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Productivity-Enhancing Reallocation during the Great Recession: Evidence from Lithuania*

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ABSTRACT

This paper studies the impact of the Great Recession on the relationship between reallocation and productivity dynamics in Lithuania. Using detailed microlevel data, we first document the aggregate contribution of firm exit and employment reallocation to productivity growth. Next, we estimate firm-level regressions to confirm the findings and to perform a heterogeneity analysis. This analysis shows that productivity shielded firms from exit, and that this relationship became stronger during the Great Recession. Moreover, we demonstrate that more productive firms experienced on average lower employment losses, and that this effect was even stronger during the economic slump. Taken together, our results suggest that reallocation was productivity-enhancing during the Great Recession. However, the analysis also indicates that reallocation intensity varied with sector's dependence on external financing or international trade as well as market concentration.

Keywords: firm dynamics, job reallocation, productivity, Great Recession

JEL codes: E24, E32, L11, J23

1 Introduction

Firm dynamics play a pivotal role in productivity-enhancing reallocation. Resources are reallocated from low-productive to high-productive business both through firm entry and exit, and the reassignment of inputs across active units. Economic crises may alter this process by either fostering the destruction of unproductive units (Schumpeter, 1939; Davis and Haltiwanger, 1992; Caballero and Hammour, 1994) or making market imperfections more salient, which may eliminate productive units from the market (Barlevy, 2002, 2003; Caballero and Hammour, 1996; Ouyang, 2009). Which hypothesis dominates may also depend on the nature of the recession (Foster et al., 2016).

While a significant literature shows that input reallocation and productivity dynamics are closely tied, less clear is whether recessions are *cleansing* or *scarring*. Understanding how aggregate shocks affect the link between reallocation and productivity is key for policy-making. If economic crises are cleansing, policies aimed at mitigating the short-term impact of aggregate shocks may be counterproductive and jeopardize long-term growth. However, if recessions exacerbate market frictions, policies to sustain long-term growth must seek to minimize short-run effects. In this paper, we investigate the impact of the Great Recession on productivity-enhancing reallocation in Lithuania in order to assess whether or not the cleansing hypothesis holds.

The impact of the Great Recession on productivity-enhancing reallocation in Lithuania is an interesting case-study for at least three reasons. Firstly, the country has experienced a dramatic economic transformation as a result of moving from a centrally planned economy to a market economy. This move led to the economy doubling in size between 1995 and 2015. The rapid economic growth was paired with a significant increase in the population of firms and a shift in industrial composition. However, these developments did not fully translate into strong productivity growth (OECD, 2018).

Secondly, the impact of the Great Recession was particularly striking compared to other developed economies, both in terms of the magnitude and the persistence of the shock. In particular, between 2008 and 2009, Lithuania experienced a GDP contraction three times larger than the Eurozone or the US economy. However, the economy bounced back quickly: by 2010, real GDP growth was already above five percent. Thus, the magnitude of the distortion along with its short-lived nature created an ideal scenario in which to test the cleansing hypothesis.

Thirdly, the dataset available covers more than 90% of all limited liability companies in the private sector (see Constantinescu and Proškutė (2019) for details). The bulk of the existing literature has exclusively focused on the manufacturing sector; by contrast, we are able to provide evidence for the whole private sector. This also allows us to perform a detailed heterogeneity analysis to assess differences in the impact of the Great Recession on the link between reallocation and productivity across industries.

We proceed with our analysis in two steps. We first take an aggregate perspective and decompose year-on-year changes in the population of firms, employment, and productivity into the contribution of firm dynamics (entry and exit) and job reallocation. By means of this aggregate decomposition, we shed light on the impact of the Great Recession boosting productivity-enhancing reallocation. The aggregate analysis indicates that reallocation increased during the Great Recession in Lithuania, and that this reallocation was productivity-enhancing. Specifically, we show that the firm exit rate spiked during the recessionary period and overall job reallocation increased, spurred by job destruction. This increase in firm exit and employment reallocation was associated with productivity gains, which helped to attenuate the loss in aggregate productivity.

In a second step, we focus on the reallocation process at the micro-level. We estimate firm-level regressions to evaluate whether the Great Recession accelerated productivity-enhancing reallocation, looking both at firm exit and employment growth of incumbent firms. Our analysis shows that productivity shielded firm from exit, and that this relationship became stronger during the Great Recession. Moreover, we demonstrate that more productive firms destroyed on average less jobs, and that this effect was stronger during the economic slump. These two pieces of evidence reinforce our previous findings, suggesting that the Great Recession was a period of intensified productivity-enhancing reallocation. However, our heterogeneity analysis highlights the importance of the nature of the shock. In other words, we show that the link between productivity and firm exit or employment growth did not strengthen during the Great Recession in sectors that were most affected by the shock, i.e. those more dependent on external financing or international trade. We also find a stronger relationship during the Great Recession between productivity and firm exit or employment growth in less competitive industries. Finally, we find suggestive evidence of creative entry during the Great Recession: newly created firms were relatively more productive.

The remainder of the paper is structured as follows: Section 2 reviews the related literature and explains the Lithuanian context. Section 3 describes the data and main concepts, whereas Section 4 documents the evolution of firm dynamics, labor reallocation, and aggregate productivity growth. Section 5 introduces the micro-econometric model and discusses the results of the firm-level relationship between reallocation and productivity. Section 6 concludes.

2 Background

2.1 Related literature

The view of economic crises as periods of productivity-enhancing reallocation dates back to the Schumpeterian view of recessions as catalysts of a creative destruction (Schumpeter, 1939). Theoretical macro-models developed to formalize this idea have shown that recessions have *cleansing effects*: the relatively lower cost of reallocation during downturns favors the emergence and the growth of more productive organizations, and low-productive units are eliminated from the market (Davis and Haltiwanger, 1990; Caballero and Hammour, 1994; Mortensen and Pissarides, 1994).

However, in the presence of market imperfections, economic slumps may have *scarring effects*, as they hinder rather than facilitate productivity-enhancing reallocation. For instance, in the presence of credit constraints, market fundamentals such as productivity may become less relevant to driving reallocation if credit markets are distorted in a recession (Barlevy, 2003; Osotimehin and Pappada, 2016). Alternatively, in a labor market with incomplete contracts, reallocation may fail to accelerate during economic crises (Caballero and Hammour, 1996). Moreover, the general fall in profitability during recessions may also prevent firms from growing or entering the market, which reduces job creation and thereby hampers productivity-enhancing reallocation (Barlevy, 2002; Ouyang, 2009).

Opposing views on whether recessions accelerate or hamper productivity-enhancing reallocation have stimulated a significant amount of empirical research. Empirical exercises may be classified in two broad groups: decomposing aggregate productivity growth or estimating firm-level regressions. Productivity growth decomposition exercises look at the cyclical evolution of the components of productivity growth that are divided into individual productivity of firms, reallocation of market shares across firms with different

productivity levels, and net firm entry. The evidence in this sphere suggests that during recessions, resource reallocation tends to accelerate during downturns (Davis and Haltiwanger, 1992; Davis et al., 2012) and this increase is associated with productivity gains driven by the exit of the least productive firms and the reallocation of market shares from low to high productive firms (Foster et al., 2001; Bartelsman et al., 2018).

More recently, firm-level studies have focused on the impact of severe recessions on resource reallocation and productivity growth. Hallward-Driemeier and Rijkers (2013) investigate the cleansing hypothesis in the context of the East Asian crisis using Indonesian manufacturing firms. The authors find that productivity-reallocation did not accelerate during that crisis and provide evidence consistent with the scarring effect hypothesis. Similar findings are found in Uruguay (Casacuberta and Gandelman, 2006) and Colombia (Eslava et al., 2011). Focusing on the Great Recession environment, Foster et al. (2016) for the US, Bartelsman et al. (2018) for the European Union, and Ikeuchi (2017) for Japan show that reallocation was *less* productivity-enhancing compared to previous crises. Carreira and Teixeira (2016) show evidence favoring the cleansing hypothesis in Portugal during the Great Recession but they stress that credit frictions also drive productive firms out of the market, which may explain why cleansing effects were less intense during the Great Recession compared to previous economic downturns. Domini and Moschella (2018) find that the cleansing hypothesis did not hold during the Great Recession in the French manufacturing sector.

