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## Article

# Firm productivity, heterogeneity and macroeconomic dynamics: A data-driven investigation

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# Firm productivity, heterogeneity and macroeconomic dynamics: a data-driven investigation

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## ABSTRACT

In this paper, we offer a unique firm-level view of the empirical regularities underlying the evolution of the Lithuanian economy over the period of 2000–2014. Employing a novel dataset, we investigate key distributional moments of real and financial variables of Lithuanian firms. We focus in particular on the issues related to productivity, firm birth and death and the associated employment creation and destruction across firm sizes, industry classification and trade status (exporting vs. non-exporting). We refrain from any structural modelling attempt in order to map out the key economic processes across industries and selected firm characteristics. Nevertheless, existing theoretical and empirical findings guide our analysis and the selection of the main variables to investigate. We uncover similar regularities as already highlighted in the literature: trade participation and firm productivity are strongly positively linked, the 2008 recession has had a cleansing effect on the non-tradable sector, firm birth (death) is highly pro (counter)-cyclical. The richness of the dataset allows us to produce additional insights: for example, we observe an increasing share of exporting but a constant share of importing firms since 2000.

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L11; L25

## 1. Introduction

The current study offers a novel view of the evolution of the Lithuanian economy using firm-level data. We employ a new dataset covering almost the entire business registry over the period of 2000–2014. Access to firm-level financial and productivity variables allows us to observe important stylized facts that underpin macroeconomic dynamics, diffusion of economic shocks and economic policy effects.

Investigating firm-level data and mapping its heterogeneity offers a number of benefits in both economic analysis as well as policy-making. One of the primary interests lies in linking the observed firm heterogeneity to movements of macroeconomic variables. The historical focus on the first moments of the underlying distributions, arguably the result of data constraints, limits our understanding of the complex processes that shape the observed macro dynamics. Firm-level data are essential inputs in the estimation of structural parameters as pointed out by Lucas (1976), while policy-making stands to

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benefit from better targeting of its programmes. This has been recently reiterated by Ghironi (2018) who points towards the need for more encompassing, empirical micro-foundations in the development of macroeconomic models. The issue has been recognized in academic research, including the pioneering theoretical studies by Hopenhayn (1992), Melitz (2003), Helpman, Melitz, and Rubinstein (2007), Chaney (2008), as well as the more recently applied research on the firm-level data by Bartelsman and Doms (2000), Hsieh and Klenow (2009), Bartelsman, Haltiwanger, and Scarpetta (2013), Ariu et al. (2017), to mention only a few.

The established link between firm-level heterogeneity and macroeconomic dynamics can be extremely useful for predicting macro-level outcomes, see e.g. Melitz and Redding (2013), Bartelsman and Wolf (2014), Bas, Mayer, and Thoenig (2015). Unsurprisingly, the awareness of firm-level diversity is becoming increasingly important in advising economic policy and helping it to achieve the desired goals (Altomonte, Navaretti, di Mauro, & Ottaviano, 2011; Costinot, Rodríguez-Clare, & Werning, 2016; Gaulier & Vicard, 2012, etc.).

Another important objective of the firm-level heterogeneity analysis is understanding its origins, see, e.g. Bartelsman and Doms (2000), Gamberoni, Giordano, and Lopez-Garcia (2016), Ferrando et al. (2015) among others. If heterogeneity is a potential accelerator of unfavourable outcomes, it could be dealt-with by the relevant economic policies. Rather than counteracting the potential negative effects of firm heterogeneity on aggregate outcomes, one may tackle its source: Banerjee and Duflo (2005), Bartelsman et al. (2013) and Ronchi and di Mauro (2017).

In this paper, we aim at outlining firm diversity across several dimensions without taking a stand on its possible structural origins. We deliberately maintain a shallow probing depth and in return offer a very wide overview of the underlying dynamics. The complexity of current economic mechanisms pose serious challenges to any type of policy targeting enhanced competitiveness, wage and productivity inequality. By tracing out the boundaries of many important fragments, we hope to gain a better view of the entire puzzle and hopefully lead to a better understanding of policy targets and expected outcomes. While most of the analysis is descriptive, we nevertheless condition important firm-level variables on observable firm characteristics, such as their size, industrial sector, age and export status; all relevant dimensions of analysis as highlighted by the surveyed literature. This does not help to fully explain and identify the reasons of the observed variance in economic activity, worker churn, growth, exporting behaviour and productivity of the Lithuanian firms. It points however towards possible explanations related to the observed firm-level dynamics. Cross-referencing the stylized facts of the Lithuanian firms to those observed in other economies, we also implicitly rely on the structural explanations provided for the already-documented evidence.

In this paper, we abstract from analysing wider consequences of firm heterogeneity: besides illuminating the structure of the economy and underlying trends behind the aggregate macro statistics, we do not explore more sophisticated micro-macro relationships or their potentially dynamic nature.

When portraying the situation of the Lithuanian firms, we prepare the ground for the analysis of some more detailed questions to be analysed in the future, such as the micro-level sources of growth, the impact of firm heterogeneity on productivity dynamics, the trends in trade and their linkages to the productivity evolution, to name a few.

The rest of the paper is structured as follows. In Section 2, we give a short description of our dataset, detailing the sample coverage, the most important definitions used in the paper, general rules and special treatment of the data. Section 3 presents firm population and its demographic facts: firm birth and death rates, ageing trends and similar characteristics. Next, employment characteristics, job creation and destruction are discussed in Section 4. Section 5 delves into foreign trade characteristics; firm ‘exporter’ and ‘importer’ statuses are analysed cross-referencing them with the other observable firm characteristics. Firm growth tendencies in terms of firm value-added and employment are discussed in Section 6. Section 7 concludes.

## 2. Data

### 2.1. Short dataset description

The dataset used in the analysis covers the entire population of firms active in Lithuania over the period from 1995 to 2014.<sup>1</sup> Yet, most of the analysis is based on a shorter time series from 2000 to 2014 to ensure that the variables in the dataset are consistent across years and comply with the international accounting standards.<sup>2</sup> The only exception where we use the original length of the dataset is when considering firm demographics, birth and death analysis in Section 3 and whenever firm age is considered. The set covers all forms of business entities, except for sole proprietorships or associations (unlimited liability business forms) and public establishments (bodies). Along the economic activities’ split two NACE Rev.2 (hereafter – ‘NACE2’) industries, Financial and Insurance Services (K) and Public Administration and Defense (O), have not been provided in the original database. Since most schools and hospitals are public bodies in Lithuania, they are not tracked by the available set, therefore Education (P) and Health (Q) sectors are relatively small in our sample, only reflecting private firms in these sectors. Agriculture sector (A) is not well represented, since most activities are taking place as sole proprietorship business entities.

A few very large companies, the inclusion of which would violate data confidentiality requirements, are excluded from the dataset. Although there is a possibility that a small number of firms have failed to submit the legally requested annual business statistics form (questionnaire), double checking against alternative statistical sources (usually macro-aggregates) allows us to believe that we cover close to 95% of the active firms across all years when the ‘population of firms’ is defined as all private profit-seeking limited liability nonfinancial companies.

