	-0.010***	-0.003	-0.021***			
	0.004	0.004	0.006			
TFP				0.077***	0.070***	0.090***
				0.003	0.004	0.005
TFP*Post				-0.012***	0.003	-0.026***
				0.004	0.005	0.006
Emp	-0.870***	-0.890***	-0.828***	-0.883***	-0.900***	-0.846***
	0.007	0.010	0.011	0.007	0.009	0.011
Emp^2	0.047***	0.050***	0.041***	0.046***	0.048***	0.041***
	0.002	0.004	0.003	0.002	0.004	0.003
Emp*Post	0.076***	0.075***	0.079***	0.079***	0.076***	0.084***
	0.009	0.012	0.015	0.009	0.012	0.015
Emp^2*Post	0.003	0.005	0.000	0.003	0.006	0.000
	0.003	0.005	0.005	0.003	0.005	0.005
Age	0.081***	0.076***	0.095***	0.077***	0.069***	0.099***
	0.005	0.005	0.009	0.005	0.006	0.009
Age*Post	-0.051***	-0.055***	-0.044***	-0.052***	-0.056***	-0.048***
	0.006	0.007	0.011	0.006	0.007	0.011
Exp	0.020***	0.024***	0.016***	0.018***	0.021***	0.015***
	0.003	0.004	0.004	0.003	0.004	0.004
Exp*Post	-0.011***	-0.014**	-0.008	-0.009**	-0.012**	-0.007
	0.004	0.006	0.005	0.004	0.006	0.005
Pat	0.028***	0.039**	0.016	0.027***	0.038**	0.015
	0.010	0.016	0.011	0.010	0.016	0.011
Pat*Post	-0.021*	-0.036*	-0.007	-0.019*	-0.033*	-0.005
	0.012	0.018	0.015	0.012	0.018	0.015
Const.	1.141***	1.055***	1.249***	1.178***	1.092***	1.279***
	0.008	0.010	0.017	0.009	0.010	0.017
N. obs.	1,161,740	727,848	433,892	1,147,217	718,135	429,082
N. firms	186,204	123,062	63,142	184,115	121,619	62,496
Adj. R^2	0.354	0.356	0.350	0.354	0.357	0.350

Notes: year and industry dummies are included; *, **, and *** denote $p<0.10$, $p<0.05$ and $p<0.01$, respectively (based on robust standard errors, clustered at the firm level).

of exit increases since 2008, whereas the advantage of older firms decreased. In fact, they become more likely to exit, in agreement with the results from previous tables. As in Table 7, it turns out that exporters only enjoy a premium, in terms of survival, in less financially dependent sectors. However, in this case, exporters significantly increase their probability of survival in the post-2008 period, at least in the specifications using HLP.[23] The opposite is true of patentees' premium, which, differently from Table 7, significantly decreases, though remaining very large.

Table 10: Estimation of Equation 3 by a Cox proportional-hazards model.

	(1)	(2)	(3)	(4)	(5)	(6)
ExtFin		≤ 0	> 0		≤ 0	> 0
HLP	0.683***	0.717***	0.625***			
	0.005	0.006	0.007			
HLP*Post	1.034***	1.025**	1.056***			
	0.009	0.012	0.016			
TFP				0.671***	0.693***	0.627***
				0.005	0.006	0.007
TFP*Post				1.048***	1.043***	1.067***
				0.010	0.013	0.017
Emp	0.431***	0.439***	0.422***	0.502***	0.508***	0.490***
	0.004	0.005	0.006	0.004	0.005	0.008
Emp^2	1.098***	1.099***	1.099***	1.082***	1.085***	1.082***
	0.002	0.003	0.003	0.002	0.003	0.004
Emp*Post	0.903***	0.889***	0.933***	0.880***	0.865***	0.914***
	0.010	0.012	0.017	0.010	0.012	0.019
Emp^2*Post	1.009***	1.009***	1.007*	1.015***	1.016***	1.011***
	0.002	0.003	0.004	0.003	0.003	0.004
Age	0.970***	0.992	0.915***	0.939***	0.969***	0.870***
	0.005	0.006	0.009	0.005	0.006	0.009
Age*Post	1.195***	1.182***	1.223***	1.198***	1.183***	1.233***
	0.009	0.011	0.018	0.010	0.012	0.019
Exp	0.978	0.914***	1.063**	0.930***	0.876***	1.011
	0.016	0.020	0.025	0.016	0.020	0.025
Exp*Post	0.925***	0.932**	0.907***	0.968	0.973	0.947
	0.020	0.028	0.030	0.022	0.031	0.033
Pat	0.071***	0.061***	0.083***	0.063***	0.051***	0.078***
	0.015	0.019	0.023	0.014	0.017	0.024
Pat*Post	2.472***	3.072***	1.994**	2.670***	3.402***	2.122**
	0.591	1.060	0.665	0.685	1.277	0.750
Post	1.084***	1.173***	0.909**	1.048*	1.140***	0.890**
	0.027	0.035	0.044	0.028	0.036	0.046
N. obs.	1,287,215	816,308	470,907	1,264,213	800,452	463,761
N. firms	207,345	138,029	69,316	203,960	135,671	68,289
Pseudo R^2	0.021	0.018	0.028	0.020	0.018	0.027

Notes: year and industry dummies are included; coefficients are exponentiated; *, **, and *** denote $p<0.10$, $p<0.05$ and $p<0.01$, respectively (based on robust standard errors, clustered at the firm level).

[23] In the same specifications, we also notice that exporters are significantly disadvantaged in more dependent sectors.

6 Conclusions

This paper puts under scrutiny the 'cleansing hypothesis', according to which recessions are periods of accelerated reallocation of inputs and output from less efficient to more efficient firms. In particular, we investigate this hypothesis during the Great Recession, looking at the reallocation of employment across firms in the French manufacturing sector, both via firm growth and via firm exit, during the 2002-2013 period.

Results show that more productive firms, which during normal time enjoy faster growth and lower probability of exit, significantly decreased their advantage during the Great Recession. This is at odds with the cleansing hypothesis, and in line with recent evidence according to which the Great Recession was not a phase of increased productivity-driven reallocation. These results hold controlling for age, size, export and innovative propensity of the firms.

This study acknowledges the complex nature of the Great Recession and devotes attention to its extensions to international trade (the trade collapse) and finance (the credit crunch). Regarding the former, results suggest that the attenuation of productivity-enhancing reallocation is driven by sectors that are more dependent on external finance. As for the latter, the interaction of the export status variable with the crisis dummy shows a negative coefficient, confirming that the employment growth premium that exporting firms normally enjoy over non-exporters significantly decreased because of the trade collapse. However, the positive relation of export propensity with firm survival did not significantly change during the Great Recession.

These findings have broad implications for policy. A particular attention should be devoted to the short- and long-run consequences of the weakening of the reallocation process, which may further aggravate the slowdown of productivity growth that started in the years before the Great Recession (Cette et al., 2016). In this regard, the policy response to deep non-cleansing recessions should contain counter-cyclical measures, aimed at reducing the length and entity of the recession, thus reinstating the full potential of productivity-enhancing reallocation.

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