2.2 The Lithuanian context

In this section, we offer a general picture of the Lithuanian economy between 1995 and 2015 and compare its evolution with the US and Euro area economies in terms of GDP growth and unemployment. Figure 1 shows that Lithuania exhibits an average GDP growth over the period of roughly 4.5%, which translated into the economy doubling in size in terms of real GDP between 1995 and 2015. Importantly, the average growth rate was around three times larger than the Euro area average or the US economy.

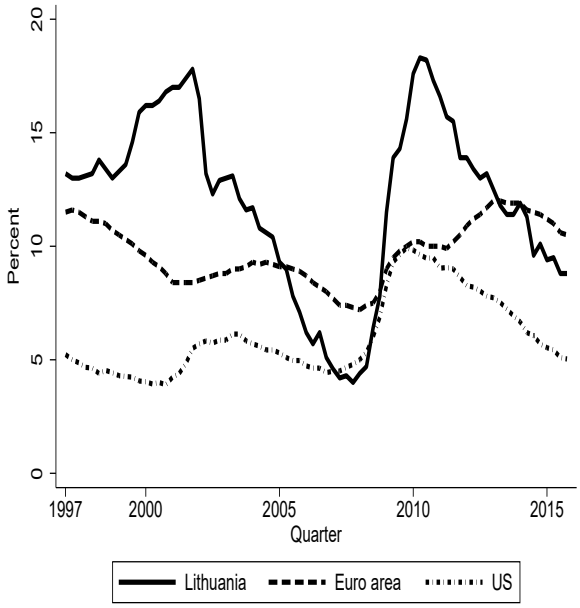
The industrial composition of the Lithuanian economy has also experienced significant changes.[1] The most prominent shifts were observed in the agricultural sector, as the share

[1]Figure A.1 in the appendix portrays the evolution of employment in different sectors of the economy over 1995-2015.

Figure 1: Lithuanian economy, 1995-2015

(a) Real GDP growth rate

(b) Unemployment rate



Source: Eurostat and OECD. Notes: The figure displays quarterly real GDP growth and unemployment rates in Lithuania and the Euro area between 1995 and 2015. The real GDP growth rate is calculated as a percentage change compared to the same period in the previous year.

of total employment fell from 18.6% in 1995 to 9% in 2015. The economic convergence was associated with the rise of the service economy, as illustrated by an increase in the share of employment in wholesale and retail trade from 22% in 1995 to 27.1%, while other Business Services (IT, financial services, real estate, etc.) almost doubled in employment. Despite the strong economic performance and a restructuring of the industrial composition, raising productivity has been identified as one of the most important remaining challenges. The incompleteness of this goal has hindered full catch-up and more inclusive growth (OECD, 2018).[2]

During the period under analysis, the Lithuanian economy also experienced two major economic crises. The first economic contraction occurred in the late 1990s and was triggered by the Russian financial crisis, which led to the collapse of Lithuania's major export market. This shock, however, created the opportunity to shift exports towards western countries, which guided Lithuania to join the the World Trade Organization in 2001 and begin EU accession talks that resulted in full European Union (EU) membership in 2004. During the following five years, the Lithuanian economy exhibited almost double

[2]By 2015, labor productivity was still at around two-thirds of the Euro-area average, only above Latvia and Estonia.

digit annual growth rates.

Central for our analysis is the second economic downturn: the Great Recession, which began with the financial collapse of the US economy between 2007 and 2008, and hit Lithuania particularly hard. At the height of the crisis in 2009, the Lithuanian economy contracted by more than 15% in real terms. While similar contractions took place in other Baltic states, Lithuania experienced a contraction three times more severe than the Euro-area average or the US economy. The magnitude of contraction can be explained both by internal and external reasons. Regarding the former, the economic upturn preceding the Great Recession was marked by significant imbalances: double-digit inflation, a bubble in the housing sector, appreciating real exchange rates, and accelerating wage growth that exceeded productivity growth. The domestic bubbles burst in early 2008, when banks substantially reduced credit supply and began tightening credit conditions. Regarding the latter, due to the high dependence on exports of the economy, the collapse of international trade magnified the impact of the economic crisis.

An interesting and relevant fact concerning the evolution of the Lithuania economy during the Great Recession period is the somewhat short-lived nature of the economic shock: the sharp decline followed a rapid recovery, with growth rates above the Euro-area and US averages in the early 2010s. Thus, the extraordinary economic growth that was exhibited, along with the observed differences in the magnitude and persistence of the Great Recession's impact on the Lithuanian economy relative to neighboring European countries and the US, constitutes an interesting case-study to evaluate whether reallocation was productivity-enhancing during the Great Recession.

3 Data

3.1 Survey of firms

Our main data source comes from an annual survey of firms carried out by the Statistics Department of Lithuania over the period 1995-2015. The survey is legally mandated for all forms of business, except for sole proprietors or associations and public administration entities. Firms in financial and insurance activities are also excluded from the dataset. Additionally, agriculture as well as healthcare and education are poorly represented, as these activities are typically performed by sole proprietor firms and public entities,

respectively.[3]

The dataset contains detailed firm-level information retrieved from balance sheets and income statements, including information on firms' foundation and liquidation dates, employment, sector of activity, ownership, assets, liabilities, equity, value-added, revenues, and profits, among others. Unfortunately, before 2000 most of these variables do not comply with international accounting standards. Therefore, we provide evidence on firm dynamics and job reallocation over the whole period available, but the main analysis is restricted to 2000-2015, when we can properly measure firm-level productivity.

We impose the following restrictions on the original dataset to obtain our analysis sample. Firstly, we exclude enterprises with no continuous entries and those with more than 250 employees during the first year in business. Secondly, we do not consider firms in the primary sector or education and health activities due to the lack of representativeness. Finally, we remove firms that in at least one year exhibit industry-specific growth rates below or above the 1st and 99th percentiles of the production function variables: sales, employment, tangible fixed assets, and materials. These constraints yield a final sample of 77,888 (73,822) firms observed over 438,450 (401,413) firm-year observations between 1995 (2000) and 2015.[4]

3.2 Measurement

Employment. The notion of firm-level employment refers to the average business size over the reference period, n_{it}. Following Davis et al. (1996)'s seminal work, we define changes in aggregate employment, ΔN, as a weighted average of firm-level employment changes, Δn_i,

$$\frac{\Delta N}{\bar{N}} = \sum_i s_{it} \frac{\Delta n_i}{\bar{n}_i} \tag{1}$$

where $s_{it} \geq 0$ sum to 1 and represents the employment share of firm i at time t. Employment changes are expressed in growth rates, dividing the net change by the average employment stock between $t-1$ and t: $\bar{N} = 0.5(N_t + N_{t-1})$ and $\bar{n}_i = 0.5(n_{i,t} + n_{i,t-1})$. This growth rate measure lies in the closed interval $[-2, 2]$ and has become standard in analyses of firm dynamics because it shares some useful properties of log differences but also accommodates firm exit and entry at the endpoints of the distribution.

[3]For a more detailed description of the data, see Constantinescu and Proškutė (2019).

[4]Summary statistics of key variables for selected years are displayed in Table A.1 in the Appendix.