In terms of value-added (GDP), our sample covers from 20% in year 2000 to 43% in 2014 (the average coverage being equal to approximately 30%); employment in the firms analysed makes on average 54% of the entire labour force in Lithuania (the percentage was also growing gradually over years, from 43% in 2000 to 62% in 2014).

The firm-level variables in our dataset may be broadly categorized as follows:

- Balance-sheet variables, such as fixed and current assets, long-term and short-term liabilities, equity. Fixed assets are further categorized into intangible, tangible, financial and other assets. Current assets are split into inventory, cash, receivables and other subcategories. Current as well as long-term liabilities consist of financial, trade and accrued liabilities.

- Income statement variables, such as revenue, costs of goods sold (COGs), value added, net profit, operating expenses, etc.
- Productivity determinants, such as the average number of employees over the course of the year, average number of hours, value-added. Starting with 2004 the average number of employees is split into full-time and part-time workers; a new variable of the total number of hours worked is included. From 2008, total number of hours worked is divided between full-time and part-time employees.
- Foreign trade variables: the value of exports and imports the firm may have.<sup>3</sup>
- Miscellaneous variables indicating the year of legal establishment of the firm, the main economic activity of the firm (NACE2), etc.

## 2.2. Special definitions

When assigning the firm to a particular size category we use a special European Commission small- and medium-sized enterprises (SMEs) definition as specified in Table 1<sup>4</sup> and assign a firm to one of the following four classes: micro, small, medium and large. Both book size of assets or turnover as well as employment numbers are jointly used to determine to which category a considered firm belongs. The table indicates the thresholds in terms of annual sizes of total assets, turnover and average employment for different firm size classes.<sup>5</sup>

The classification is dynamic. Each year, we evaluate all firms in our dataset based on the criteria detailed above and assign them to one of the size groups. This allows us to investigate the economic and financial characteristics of a particular size class across time in a consistent fashion.

We use multiple definitions of ‘exporting’ and ‘importing’ in this paper. According to the loosest one, a firm is categorized as exporting if it reports non-zero revenues from exporting in any given year. This way even firms that report exporting only once throughout their lifetime will be included in the group for that particular year. We also use a stricter definition of an ‘exporter’ or ‘importer’ requiring the firm to have the exports of at least 1% of its sales revenues and the imports making at least 1% of its cost of goods sold that year. Finally, the strongest definition has the aforementioned 1% value requirement and defines a firm as exporter (importer) if at least three years of exporting (importing) activity are observed; the latter condition being borrowed from Berthou et al. (2015). In the remainder of the paper, we call these firms ‘permanent exporters (importers)’ since it ignores any small-value or very occasional exports (imports) among the firms.

## 2.3. Preliminary treatment of data

Before calculating any statistics or running any particular calculations, we remove the erroneous entries in the variables for that particular task by applying simple rules,

**Table 1.** Firm size definitions

Size	Headcount	Turnover	Assets
Micro	< 10	≤ 2 mn EUR	≤ 2 mn EUR
Small	≥ 10 and < 50	> 2 and ≤ 10 mn EUR	> 2 and ≤ 10 mn EUR
Medium	≥ 50 and < 250	> 10 and ≤ 50 mn EUR	> 10 and ≤ 43 mn EUR
Large	≥ 250	> 50 mn EUR	> 43 mn EUR

requirements on value limits and implementing consistency checks. The rules usually rely on growth rates of the main variables, where extreme growth rates (outliers) are eliminated from the sample. One of the more frequent reason for observing anomalous growth rates are mislabelling cases where the same firm ID is assigned to a different economic entity over time. If implausible negative values instead of positive ones are detected, particular firms (observations) are excluded from the sample. Consistency checks include ratios between the variables and their plausible ranges. Ratios for which the theoretical values lie between 0 and 1 are computed and all entries outside this interval are removed.

Usually during this editing exercise little genuine economic information is lost, fact confirmed also by the subsequent statistic and econometric exercise performed using both the full sample and the 1–99 trimmed sample.

After the preliminary treatment of the data, we compute our key variables to assess the dynamics of both financial and real variables along four main directions: firm size, industry, age and trade status. In particular situations, we slice our data across two dimensions simultaneously to investigate the relative importance of the considered taxonomy.

For financial variables, we use deflated values (using the 2010 prices) to ensure their meaningful comparability over time.<sup>6</sup>

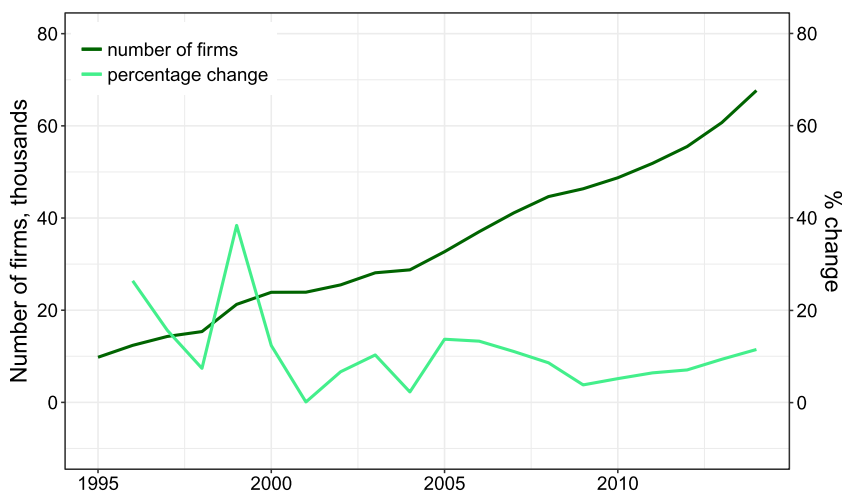
### 3. Firm population, birth, ageing and death

#### 3.1. Firm population

Our dataset allows monitoring of firm evolution almost from its very inception year. When Lithuania regained its independence in 1990, the firm count started at zero that year. Our firm population data starts in 1995, we miss therefore only five years of this evolutionary dynamics. From 1995 to 2014, the number of firms has increased almost seven times from slightly below 10,000 establishments to almost 70,000 firms, producing a compound annual growth rate of 10.7% (Figure 1). Naturally, the growth rate of the number of firms has not been uniform throughout the period, fluctuating around 20% at the beginning of the period in 1995–2000, and then moderating to less than 10% in 2000–2014. The global financial crisis period of 2008–2009 is marked by a mild slowdown in the growth of firm birth.

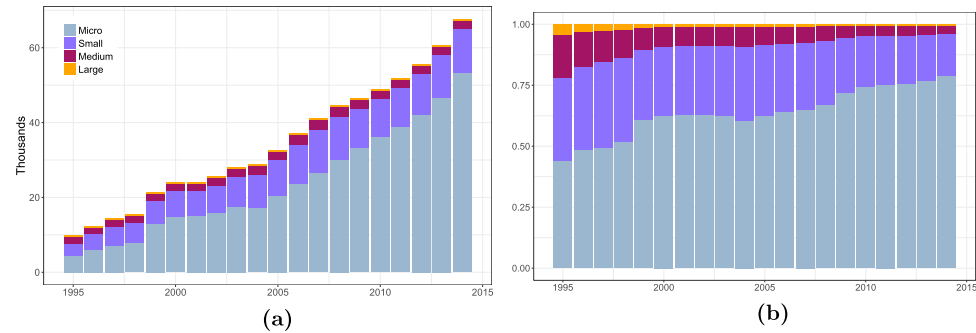
The split of the overall firm population in our dataset by size is shown in Figure 2. The stacked bars indicate the total number (Panel 2(a)) or share (Panel 2(b)) of firms split by their size category. The starkest observation is the fact that firm population is by and large dominated by micro firms and not only their count but also their share is continuously increasing. More than 90% of all firms are micro, another 5–7% are small firms and only 3–5% of firms are medium or large firms.

In order to have a balanced view of the importance of the four group sizes, the aggregate employment and employment shares by firm size are shown in Figure 3. It shows that roughly half of the employment in 2014 is allocated between large and medium firms, yet this share has been declining fast over the entire period.<sup>7</sup> This is an important feature of the Lithuanian economy that must be kept in mind when assessing the competitiveness of the country in aggregate: while some favourable indicator dynamics is observed in the large- or medium-sized firm group, the overall effects might be dominated and outweighed by the number and share of small and micro firms.



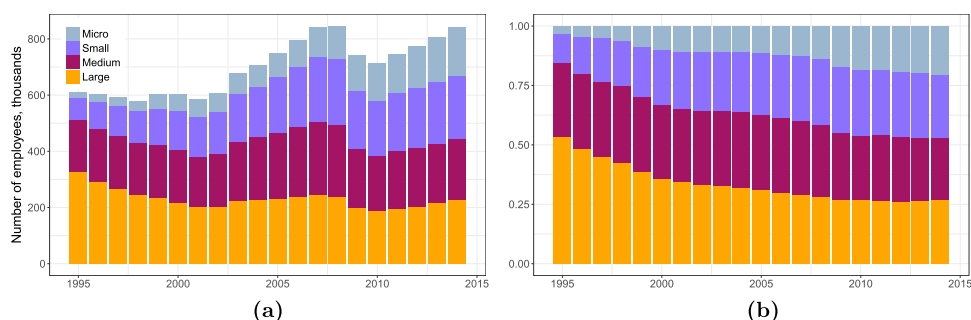
**Figure 1.** Firm population in Lithuania.

Table 2 provides a look into the industrial composition of our dataset. It shows that the entire population of firms is dominated by service providers (more than 80% and increasing) while the share of manufacturing firms has been declining sharply and is now barely making 10% of the entire firm count. Definitely, the picture is very different for the number of employees or value-added structures, which reveal a number of engaging facts. The comparison of firm shares vs. employment shares points to the relative size of firms across sectors. Similarly, the contrast between the shares of value-added vs. employment shares indicates the sectors with higher and lower productivity in the economy. For example, manufacturing is among the two largest sectors in terms of employees and value-added created. The stark difference between the firm count share and the value-added created in manufacturing reflects the fact that it is dominated by large and medium firms that create a substantial value-added per employee. On the contrary, the largest number of firms and employees is observed in Wholesale and Retail trade, yet the value-added does not match the same proportion. Transport, Information, Real estate activities are more productive when compared to the aggregate average (their value-added share is higher than employment share in the economy) while Construction,



**Figure 2.** Firm population in Lithuania by size. (a) Number of firms and (b) share of firms.





**Figure 3.** Employment composition by firm size. (a) Number of employees and (b) share of employees.

Support and Entertainment services feature a lower than average productivity with value-added shares falling behind the employment shares in the economy. Overall, services have increasing employment shares in the economy over time, yet the largest increases show up in lower value-added per employee activities (Hotels, restaurants, Support, and Health services).

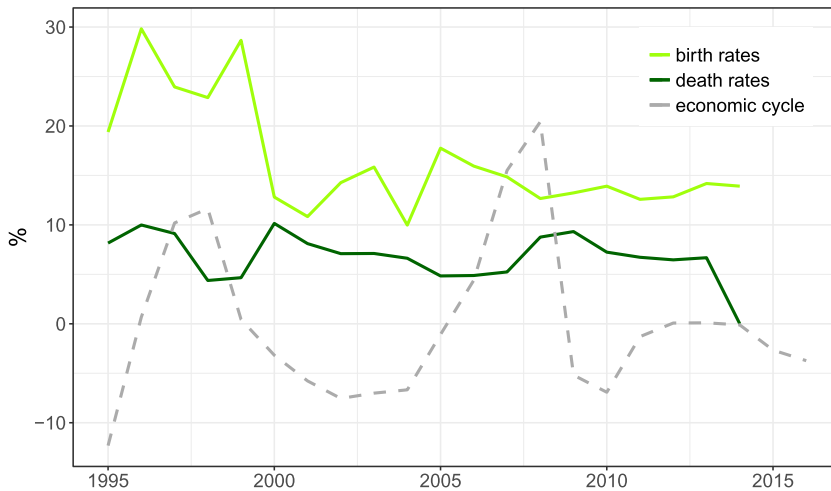
### 3.2. Firm birth and death rates

There has been some churn within the population of firms throughout the period of 1995–2014 with existing firms exiting the market<sup>8</sup> and new firms being created. We refer to these processes as firm death and firm birth, calculate the firm death and birth rates as a percentage of the total number of existing firms, and depict their dynamics in Figure 4.

There are four features that stand out when considering the figure. First, firm birth rates are 1.5–2 times higher than firm death rates. Second, firm birth rates are much more volatile than death rates throughout the whole period of 1995–2014. The two phenomena produce an already-observed continuous increase in the total number of firms. This stands in contrast with many developed economies, where the number of firms is

**Table 2.** Industrial structure of firms, employment and value-added.

Industry	Firm shares				Employment shares				VA shares			
	2000	2005	2010	2014	2000	2005	2010	2014	2000	2005	2010	2014
A – Agriculture	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%	1%
B – Mining	0%	0%	0%	0%	0%	0%	0%	0%	2%	1%	1%	1%
C – Manufacturing	17%	14%	10%	9%	34%	30%	23%	22%	28%	25%	25%	22%
D – Electricity	1%	0%	0%	2%	5%	3%	2%	2%	9%	7%	7%	5%
E – Utilities	1%	1%	1%	1%	2%	2%	2%	2%	2%	1%	2%	2%
F – Construction	7%	9%	10%	10%	11%	12%	11%	11%	7%	11%	7%	9%
G – W&R trade	42%	36%	33%	31%	20%	24%	26%	25%	19%	21%	21%	24%
H – Transport	8%	8%	9%	10%	11%	10%	11%	12%	12%	12%	13%	14%
I – Hotels, restaur.	5%	5%	4%	4%	2%	3%	4%	4%	1%	2%	1%	1%
J – Information	3%	4%	4%	4%	3%	3%	3%	3%	9%	7%	7%	5%
L – Real estate	4%	5%	6%	6%	2%	2%	2%	2%	3%	3%	4%	4%
M – Professional serv.	6%	9%	12%	13%	3%	3%	5%	5%	3%	4%	5%	5%
N – Support serv.	3%	3%	4%	4%	3%	4%	5%	6%	3%	3%	4%	4%
P – Education	1%	1%	1%	1%	0%	0%	1%	1%	0%	0%	0%	0%
Q – Health	1%	2%	2%	2%	1%	1%	2%	2%	0%	0%	1%	1%
R – Entertainment	0%	1%	1%	1%	0%	1%	1%	1%	0%	0%	0%	1%
S – Other serv.	1%	2%	2%	2%	1%	1%	1%	1%	0%	0%	0%	0%