Net employment growth rate can then be decomposed as follows

$$\begin{aligned}\frac{\Delta N}{\bar{N}} &= \sum_{i\in N^+} s_{it}\frac{\Delta n_i}{\bar{n}_i} + \sum_{i\in N^-} s_{it}\frac{\Delta n_i}{\bar{n}_i} = \\ &= \sum_{i\in S^+} s_{it}\frac{\Delta n_i}{\bar{n}_i} + \sum_{i\in E^+} s_{it}\frac{\Delta n_i}{\bar{n}_i} + \sum_{i\in S^-} s_{it}\frac{\Delta n_i}{\bar{n}_i} + \sum_{i\in X^-} s_{it}\frac{\Delta n_i}{\bar{n}_i} \end{aligned} \tag{2}$$

the first line in Equation (2) decomposes the net employment growth rate into job creation (i.e. sum of all employment gains in expanding firms (N^+) between $t-1$ and t) and job destruction (i.e. sum of all employment losses in contracting firms (N^-) between $t-1$ and t). In the second line, we break down job creation and destruction rates into the contribution of *survivors* (i.e. firms that survive between $t-1$ and t, S) , and the contribution of *entrants* (i.e. firms that enter between $t-1$ and t, E) and *exiters* (i.e. firms that exit between$t-1$ and t, X).[5]

Productivity. Our preferred measure is firm-level total factor productivity (TFP) computed following the typical index form (Syverson, 2011)

$$\phi_{it} = q_{it} - \alpha_k k_{it} - \alpha_l l_{it} - \alpha_m m_{it} \tag{3}$$

where ϕ_{it} is firm-level productivity and lower case letters represent the logarithms of firm-level output (q), capital (k), labor (l), materials (m), and $\alpha_{j=\{k,l,m\}}$ is the j-factor elasticity. We use sales revenue as a proxy for gross output, implying that our measure of productivity is a revenue measure and heterogeneity in firm-level prices are embedded.[6] Labor refers to our notion of firm-level employment. We proxy capital using tangible fixed assets, whereas materials refer to the purchases of raw materials, fuel, and other materials used for production. All monetary variables are in euros of 2015, deflated using (two-digit level) industry-specific price indices. The factor industry-specific elasticities are estimated by regressing firm-level output on the three production factors considered,

[5]Exit is defined as the last year when a firm identifier is observed in the data. This implies that the contribution of firm exit (and job destruction) might be overestimated if mergers and acquisitions are pervasive.

[6]We choose sales revenue over value-added because the latter is not perfectly measured, and around 20 percent of the firms exhibit at least one year with negative values. Nevertheless, we test the robustness of the results with respect to this decision using value-added as a proxy for output whenever it is well-defined.

using the intermediate input proxy method developed by Levinsohn and Petrin (2003).[7] The TFP measure is given by the residual of the estimated equation.

Using our estimated firm-level productivity, aggregate productivity at time t, Φ_t, is defined as the weighted average of firm-level productivity

$$\Phi_t = \sum_i w_{it}\phi_{it} \tag{4}$$

where $w_{it} \geq 0$ sum to 1 and represents firm's employment shares. Olley and Pakes (1996) showed that total productivity can be decomposed each period into the sum of firm average productivity and a term that is proportional to the covariance of firm market shares and productivity

$$\Phi_t = \bar{\phi}_t + \sum_i (w_{it} - \bar{w}_t)(\phi_{it} - \bar{\phi}_t) = \bar{\phi}_t + cov(w_{it}, \phi_{it}) \tag{5}$$

where $\bar{\phi}_t = \frac{1}{n}\sum_i \phi_{it}$ is the unweighted average of firm-level productivity and $\bar{w}_t$ is the average market share. Changes in productivity between two periods, $\Delta\Phi$, can thus be decomposed into an object that captures shifts in the productivity distribution (via changes in the first moment) and another object that captures market shares reallocation across firms through the change in the covariance[8]

$$\Delta\Phi = \Delta\bar{\phi} + \Delta cov \tag{6}$$

Melitz and Polanec (2015) extend the Olley-Pakes method to accommodate firm entry and exit as follows

$$\begin{aligned}\Delta\Phi &= (\Phi_{S,t} - \Phi_{S,t-1}) + w_{X,1}(\Phi_{S,t-1} - \Phi_{X,t-1}) + w_{E,t}(\Phi_{E,t} - \Phi_{S,t-1}) = \\ &= \Delta\bar{\phi}_S + \Delta cov_S + w_{X,t-1}(\Phi_{S,t-1} - \Phi_{X,t-1}) + w_{E,t}(\Phi_{E,t} - \Phi_{S,t})\end{aligned} \tag{7}$$

The term $\Phi_{S,\tau}$ is the total productivity of survivors (S), whereas $\Phi_{X,t-1}$ and $\Phi_{E,t}$ stand

[7]The estimation strategy allows us to account for the endogeneity of input demand that emerges because the demand of inputs is also determined by firm's knowledge of its productivity level. We implement this procedure using *prodest* Stata's command developed by Rovigatti and Mollisi (2018).

[8]Notice that by using employment weights, changes in the covariance term allow us to quantify the co-movement between producitivity and employment reallocation.

for total productivity of exiters (X) and entrants (E), respectively. The variable $w_{X,t-1}$ represents the market share of exiters (by construction measured in $t-1$) and $w_{E,t}$ is the market share of entrants (measured in t). Thus, the first line in Equation (7) decomposes total productivity change into the contribution of survivors, exiters, and entrants. In the second line, the contribution of survivors is further split into the within-firm component ($\bar{\phi_S}$) and the reallocation term (cov_S).

4 Reallocation and productivity at the macro level

4.1 Firm dynamics and job reallocation

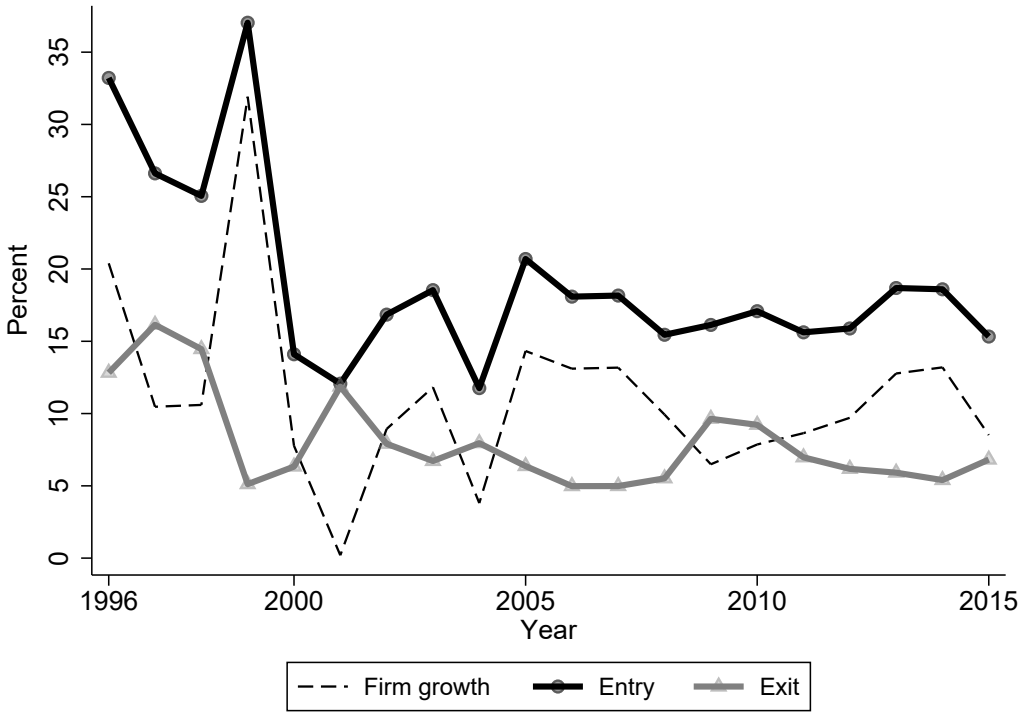
Figure 2 shows firm entry and exit rates in Lithuania from 1995 to 2015. We calculate the rates as relative changes with respect to the population of firms between two consecutive years, so the difference between firm entry and exit equals firm growth. The evidence reveals a significant increase in the population of firms in Lithuania since the 1990s, driven by an average entry rate of 19 (16) percent over the whole period (2000-2015), whereas the firm exit rate was roughly 8 (7) percent. The excess of firm entry relative to firm exit differs from the evidence in many developed economies, where the number of firms is solidly constant due to similar magnitudes of firm entry and exit rates. During the Great Recession, the firm exit rate spiked from 4 percent in 2007 to slightly above 8 percent in 2009, while the firm entry rate slightly increased. The hike in the firm exit rate suggests that reallocation accelerated during the economic slump.