**Figure 4.** Firm birth and death rates over economic cycle.

relatively constant and the birth and death rates of firms are of a similar magnitude, see e.g. Baldwin and Gorecki (1991), Sadeghi (2008). Third, there is a small negative correlation of  $-0.29$  between the changes in firm birth and death rates. This is consistent with the findings in the U.S. Manufacturing sectors by Dunne, Roberts, and Samuelson (1988). Their study suggests that industry-specific factors are important in determining entry and exit patterns; after controlling for them, the entry and exit rates become negatively correlated within industries. Finally, the economic cycle (HP-filtered real GDP series) has a positive correlation of  $0.35$  with firm birth rates and a moderate negative correlation of  $-0.13$  with firm death rates. The combination of the latter two observations (extensive margin of firm growth) is cross-referenced with firm growth rates (intensive margin) in Section 4 where we compare the relative importance of the two ways of firm adjustment to the economic cycle.

### 3.3. Firm birth and death rates by Industries

We further analyse firm birth and death rates by economic activities (NACE2) in Figure 5 and Figure 6. We select eight largest industries in terms of the number of firms: Manufacturing, Construction, Wholesale and Retail trade, Transportation, Accommodation and food services, Information and communication, Real estate activities and Professional, scientific and technical services. It reveals that most churn has been occurring in Construction and Accommodation and food service sectors, where birth and death rates have been high and also the most volatile throughout the period. On the contrary, Manufacturing and, surprisingly, Real estate sector have been among the most stable sectors with firm birth and death rates being very moderate and least volatile compared to others. In the figures, the sector of Professional, scientific and technical services is quite an exception, exhibiting high and volatile birth rates but low and quite stable death rates. The remaining sectors stand in the mid-range in their firm birth, death rates and volatilities of these rates.

Another regularity visible in the figures is a strong drop in firm birth rates in all the industries in 2004, a strong slowdown in firm creation during the 2008–2009 crisis and

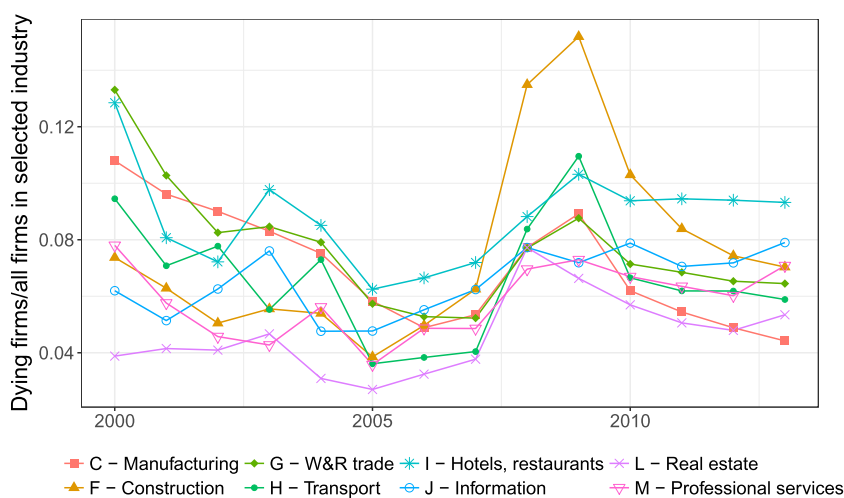


**Figure 5.** Firm birth rates in selected economic activities.

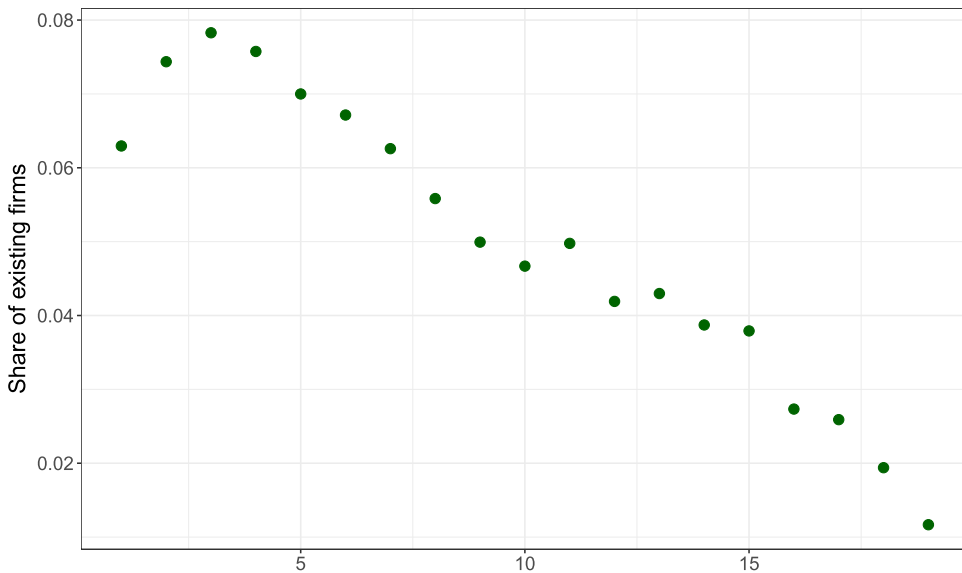
a large increase in firm death rates during the latter episode. This reveals firm births and deaths create an important adjustment margin during the economic cycle. The period of 2008–2009 featuring the accelerated firm deaths potentially hints at a possible ‘cleansing effect’ of the crisis as indicated and discussed in Caballero and Hammour (1991), and Foster, Grim, and Haltiwanger (2016), Osotimehin and Pappadà (2017).

### 3.4. Firm death rates by age

Several research streams have been developed to investigate firm exit decisions (and their probabilities) at a certain age. The causes put forward range from deficiencies in general management skills for young firms, a changing competitive environment for older



**Figure 6.** Firm death rates in selected economic activities.



**Figure 7.** Firm death rates by age.

organizations (Thornhill & Amit, 2003), random output prices as a proxy for idiosyncratic firm shocks (Dixit, 1989) to firm profitability and other financial characteristics (Scharj, 1991) or organizational rigidities (Loderer & Waelchli, 2010). Figure 7 depicts firm death rates as a function of their age. The numbers in the graph can be interpreted as death probabilities at a certain age, e.g. a firm has a 6% probability in the first year (one has to note that in our sample we do not observe firms that do not reach 1 year of age); conditional on surviving the first year the firm faces a 7.5% death probability in the second year. The peak of firm death probability is at its third year in the market after which this conditional probability starts declining slowly. At the age of 7 years, a firm's conditional probability of death becomes smaller than in the first year. Consequently, the survival probabilities (based on cumulative death rates) for firms of different ages reveal that only 51% of all firms live longer than 10 years and only 38% of all firms enter the age of 20.

Since these death rates are calculated conditional on firm's age only and ignore any economy-wide, industrial, and other firm characteristics which are definitely playing a role, the causal relationship between these 'deep' factors and death rates is hard if not impossible to infer. However, despite all the factors that we are not accounting for, the shape of death rates by age is a surprisingly close match to the findings of studies in other countries, e.g. Bhattacharya, Borisov, and Yu (2015), Morris (2009), Carroll (1983), Freeman, Carroll, and Hannan (1983), Sørensen and Stuart (2000).

To correct at least partially for the missing factors standing behind the evidence in Figure 7, we also provide the graphs of death rates of firms by age for different economic activities and firm sizes. Figure 8 shows that firms engaged in the selected broad economic activities follow a similar hump-shaped death rate pattern.

Death probabilities by age are the highest in Construction and Transportation sectors and lowest in Electricity. Overall, the death probabilities in service industries (F, G, H, I)



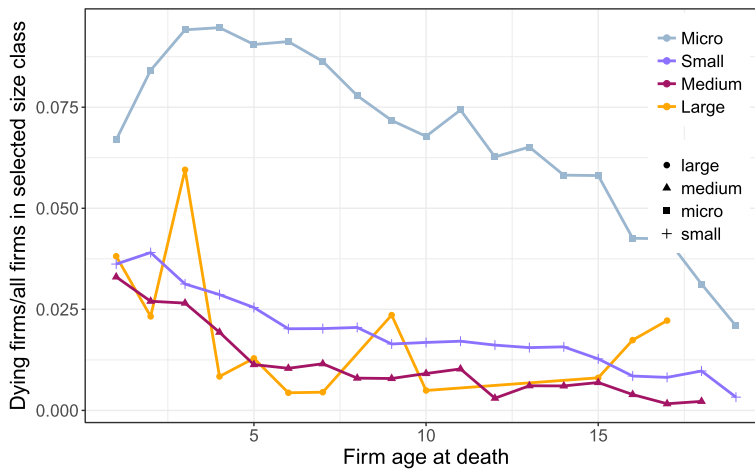
**Figure 8.** Firm death rates by age in selected economic activities.

are higher than in Manufacturing. The peak age of death rates seems to reflect the fixed costs (sunk costs) in each economic activity: the higher the fixed costs, the higher the peak age of death and the average age of firms in the sector (Table 3).<sup>9</sup>

Figure 9 depicts firm death rates by age and size. Along the size dimension, we see that micro firms are the ones most likely to die over their entire lifecycle; small, medium and large firms hold considerably smaller probabilities of death. This is consistent with the findings of Baggs (2005) revealing that the vulnerability of Canadian firms (to trade liberalization shock) is mitigated by firm's larger scale and smaller leverage. In line with these empirical findings (Jovanovic, 1982) builds a theoretical model of firms having incomplete information and learning about their efficiency as they operate; while efficient firms grow and survive, the inefficient ones shrink and exit the market, thus, producing a negative relation between firms' sizes and exit probabilities.

**Table 3.** Firm average age by broad economic activities in 2014.

Industry	Average age
A – Agriculture	6.6
B – Mining	10.1
C – Manufacturing	9.4
D – Electricity	4.1
E – Water supply	10.4
F – Construction	7.4
G – Wholesale and retail trade	7.5
H – Transportation and storage	7.2
I – Hotels and restaurants	7.2
J – Information and communication	6.8
L – Real estate	9.8
M – Professional, scientific and technical activities	6.3
N – Administrative and support service activities	6.5
P – Education	6.4
Q – Health services	7.3
R – Arts, entertainment and recreation	5.1
S – Other services	7.2

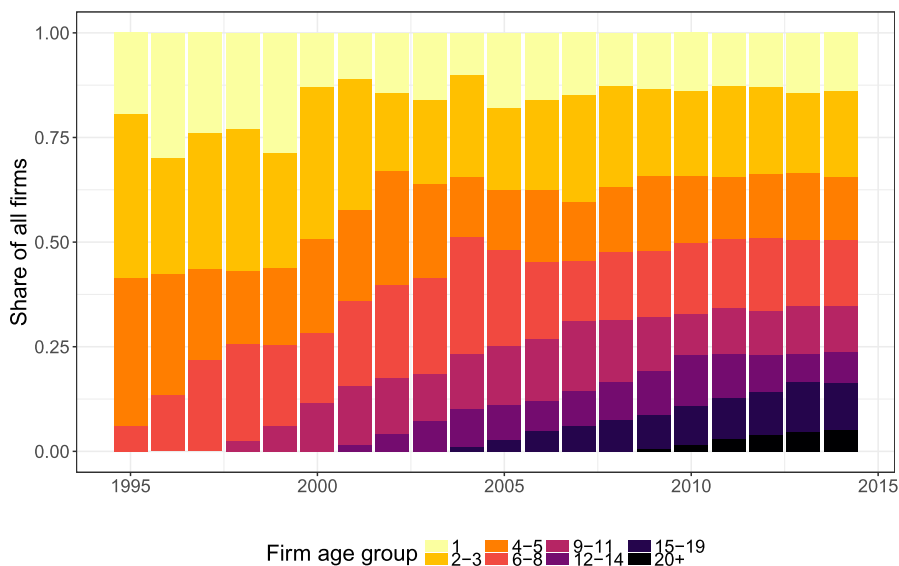


**Figure 9.** Firm death rates by age and size.

### 3.5. Firm composition by age

Looking at the overall firm population split by age, several tendencies emerge (Figure 10). It reveals that the age structure of firms in the economy is evolving there is a fraction of firms that survives since 1990. The cohort of firms 20 years and more is continuing to expand steadily since 2010. On the contrary, during the intense economic reform period of 1990–2000, the ratio of newly created firms (of one year of age) has stabilized around 15%. Since 2005 the proportion of 6+ years cohort has also stabilized around 50%.

As a result of the firm age structure non-stationarity, the average age of firms is still increasing (in 2014 the average firm age was 7.5 years), yet at a decreasing rate. This



**Figure 10.** Firm composition by age groups.

depicts the joint effect of firm death rates by age and their proportion in the entire population of firms in the economy.

#### 4. Employment flows

We explore the evolution of employment through the epistemological lens of labour flows developed by Davis, Haltiwanger, and Schuh (1998), Davis, Faberman, and Haltiwanger (2006), Davis, Faberman, and Haltiwanger (2012). Our basic observational unit is the firm. The disadvantage of using firm rather than plant data (as done by the studies mentioned before) is that several production sites may be included in the measurements provided for the firm. The potential impact of heterogeneous plant-level characteristics will be then averaged out when analysing the aggregate firm dynamics. This may be of particular concern when considering the determinants of firm growth and productivity. As data are available only at the firm level, we will focus our attention at this resolution detail, keeping in mind the above-mentioned issue when computing and interpreting the labour flow dynamics.