In Figures 3 and 4, we investigate the patterns of job reallocation (job creation and destruction) over time, with a primary interest in the Great Recession period. We rely on the decomposition of net employment growth described in Section 3.2. The evidence shows that net employment growth figures mask a significant amount of job reallocation. On average, 13 percent of the jobs are created and 10 percent are destroyed every year. Importantly, firm entry and exit played a key role: one-third of the jobs created each year were due to firm start-ups and around one-fourth of the jobs destroyed are consequence of business shut-downs (see Figure 4).[9] Overall, the findings indicate that over the period under analysis the excess of job reallocation was substantial (17 percent).[10]

Job reallocation patterns were markedly distorted by the Great Recession. The large

[9]Before 2000, the extraordinary entry of firms explains most of the job creation observed in Lithuania

Figure 2: Firm dynamics, 1995-2015



Notes: The figure displays the growth rate of the number of firms along with entry and exit rates between 1995 and 2015. Rates are computed as relative changes with respect to the average stock of firms between $t-1$ and t.

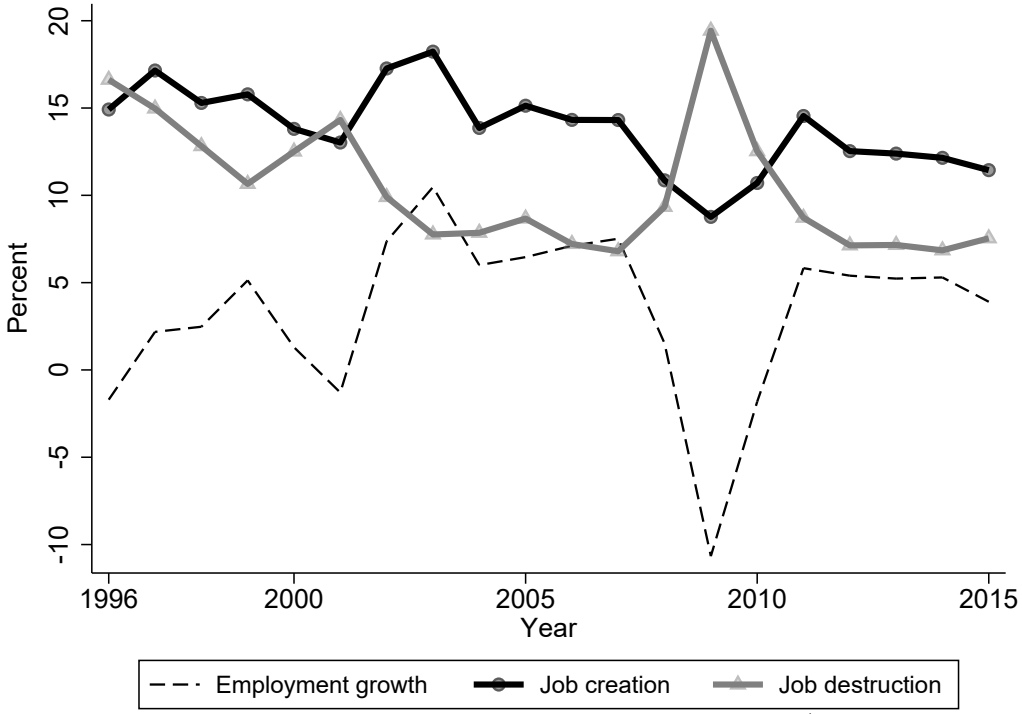
employment losses observed during the economic downturn (10 percent contraction) were driven by both a slowdown in job creation and a spike in job destruction. The job destruction rate tripled in 2009 relative to its value in 2007, whereas the job creation rate almost halved. Despite the countervailing forces, overall job reallocation increased by 7 percentage points in 2009. Changes in job flows over the Great Recession hide, however, important heterogeneity in the contribution of firms dynamics. The decrease in job creation was entirely driven by continuing firms whose job creation rates dropped from 10 percent in 2007 to 4 percent in 2009. Firm entry tempered this sharp decrease, as the contribution to job creation slightly increased, in line with the observed patterns in the firm entry rate. Conversely, job destruction by surviving and exiting firms increased by the same factor.

The results reveal three main facts about the impact of the Great Recession on the reallocation process supporting the view that recessions are a time of cleansing: during

(66 percent). After 2000, the contribution of firm entry decreased to around 30 percent.

[10]Excess of job reallocation refers to the difference between job reallocation (job creation plus destruction) and the absolute value of net employment growth. This is a measure of churning, indicating the amount of job reallocation over and above the amount required to accommodate net employment changes.

Figure 3: Net employment growth, 1995-2015



Notes: The figure displays net employment changes rate and its components (job creation and destruction) between 1995 and 2015. Rates are computed as relative changes with respect to the average employment stock between $t-1$ and t.

economic downturns, outdated or unproductive firms or jobs are weeded out from the productive system faster. Firstly, the firm exit rate doubled, whereas firm entry remained stable.[11] Secondly, the destruction margin exhibited a larger responsiveness relative to job creation. Thirdly, overall job reallocation increased. These facts are at the heart of theoretical models that predict a positive link between job reallocation and productivity growth. In this class of models, reallocation boosts productivity. This is even more true during economic slumps due to the lower marginal cost of creating a job (Davis and Haltiwanger, 1990; Caballero and Hammour, 1994; Mortensen and Pissarides, 1994).[12]

4.2 Productivity growth

Thus far, the uncovered patterns are consistent with the cleansing effect paradigm. However, a key question is whether the observed changes in these patterns over the Great

[11]Lower firm entry rate may undermine the cleansing effect of recessions, as low-productive firms may be "insulated" from exit because fewer new plants are created during recessions (Caballero and Hammour, 1994).

[12]Less costly job creation during economic downturns can arise due to a lower opportunity cost of time Davis and Haltiwanger (1990), lower sunk costs of job creation (Caballero and Hammour, 1994), or higher a probability of filling a vacancy in slack labor markets (Mortensen and Pissarides, 1994).

Figure 4: Job reallocation, 1995-2015

Notes: The figure displays the job creation and destruction rates between 1995 and 2015. Survivors refer to firms that survive between $t-1$ and t. Entrants are firms that enter between $t-1$ and t. Exiters are firms that exit between $t-1$ and t. Rates are computed as relative changes with respect to the average employment stock between $t-1$ and t.

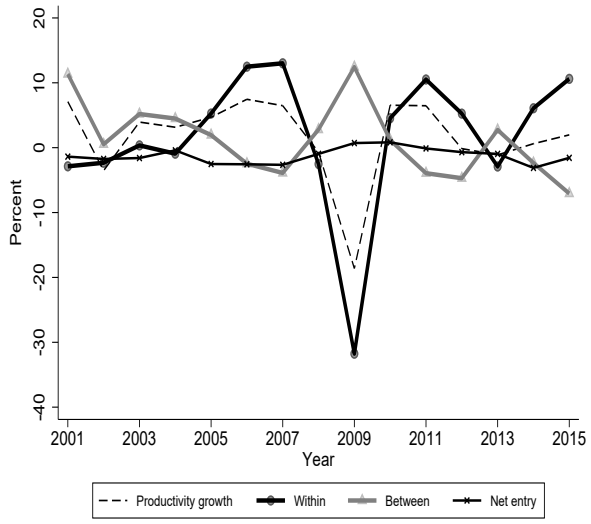
Recession translated into higher productivity growth. If the Great Recession accelerated productivity-enhancing reallocation, one would expect an increase in the contribution of firm exit, and potentially entry, to productivity growth, along with stronger a correlation between productivity changes and reallocation of employment shares of continuing firms. To investigate this question at the macro level, we rely on the productivity growth decomposition explained in Section 3.2.

We report the results of the decomposition in Figures 5. Between 2000 and 2015, in line with growing patterns in the Lithuanian economy, aggregate total factor productivity grew at an average rate of 2.25 percent.[13] The developments of productivity growth were mostly driven by the contribution of incumbent firms, with an average productivity growth of 3.25. However, there is significant heterogeneity over time with respect to the contribution of the sub-components: firm average productivity (within term) and the reallocation of employment from less to more productive units (between term). Changes in aggregate productivity during the periods of rapid economic expansion (before and

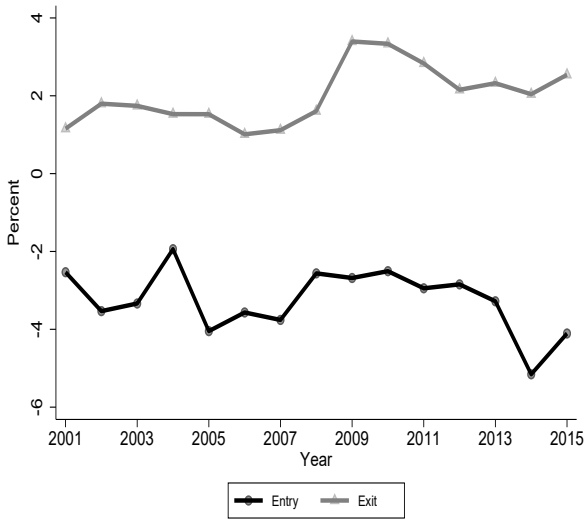
[13] Aggregate labor productivity, measured either as sales revenue or value-added per worker, exhibits similar developments with an average growth rate slightly above 3 percent, but the dispersion is somewhat larger.

Figure 5: Productivity growth, 2000-2015

(a) Main Components



(b) Decomposition of Net entry



Notes: The figure displays total factor productivity growth (in log changes) and its components between 2000 and 2015. Within productivity growth is the change in the unweighted average labor productivity. Between productivity growth is the change in productivity due to market share reallocation across firms. Within and between components are computed over survivors. Net entry refers to the contribution of firm entry and exit to productivity growth.

after the Global Recession, see Figure 1), are dominated by growing firm average productivity (within term). The periods of economic turbulence, by contrast, are driven by the between component, i.e. reallocation of employment from less to more productive firms. By contrast, the contribution of net entry was milder, with a negative average contribution over time of 1 percent, and exhibited less volatility. A closer look at the individual contribution of firm entry and exit indicates that exiting firms were on average low productive units, whereas newly created firms were less productive than incumbents (see Figure 5b).

The Great Recession is associated with a sharp increase in the contributions of the between term as well as the exit term and, to a lesser extent, the entry component. By contrast, the within component exhibited a large negative contribution, thereby driving the massive negative productivity growth (-19 percent) observed during the economic slump. The improvement in the contribution of the between component, paired with the abrupt decrease in the contribution of the within term, suggests that firms that experienced the largest productivity losses also suffered the largest declines in their employment shares. In other words, there was a pronounced reallocation of employment shares in favor of the most productive units, which mitigated the negative impact of the Great Recession

on productivity. The increase in the contribution of exit to productivity growth is also indicative of "creative destruction" or cleansing effects: during the Great Recession, there was an increase in the exit rate of the less productive units in the market. The figure also provides suggestive evidence of "creative entry": newly created firms during the Great Recession were somewhat more productive relative to new entrants in the run-up to the crisis.[14] Taken together, the results from the aggregate productivity decomposition are broadly consistent with the cleansing hypothesis.

5 Reallocation and productivity at the micro level

The previous section provides compelling aggregate evidence pointing to the cleansing effect of the Great Recession in the Lithuanian economy: the contribution of firm exit to productivity growth increased, and the more productive firms captured a larger share of the market in terms of employment. If the cleansing hypothesis also holds at the micro level, we should observe that during the Great Recession (i) a *higher* individual exit probability for low productive firms, and (ii) a *stronger* correlation between firm productivity and employment growth. We investigate these hypotheses in the following sections.

5.1 Econometric model

To study whether the link between economic crises and productivity-enhancing reallocation also holds at the micro level, we adopt a strategy similar to that of citefoster2016 and estimate linear regression models of the following form

$$y_{it} = \beta_1 p_{it-1} + \beta_2 p_{it-1} GR + \beta_3 x_{it-1} + \beta_4 x_{it-1} GR + \delta_s + \delta_t + \epsilon_{it} \tag{8}$$

where y_{it} is the outcome variable of interest for firm i at time t: the probability of exit at time t and net employment growth rate between $t-1$ and t. p_{it-1} is our estimated firm-level (log) total factor productivity. GR is an indicator variable for the Great Recession years: 2008-2010. x_{it-1} are firm-level observed characteristics referring to indicators for

[14] Notice that newly created firms are still less productive relative to incumbent units during the Great Recession. However, the less negative contribution to productivity growth implies that they are more productive relative to entrants right before the economic slump.

firm's size and age categories, ownership, a proxy for the financial situation based on the leverage ratio (debt to total assets greater than 0.50) and international trade status of the firm using two indicator variables for import and export activities, respectively.[15] δ_s and δ_t are genuine industry and year fixed effects, respectively, and ϵ_{it} is the error term.

This type of reduced-form specification emerges from the modeling of selection and growth in firm dynamics literature, where firms are subject to idiosyncratic shocks that affect their survival and growth (e.g. Hopenhayn and Rogerson, 1993). Predictions of this class of models have strong empirical support, concluding that firm exit probability is decreasing in productivity levels and high productivity firms, conditional on initial size, are more likely to grow (see Syverson, 2011, for a detailed review). Therefore, our empirical specification allows us to directly test whether the Great Recession spurred productivity-enhancing reallocation.

5.2 The destruction margin: Firm exit

We begin by looking at the destruction margin. Table 1 presents the estimates of our benchmark specification to study the link between productivity and firm exit and the impact of the Great Recession on it. We rely on three different definitions for our firm-level productivity measure: our preferred total factor productivity (TFP) measure based on sales as well as labor productivity, measured as sales per worker or per hour.[16] Our results are consistent with an extensive literature showing a negative correlation between firm-level productivity and exit, regardless of the productivity measure. Of primary relevance, we find direct evidence of the cleansing hypothesis: productive advantages shielded firms from being eliminated from the market, and this link between firm exit and productivity levels strengthened during the Great Recession.

We perform a battery of sensitivity analyses that confirm our results. Firstly, despite slight differences in the magnitude of the effect, Table A.2 shows that our results are qualitatively invariant to the use of alternative productivity measures based on value-added instead of sales. Secondly, we estimate a discrete-time duration model using a logit specification with a non-parametric baseline hazard.[17] We also extend the model

[15]Firm survival and employment growth follow the same data-generating process, i.e. the one determining labor demand/firm size, and hence we use the same set of controls.

[16]The sales per hour productivity measure is estimated in a restricted sample over the period 2004-2015, when hours are available.

[17]Our non-parametric specification of the duration dependence pattern consists of a total of 20 dummy

Table 1: Firm exit probability and productivity

	TFP	Sales per worker	Sales per hour
Productivity	-0.0343***	-0.0362***	-0.0265***
	(0.0006)	(0.0006)	(0.0005)
Productivity × GR	-0.0087***	-0.0070***	-0.0098***
	(0.0010)	(0.0011)	(0.0012)
Observations	352,805	352,805	302,465
R-squared	0.0633	0.0709	0.0518
Industry FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

Notes: TFP is our (lagged) estimate of firm-level productivity based on sales revenue. Sales per hour is estimated in the restricted sample 2004-2015 when hours are available. GR is an indicator variable for the Great Recession period, 2008-10. All specifications include as controls indicators for firm's size (2), age (2), ownership (2), exporter status (positive exports), importer status (positive imports), and financial situation (debt to total assets greater than 0.50) along with their interaction with GR. Bootstrap standard errors cluster at the firm level in parentheses (100 repetitions). *** p<0.01, ** p<0.05, * p<0.1.

to include unobserved heterogeneity by means of normally distributed random effects, looking only at firms that enter from 2000 onward.[18] The results under this alternative modeling assumption hold true (see Table A.3). Finally, we re-estimate our benchmark model enlarging the Great Recession period dummy to cover 2008-12, differentiating the pre- and post-Great Recession periods, using a more flexible specification for time effects with industry-year specific fixed-effects, or ranking firms according to either a two-year lag or average TFP instead of using a one-year lag. The results of these alternative specifications are reported in Table A.4 and convey the same message: more productive firms are less likely to exit; this relationship strengthened during the Great Recession and weakened thereafter.