*Employment Gains* $_{i,(t,t-1)}$  are defined as the increases in the reported number of positions for firm  $i$  over the period  $(t, t - 1)$ . If a firm  $j$  reports a decrease in the total number of positions, then the change is registered as an *Employment Loss* $_{j,(t,t-1)}$ . As our data are available at yearly frequency only, within the period labour flows will not be available. A firm creating and destroying the same number of jobs within the span of a given year will appear as having no changes in the number of positions. In line with Davis et al. (1998), we define *Gross Job Creation* $_t = \sum_i \text{Employment Gains}_{i,(t,t-1)}$ . This aggregate measure of job creation captures created jobs in both existing as well as at time  $t$  newly established firms. In a similar way, *Gross Job Destruction* $_t = \sum_i \text{Employment Losses}_{i,(t,t-1)}$ .

It is useful to distinguish between labour flows caused by firm entry and exit and those of incumbent firms (Figure 11). Churning, along with its potential implications for factor reallocation and aggregate productivity, has been investigated empirically for both developing and developed economies (see Bartelsman, Haltiwanger, & Scarpetta, 2009; Eslava, Haltiwanger, Kugler, & Kugler, 2004; Fernández et al., 2017; Haltiwanger, Scarpetta, & Schweiger, 2014; Lopez-Garcia, di Mauro, & the CompNet Task Force, 2015). Labour and capital released through firm death become available for use in higher productivity firms leading on average to increased sectorial productivity (Davis et al., 1998). Recessions are particularly violent reallocation episodes, recent evidence suggesting though that not always productivity-enhancing to the same degree (Foster et al., 2016). The role of firm birth and death remains nevertheless essential in uncovering the possible cleansing effects, if any, of recessions as well as the quantitative and qualitative impact of churning on productivity-enhancing reallocation.

Our study uses the same underlying raw data as Lopez-Garcia et al. (2015) and Fernández et al. (2017). An essential difference is that whereas comparability criteria and national confidentiality constraint the above-mentioned studies to work with a sectorial moving-window three years average across incumbent firms only, we compute the yearly flows for individual firms and then aggregate for yearly estimates (across different dimensions of interest, such as size and NACE2 industry). Furthermore, we distinguish between flows from existing and entering/exiting firms. We provide so a sharper distinction in the cyclical dynamics of labour streams. Although we do not employ a longitudinal



(a)



(b)

Figure 11. Labour flows by firm size. (a) Employment gains and (b) employment losses.



linkage algorithm as present in the U.S. BLS Business Employment Dynamics program (Clayton & Spletzer, 2009), we invest substantial energy in checking that firm IDs do indeed track the same economic entity across time.

Panel 11(a) shows that micro firms create rather similar gross levels of employment in newly established and existing firms. The split remains constant across time. More variability is present in the other size categories, with the bulk of job creation coming from the growth of existing firms. As very firms are born large (recall our size definition captures both assets and employment), most of the new additions will be observed in the micro and small categories. Employment through firm birth for medium and large firms has been decreasing over time. Also important to notice is the different cyclical sensitivity across the different size groups. Micro firms are increasing employment levels across time consistently, both in new and existing enterprises, regardless of the state of the economy. Large and medium companies add less jobs in the crisis years and also exhibit lower gross average flows following the crisis. This provides some preliminary evidence of the persistent effects of the 2008 crisis on economic dynamism. Although the time span is too short to label this as a long-term effect, it is interesting to observe that a similar trend has been established for the U.S. (Foster et al., 2016).

Job destruction is shown in 11(b). The spike in job destruction is noticeable for all size categories, except for large firms. The crisis effects reverberate quickly through the economy prompting micro, small and medium to quickly adjust labor inputs. In line with the observation related to job creation, lower levels of churning are observed post-2008. Micro firms tend to defy this trend, with increasing exit levels over time and also large aggregate job outflows in the years following the crisis.

Overall, job creation and destruction flows and rates are in line with the empirical findings presented by Haltiwanger et al. (2014) for a cross-section of developing and developed countries (both European and non-European). Employment turnover is substantially larger than net employment changes with noticeable differences across size groups. Micro and small firms are the primary contributors to gross flows. In terms of rates (available from the authors), the aggregate average job creation rate is higher than the job destruction rate exhibiting also a similar qualitative behaviour during the crisis. Creation rates drop in 2009 at a minimum of 8% compared to an average of 15% prior to 2009 while the job destruction rate jumps to a maximum of 21% in 2009 against an average of 12%. Following the crisis, both rates are lower than their historical averages.

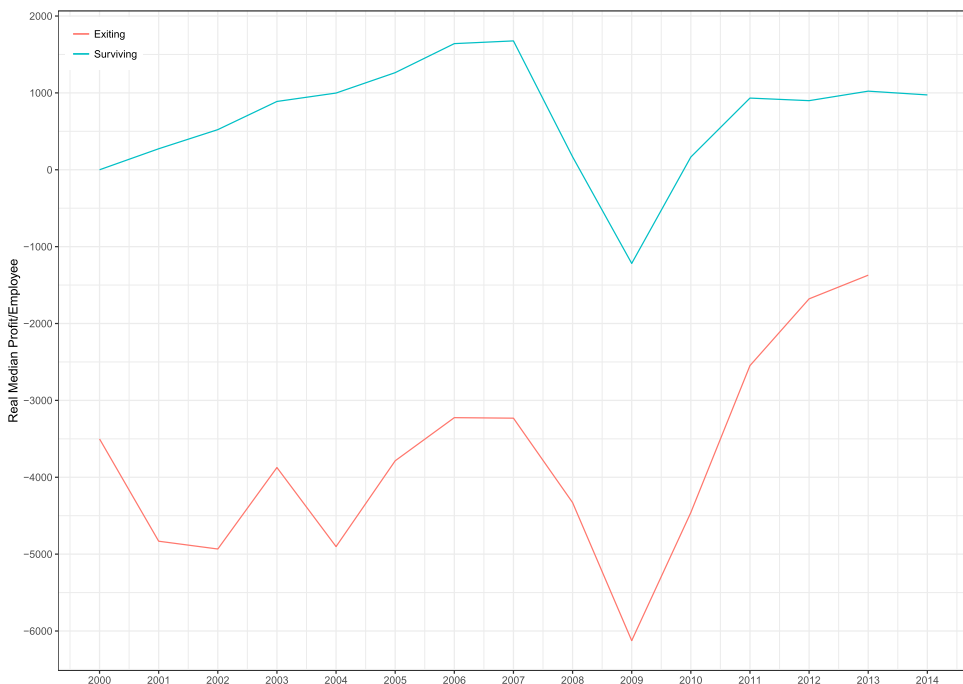
When considering potential aggregate effects of lower economic dynamism (understood as lower levels of churning), in particular focusing on its productivity enhancing effects, a corroborating piece of evidence is provided in Constantinescu and Nguyen (2018). Using a multivariate unobserved component model to estimate the level of potential output and the associated output gap, the authors find a lower level of average growth in potential output for the Lithuanian economy following the 2008 crisis. The effect of aggregate credit growth is muted after the crisis while featuring prominently in driving the pre-crisis estimated output gaps. Limitation in accessing credit are indicated by Foster et al. (2016) as one of the likely explanations for the lack of cleansing effects of the 2008 recession in the US economy and the feeble productivity gains, as compared to previous recessionary episodes.