We now investigate the heterogeneity of our results according to three key dimensions: financial constraints, international trade, and market concentration. The Great Recession had its roots in the financial sector with major real effects due to the credit crunch (Bernanke, 2018). To investigate whether credit constraints affect our main findings,

variables corresponding to firm's age.

[18]We estimate the random effects model in the 2000-2015 sample to avoid the problems that arise in duration models with left-truncated data when including unobserved heterogeneity (van den Berg and Drepper, 2016).

Table 2: Firm exit and productivity: Financial dependence

	Low	Medium	High
TFP	-0.0356***	-0.0315***	-0.0389***
	(0.0009)	(0.0009)	(0.0022)
TFP × GR	-0.0114***	-0.0054***	0.0011
	(0.0014)	(0.0017)	(0.0046)
Observations	190,248	127,435	35,122
R-squared	0.0678	0.0552	0.0618
Industry FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

Notes: TFP is our (lagged) estimate of firm-level productivity based on sales revenue. GR is an indicator variable for the Great Recession period, 2008-10. Industry-level financial dependence is defined as the median value of the ratio of gross capital formation minus operating result over gross capital formation across firms within the industry between 2000 and 2007. Low, medium, and high financial dependence are industries with a financial dependence index below the first quartile, between first and third quartile, or above the third quartile, respectively. All specifications include the same set of controls as Table 1. Bootstrap standard errors cluster at the firm level in parentheses (100 repetitions). *** p<0.01, ** p<0.05, * p<0.1.

we follow early literature to identify firms' needs for external financing according to the ratio of gross capital formation minus operating result over gross capital formation (Rajan and Zingales, 1998; Bricongne et al., 2012). To obtain an industry-level index, we assign to each of our 46 industries the median value of the ratio across firms in the industry based on the pre-crisis period (2000-07). Table 2 reports the results of our benchmark specification for a broad industry classification based on whether they exhibit low, medium, or high financial dependence.[19] Our findings show that the link between productivity and firm exit is similar across groups. However, the intensity of the creative destruction process during the Great Recession was lower in industries with higher dependence on external funding, to the point that the effect disappears for the more dependent group. Put differently, firms that were more vulnerable to changing credit conditions did not experience an increase in their productive advantage in terms

[19]To define these three broad categories, we look at the overall distribution of our financial dependence index and define low, medium, and high financial dependence based on whether the industry index falls below the first quartile, between the first and the third quartile, or above the third quartile, respectively.

of survival during the Great Recession. This evidence is in line with theoretical work by Osotimehin and Pappada (2016), who find that there is a cleansing effect of recessions in the presence of credit frictions but that credit constraints mitigate the ability of economic slumps to accelerate the creative destruction process.

Table 3: Firm exit and productivity: International trade dependence

	Manufacturing	Construction	Non-tradadable Services	Tradable Services
TFP	-0.0366***	-0.0376***	-0.0380***	-0.0336***
	(0.0017)	(0.0022)	(0.0015)	(0.0006)
TFP × GR	0.0005	-0.0096**	-0.0066**	-0.0047***
	(0.0037)	(0.0040)	(0.0032)	(0.0014)
Observations	51,411	38,883	49,930	212,581
R-squared	0.0687	0.0825	0.0634	0.0601
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

Notes: TFP is our (lagged) estimate of firm-level productivity based on sales revenue. GR is an indicator variable for the Great Recession period, 2008-10. Tradable service sector embeds all industries in the service sector with an average ratio of trade (export plus imports) to sales greater than 0.10 between 2000 and 2007. All specifications include the same set of controls as Table 1. Bootstrap standard errors cluster at the firm level in parentheses (100 repetitions). *** p<0.01, ** p<0.05, * p<0.1.

During the Great Recession, international trade collapsed by around 20 percent (Eaton et al., 2016). The impact on the Lithuanian economy was even harsher: total exports shrank by almost 27 percent between 2008 and 2009.[20] This suggests that differences in openness to trade could weaken the link between productivity and survival during the Great Recession, as long as more productive firms are more likely to export or, more broadly, to engage in international trade (Bernard et al., 2003). To investigate this question, we classify our 46 industries according to their openness to trade and aggregate them in four major groups: manufacturing, construction, tradable servces, and non-tradable services.[21] For each of these broad categories, we re-estimate our benchmark specification for each group (see Table 3). Our results show that the link between productivity and firm exit is similar across sectors but the impact of the Great Recession greatly differed. The

[20]The contraction in total imports was even larger, 37 percent, which translated into an improvement in the trade balance.

[21]We follow a strategy similar to that of De Gregorio et al. (1994) and define an industry as tradable if it has an average ratio of trade (export plus imports) to sales above 0.10 between 2000-07. All industries belonging to manufacturing exhibit a trade openness ratio greater than 0.10, whereas no industry within the construction sector surpasses that ratio.

cleansing paradigm did not hold true in the manufacturing sector and it was somewhat weaker in the tradable service sector. Importantly, the fact that industries that rely more on international trade show a lower intensity of the cleansing effect have implications that are similar to those of our previous findings on the role of financial dependence. Namely, our results suggest that the nature of the aggregate shock and how firms are exposed to the shock matter for the intensity of creative destruction or, more generally, the cleansing effect of recessions.

Finally, we evaluate potential differences in the impact of the Great Recession on productivity-enhancing reallocation in low and highly concentrated markets, motivated by the fact that, among all European countries, Lithuania has the largest firm productivity-size premium (Bighelli et al., 2020). We rely on the Herfindahl–Hirschman Index (HHI), using sales (employment) to define product (labor) market concentration and differentiate between highly (HHI>0.25) and non-highly concentrated industries.[22] Table 4 shows the results of our benchmark model estimated separately for low and highly concentrated industries.[23] Our analysis unveils a novel result: the protective power of productivity during the Great Recession was larger in highly concentrated industries, and this was particularly true in terms of product market concentration. This finding can be rationalized by a model where concentrated industries are characterized by a productive advantage relative to the followers. In such an environment, changes in the economic environment benefits the most productive firms in the market: the "winner takes most/all" mechanism (Van Reenen, 2018; Autor et al., 2020). Thus, in the face of a negative shock, the most productive firms in a concentrated industry are even more likely to survive compared to less concentrated industries because they have a pre-shock productive advantage with respect to other firms in the same industry. Importantly, our findings do not indicate anything about how productivity-enhancing reallocation shapes market concentration (we take it as given), but rather about the link between cleansing effects of recessions and market structure. Thus, they support the view of recessions as drivers of

[22]We follow the US Department of Justice/Federal Trade Commission 2010 horizontal merger guidelines, which state that "an HHI above 0.15 is considered *moderately concentrated* and an HHI above 0.25 is considered *highly concentrated.*" We then classify industries based on their average HHI between 2000-07.

[23]Importantly, our measure of labor market concentration may be overestimated using the HHI, as we implicitly assume segmentation across labor markets defined by a 2-digit sector of activities. Thus, if some industries demand a similar type of workers, the degree of labor concentration should be lower than the one calculated. This problem does not arise with respect to sales, as we take into account sales revenues of all firms in a given industry independently of whether they are obtained in the domestic or external markets, as well as whether firms are national or foreign.

market structure and, in particular, market concentration (Rinz, 2020).

Table 4: Firm exit and productivity: Market concentration

	Product Market		Labor Market	
	HHI≤0.25	HHI>0.25	HHI≤0.25	HHI>0.25
TFP	-0.0344***	-0.0317***	-0.0345***	-0.0257***
	(0.0006)	(0.0049)	(0.0006)	(0.0052)
TFP × GR	-0.0084***	-0.0199***	-0.0086***	-0.0137*
	(0.0010)	(0.0063)	(0.0009)	(0.0073)
Observations	346,485	6,320	348,229	4,576
R-squared	0.0629	0.0911	0.0634	0.0718
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

Notes: TFP is our (lagged) estimate of firm-level productivity based on sales revenue. GR is an indicator variable for the Great Recession period, 2008-10. HHI stands for the average Herfindahl–Hirschman Index calculated over the period 2000-07. Product market uses sales to calculate the HHI. Labor market uses employment to compute the HHI. Highly concentrated are industries with a HHI above 0.25. All specifications include the same set of controls as Table 1. Bootstrap standard errors cluster at the firm level in parentheses (100 repetitions). *** p<0.01, ** p<0.05, * p<0.1.

5.3 The intensive margin: Employment growth

If the reallocation due to the Great Recession is productivity-enhancing, we should also observe a stronger correlation between productivity and employment growth. To shed light on this relationship, we estimate our benchmark specification on the sample of surviving firms using as a dependent variable net employment growth as well as its components (job creation and destruction).

In Table 5, we report our results estimated using both OLS as well as a fixed effect transformation. Notice that with firm fixed effects, point estimates come from within firms variation, which allows us to control for all potential time invariant confounders. However, this approach also implies that only firms exposed to the Great Recession contribute to identification. Put differently, firm that enter after the Great Recession do not contribute to the identification of the parameters of interest in the fixed effects regression. Moreover, OLS and the fixed-effect transformation allows us to provide boundaries where

the true parameter falls (Bond, 2002).[24]

Table 5: Employment growth and productivity

	OLS			FE		
	All firms	Job-creating	Job-destroying	All firms	Job-creating	Job-destroying
TFP	0.0136***	-0.0123***	-0.0205***	0.0271***	-0.0170***	-0.0281***
	(0.0006)	(0.0009)	(0.0010)	(0.0013)	(0.0018)	(0.0022)
TFP × GR	0.0135***	-0.0008	-0.0091***	0.0083***	-0.0034*	-0.0111***
	(0.0013)	(0.0019)	(0.0015)	(0.0014)	(0.0019)	(0.0016)
Observations	259,220	97,582	67,434	259,220	97,582	67,434
R-squared	0.0805	0.3280	0.2224	0.1114	0.2366	0.0433
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	No	No	No	Yes	Yes	Yes

Notes: TFP is our (lagged) estimate of firm-level productivity based on sales revenue. GR is an indicator variable for the Great Recession period, 2008-10. Data includes only continuing firms. All specifications include the same set of controls as Table 1. Bootstrap standard errors cluster at the firm level in parentheses (100 repetitions). *** p<0.01, ** p<0.05, * p<0.1.

Consistent with previous literature, we find that firm-level productivity is positively related to net employment growth. Most importantly, and in line with the cleansing hypothesis, the interaction of firm-level productivity and growth is positive and significant. In other words, more productive firms increased their productivity advantage in terms of employment growth during the Great Recession. To gain further insights into this relationship, we investigate net employment growth's components by estimating our benchmark model for job-creating and job-destroying firms separately. This heterogeneity analysis reveals two interesting facts. Firstly, we find that more productive firms tend to create fewer jobs but also to destroy fewer jobs, in line with cross-country evidence (OECD, 2009). Secondly, the results indicate that the stronger relationship between employment growth and productivity during the Great Recession acts through the job destruction margin, as more productive firms are able to preserve more jobs.

Taken together, our findings suggest that the evidence in Section 5, which points to more productive firms capturing larger employment market shares, was driven by the ability of high productive firms to destroy fewer jobs rather than hire new workers. This

[24]OLS and fixed effect estimates are biased in opposite directions due to serial correlation in the error term along with the presence of lagged endogenous control variables and correlation between the transformed error and the transformed explanatory variables, respectively. The GMM approach suggested by (Arellano and Bond, 1991) to obtain unbiased estimates is not adequate to analyse periods of economic turbulence Hallward-Driemeier and Rijkers (2013) and, therefore, we avoid this procedure.

is indicative of the Schumpeterian process of creative destruction acting also through the intensive margin. To put it differently, if high productivity workers sort into high productivity firms (Abowd et al., 1999), the stronger negative correlation between job destruction and productivity during the Great Recession would imply that low productivity matches are more likely to be weeded out of the market in the face of negative aggregate shocks.

5.4 The creation margin: Firm entry

Changes in firm entry may *insulate* low productive firms from exit during recessions (Caballero and Hammour, 1994). However, to the extent that newly created firms are relatively more productive during recessions, existing units will not be fully insulated from a slowdown in firm entry. Thus, the contribution of firm entry to the cleansing hypothesis emerges through its direct effect on productivity growth, or creative entry, and its indirect effect on the responsiveness of the destruction margin, or insulating effect.

To shed light on the potential contribution of firm entry to productivity, we investigate where newly created firms fall in the productivity distribution and whether this relationship changed during the Great Recession. Notice that this is a very simple exercise and that we do not aim to model firms' entry decisions. Rather, we seek to assess the productivity level of newly created firms relative to incumbents. To this end, we estimate a simple linear probability model that correlates firm entry and productivity. The specification uses as a left-hand-side variable a binary indicator, taking value one the year a firm is first observed in the data and zero otherwise. The right-hand-side includes our measure of firm-level productivity and its interaction with the Great Recession, along with year and industry fixed effects. We also estimate the regression, including firm characteristics and their interaction with the Great Recession dummy, measured at the year of entry in order to control for size and ownership differences between entrants and incumbents.

We report the descriptive results in Table 6. The findings indicate that newly created firms tend to be less productive than incumbents, which is consistent with previous evidence for the US (Foster et al., 2008, 2016). However, as pointed out by Foster et al. (2008), it is important to keep in mind that this correlation may also capture price differences between entrants and incumbents, as our productivity measure is based on revenues rather than quantities. In terms of its interaction with the Great Recession

dummy period, we find that this negative correlation slightly changed: entrants during the economic downturn were on average more productive relative to normal times in line with the aggregate evidence discussed in Section 4.2. The results thus suggest that, during the Great Recession, firm entry was also a relevant margin that contributed to productivity growth.

Table 6: Firm entry and productivity

	Firm entry	
	(1)	(2)
TFP	-0.0531***	-0.0449***
	(0.0005)	(0.0006)
TFP × GR	0.0106***	0.0144***
	(0.0010)	(0.0010)
Observations	401,237	401,237
R-squared	0.0479	0.0774
Industry FE	Yes	Yes
Year FE	Yes	Yes

Notes: TFP is our estimate of firm-level productivity based on sales revenue. GR is an indicator variable for the Great Recession period, 2008-10. Column (2) includes as additional controls indicators for micro-firms (less than 10 employees), small and medium enterprises (10-50 employees), private and foreign ownership along with their interactions with the GR. Bootstrap standard errors cluster at the firm level in parentheses (100 repetitions). *** p<0.01, ** p<0.05, * p<0.1.

6 Conclusions

Economic crises are periods of intensive reallocation of resources due to lower costs of adjustments. However, whether this reallocation is associated with productivity gains is more controversial. Using detailed micro-data for the whole private sector in Lithuania, we show that productivity-enhancing reallocation accelerated during the Great Recession.

From an aggregate perspective, we document that during the Great Recession, both firm exit and job reallocation accelerated and that these accelerations were associated with

an increase in their to contribution to productivity growth. These results are confirmed on the micro level at both the extensive and the intensive margins. Specifically, we show that the least productive firms were more likely to leave the market, that the more productive firms destroyed jobs to a lesser extent, and that this relationship strengthened during the downturn. However, our heterogeneity analysis indicates that the industries where firms operate are important determinants of the intensity of productivity-enhancing reallocation. In particular, we find weaker effects in those sectors more affected by the economic shock, i.e. those more dependent on external funding or international trade, but stronger effects in more concentrated industries. Finally, our analysis suggests that firm entry positively contributed to level up productivity during the crisis period.