Although the available time-span does not allow us to conduct a comparative analysis of potentially different levels of cleansing over time, we can nevertheless track the profitability of exiting and surviving firms over the available period. We therefore deflate firm-level nominal profit using industry deflators and compute real median profit for exiting firms and compare it to real median profit of surviving firms. Figure 12 indicates that median profitability of surviving firms has been steadily increasing since 2000, reaching a peak in 2007. It shrinks dramatically during the crisis and settles on a lower level afterwards. Firms exit the sample at negative profit levels throughout the covered period and also feature qualitatively different dynamics. Although there is some improvement over time, median values remain in the negative domain. During the crisis, firms exit at noticeably more negative profit values as compared to the pre-crisis levels.

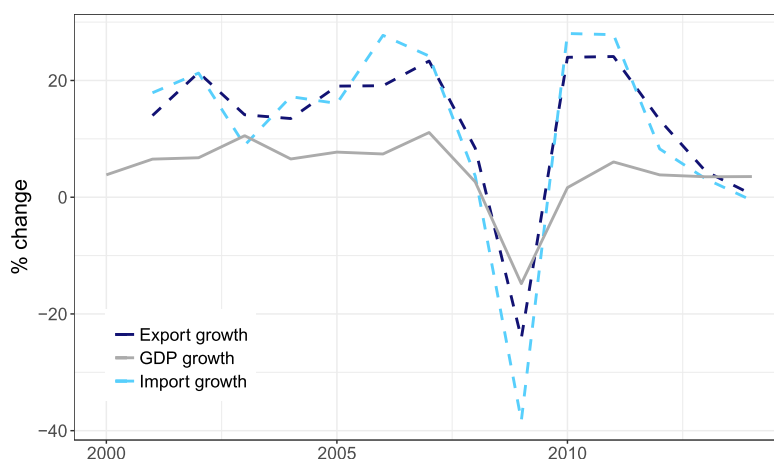
## 5. Trade

### 5.1. Evolution of exports and imports

Total imports and exports in our dataset represent 70–80% of total merchandise exports and imports recorded in national accounts (50–60% of total exports and imports of goods and services), their dynamics in terms of growth rates being very similar in the two sources for the period of 2000–2014. Lithuania has been a net importer of goods over the entire period analysed. Figure 13 depicts the dynamics of imports and exports. A noticeable feature is the pronounced pro-cyclical nature of import and export, in line with evidence for the emerging economies documented by Schmitt-Grohé and Uribe (2017). Since



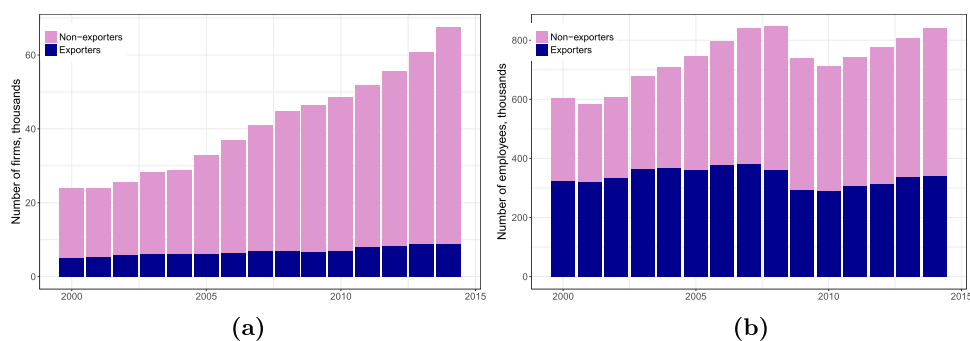
**Figure 12.** Median profit of surviving and dying firms.



**Figure 13.** Firm imports and exports in the dataset.

imports react even stronger to economic downturns and upturns than exports do, we observe a counter-cyclical trade-balance-to-output ratio over 2000–2014, also present in other emerging economies.

Figure 14 presents the counts evolution of exporting and non-exporting firms as well as the total employment in firms engaged in exporting and non-exporting activities.<sup>10</sup> The share of exporting firms in the sample is only around 17% on average over the period. These export participation shares are slightly higher than the ones in Estonia and two times higher than the shares in Latvia (Benkovskis, Masso, Tkacevs, Vahter, & Yashiro, 2018). Yet, the declining export participation shares over the sample from 20% to 13% stand in contrast to relatively stable shares in Latvia and Estonia. More importantly, the fraction of employment in companies active in exporting activities has been decreasing steadily since 2000. The overall employment level moves with the business cycle, yet the fraction decreases from around 50% in 2000 to 40% in 2014. The employment shares are again higher than in Latvia or Estonia but the declining share profile over time is different from relatively stable shares in Latvia and Estonia (Benkovskis et al., 2018). As shown further in this section, value-added per employee is higher in exporting than non-exporting firms. This fact, corroborated with the increasing employment



**Figure 14.** Number of firms and employment by firm export status. (a) Firms and (b) employment.

**Table 4.** Total value of exports and imports split by broad economic activities.

Year	C – Manufacturing		D – Electricity		G – W&R Trade		H – Transport		All other	
	% of total EXP	% of total IMP	% of total EXP	% of total IMP	% of total EXP	% of total IMP	% of total EXP	% of total IMP	% of total EXP	% of total IMP
2000	77%	37%	1%	3%	14%	50%	2%	3%	6%	6%
2001	73%	34%	2%	3%	18%	53%	2%	4%	6%	5%
2002	73%	36%	2%	4%	19%	52%	2%	4%	4%	5%
2003	73%	36%	2%	3%	18%	53%	3%	3%	4%	4%
2004	66%	31%	2%	3%	25%	58%	2%	4%	6%	5%
2005	64%	30%	1%	2%	28%	60%	2%	3%	5%	5%
2006	61%	28%	0%	2%	32%	63%	2%	2%	5%	5%
2007	60%	26%	1%	2%	33%	64%	2%	2%	5%	5%
2008	58%	29%	1%	4%	34%	60%	2%	3%	4%	4%
2009	58%	31%	1%	6%	34%	58%	2%	2%	4%	4%
2010	57%	30%	1%	8%	35%	56%	3%	3%	5%	4%
2011	55%	30%	1%	7%	36%	56%	3%	3%	4%	4%
2012	53%	29%	1%	7%	40%	58%	3%	3%	4%	3%
2013	52%	29%	0%	5%	42%	60%	3%	3%	3%	3%
2014	53%	30%	0%	4%	41%	60%	2%	2%	4%	3%