Taken together, our findings reveal the Great Recession as a period of cleansing in Lithuania, albeit one in which the intensity of the productivity-enhancing reallocation was sector-specific. This suggests that while policies should not block up the reallocation triggered by aggregate negative shocks in order to safeguard long-term growth, the nature of the shock matters. Therefore, our results call for a *slow but safe* policy approach: identify the sectors where short-run effects of the shock must be mitigated and focus the policy response there. Moreover, our analysis indicates that employment losses may be pervasive even in sectors where productivity-enhancing reallocation intensifies; thus, a strong safety net to protect workers from the negative consequences of job loss seems essential. Finally, our results point to a role for competition policy, as markets become (even) more concentrated after economic slumps.

We acknowledge that the Great Recession may not be comparable to other crisis periods. Thus, we believe that assessing the extent to which our findings hold during other crisis episodes is an productive area for future research. Moreover, in this paper we take a positive view to investigate the impact of the Great Recession on reallocation and productivity. Hence, our results do not address whether recessions are desirable or, more generally, their welfare implications. In this regard, investigating the consequences of the Great Recession on workers' labor market careers might be a fruitful direction to complement this analysis.

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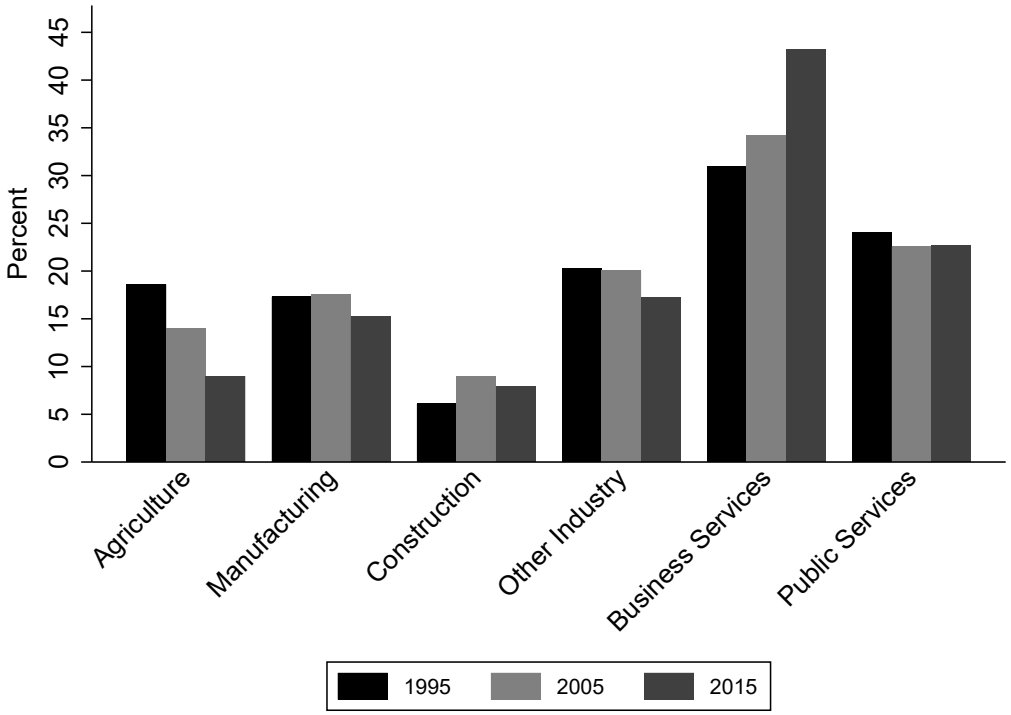
A Additional tables and figures

Figure A.1: Total employment by sector, 1995-2015



Source: Eurostat. Notes: The figure displays employment by sector between 1995 and 2015. Rates are computed as percentages of total employment.

Table A.1: Summary statistics

	2000	2005	2008	2009	2010	2015
Number of employees	25.21	21.53	17.71	14.36	13.09	10.19
Age	3.07	4.61	4.98	5.16	5.33	5.64
Private national ownership	0.89	0.90	0.91	0.92	0.92	0.91
Private foreign ownership	0.08	0.08	0.07	0.07	0.07	0.09
Exporter	0.24	0.20	0.16	0.14	0.14	0.11
Importer	0.38	0.28	0.22	0.19	0.18	0.14
Leverage ratio>50%	0.55	0.63	0.66	0.66	0.64	0.55
Manufacturing	0.20	0.17	0.14	0.13	0.13	0.12
Construction	0.09	0.10	0.14	0.13	0.12	0.11
Trade	0.43	0.39	0.35	0.35	0.36	0.34
Transportation	0.08	0.09	0.10	0.10	0.10	0.10
Professional services	0.06	0.09	0.11	0.12	0.13	0.15
Labor productivity	14211.5	16676.01	19728.66	14177.93	17384.95	20827.13
Number of firms	11,628	18,203	26,011	28,835	31,046	51,599

Notes: All number refer to annual averages. Micro-enterprises are those with less than 10 employees. Small and medium-sized enterprises are those with at least 10 but less than 50 employees. The firm is defined of private national (foreign) ownership if it's foreign equity share is less than (at least) 50%. The firm is defined as exporter or importer when export revenues or import expenses take positive values, respectively. Leverage ratio is defined as a ratio of total financial debt (current liabilities and long-term debt) over total assets. Labor productivity is defined as sales revenue per worker.

Table A.2: Firm exit and productivity: Value-added

	TFP	VA per worker	VA per hour
Productivity	-0.0231***	-0.0241***	-0.0165***
	(0.0006)	(0.0006)	(0.0006)
Productivity × GR	-0.0035**	-0.0048***	-0.0052***
	(0.0015)	(0.0015)	(0.0014)
Observations	319,194	319,194	270,011
R-squared	0.0415	0.0434	0.0319
Industry FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

Notes: VA stands for (real) value-added. TFP is our (lagged) estimate of firm-level productivity based on VA. VA per hour specification is estimated over 2004-2015 period when hours are available. GR is an indicator variable for the Great Recession period, 2008-10. All specifications include the same set of controls as Table 1. Bootstrap standard errors cluster at the firm level in parentheses (100 repetitions). *** p<0.01, ** p<0.05, * p<0.1.

Table A.3: Firm exit and productivity: Discrete-time duration model

	Logit	RE Logit
TFP	-0.3752***	-0.7466***
	(0.0072)	(0.0124)
TFP × GR	-0.0586***	-0.0597***
	(0.0127)	(0.0174)
Observations	352,805	250,778
Industry FE	Yes	Yes
Year FE	Yes	Yes

Notes: TFP is our (lagged) estimate of firm-level productivity based on sales revenue. GR is an indicator variable for the Great Recession period, 2008-10. RE Logit specification introduces unobserved heterogeneity in the logit discrete-time duration model and is estimated on firms born from 2000 onward. All specifications include the same set of controls as Table 1. Bootstrap standard errors cluster at the firm level in parentheses (100 repetitions). *** p<0.01, ** p<0.05, * p<0.1.

Table A.4: Firm exit and productivity: Time effects

	GR:08-12	GR & REC	Industry × Year	TFP-2yr	Avg. TFP
TFP	-0.0334***	-0.0396***	-0.0350***	-0.0144***	-0.0343***
	(0.0006)	(0.0009)	(0.0006)	(0.0005)	(0.0007)
TFP × GR	-0.0074***	-0.0028***	-0.0051***	-0.0052***	-0.0075***
	(0.0008)	(0.0009)	(0.0013)	(0.0011)	(0.0011)
TFP × Recovery		0.0067***			
		(0.0009)			
Observations	352,805	352,805	352,805	286,196	352,805
R-squared	0.0632	0.0616	0.0668	0.0423	0.0545
Industry FE	Yes	Yes	No	Yes	Yes
Year FE	Yes	Yes	No	Yes	Yes
Industry-Year FE	No	No	Yes	No	No

Notes: TFP is our (lagged) estimate of firm-level productivity based on sales revenue. GR is an indicator variable for the Great Recession period, 2008-10. Recovery is an indicator for the post-GR period, 2011-15. TFP-2yr uses a two-year lag in TFP as productivity measure. Avg. TFP uses the average TFP to rank firms instead of one year lagged TFP. All specifications include the same set of controls as Table 1. Bootstrap standard errors cluster at the firm level in parentheses (100 repetitions). *** p<0.01, ** p<0.05, * p<0.1.