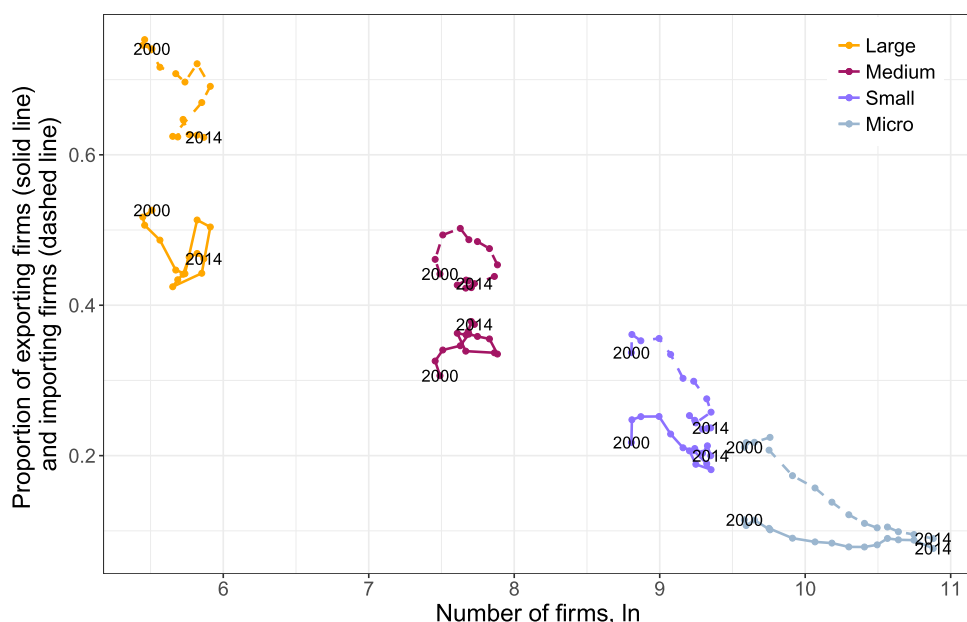
fractions observed for non-trading firms, hints to a further potential explanation of lower economic growth and calls for a more detailed analysis of the relationships between firm characteristics, export behaviour and aggregate competitiveness.

The split of exporting and importing firms<sup>11</sup> by their main economic activities is given in Table 4. It indicates the time evolution in total value of exports and imports among the economic activities, e.g. 77% of all exports come from Manufacturing, while 50% of all imports go to Wholesale and Retail sector in 2000. The table reveals that the vast majority of imports and exports (around 90%) is occurring in Manufacturing, Wholesale and Retail trade. While manufacturers are net exporters, Wholesale and Retail trade is a net importer.

The share of exporting and importing firms by size is depicted in Figure 15. The evolution of firm counts present in different size categories is shown on the x-axis. The vertical axis shows the proportion of all firms within each size category that engage in exporting (solid line) or importing (dashed line). The figure reveals a couple of features distinguishing micro and small firms vs. medium and large firms. First, micro and small firms are typically domestic firms, while large and medium firms typically engage in international trade. Second, the shares of exporters and importers have been relatively stable over time (without a clear time trend) in the medium and large firm groups, but the shares have been declining steadily over time in the small and medium firm size categories. On the other hand, all size groups share one commonality – there is a higher share (number) of importing than exporting firms within each size group and throughout the entire period.

## 5.2. Exporters and importers: foreign trade shares and concentration in sectors

If we take a closer look at the concentration of exporting and importing firms, a pronounced segmentation emerges. When we use the definition of a permanent exporter, the share of exporting firms is slowly going down from 16% in 2000 to 11% in 2014 in the total firm population. Similarly, the share of permanent importers in all firms declined sharply from 30% in 2000 to 13% in 2014. Yet despite the relatively small share of exporting and importing firms in the total firm population, these permanent importers and exporters cover around 98% of exports and imports in our dataset. Quite naturally, if we look at industry's



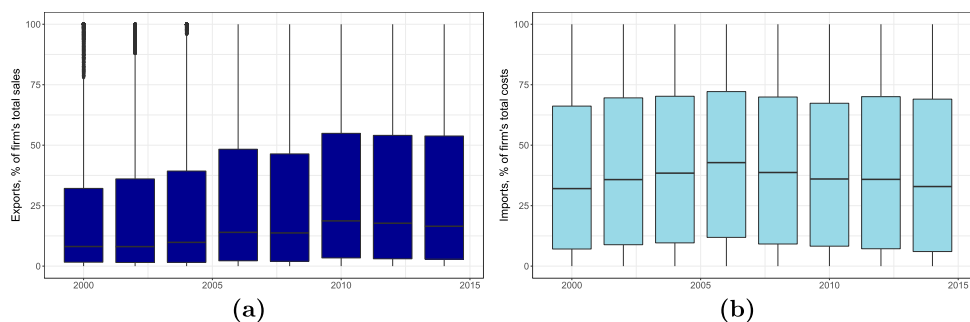
**Figure 15.** Exporting and importing firms by size (Exporters – solid line, Importers – dashed line).

export and import concentration, i.e. the share of each industry's total exports imports by its 10 largest traders, we would see that industries with a larger number of importers and exporters (Manufacturing, Wholesale and Retail trade, Construction, etc.) have a lower concentration of their exports and imports while services normally have only a few exporting firms, thus top 10 traders would often cover the entire trade of the sector.

Figure 16 provides an overview of the distribution of the trading firms' export shares (as a percentage of sales revenues) and import shares (as a percentage of total costs) over time. For this exercise we remove the 3-year-trading requirement but keep the 1% value threshold. Both figures reveal the importance of the trade channel for the firms analysed, the dependence of these firms on international trade linkages and how differently these linkages are distributed across the firms within the economy. A couple of important facts emerge from these figures. First, the figure of export shares (Panel 16(a)) features an increasing median export share across exporters and also a thicker distribution tail over the years, indicating an increasing proportion of exporting firms raising their share of exports over time. Conversely, import share distributions have not changed much over time – the median export share and the width of the distribution remain relatively constant over time (Panel 16(b)). Second, in all the years, import share distribution covers a wider range compared to the range of export shares: firms have quite disperse import shares – from 10% to 70%, while export shares are concentrated in the range of 5–30% and only by the end of the period cover the range of 10–50%.

### 5.3. Firm import-Export trade status and value-added, assets and growth

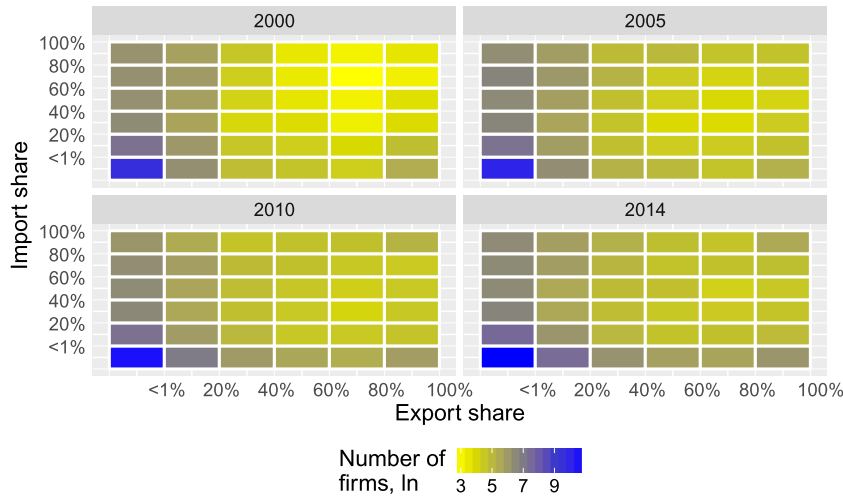
Our next inquiry focuses on the relationship between trade status (across both of its dimensions, exporting and importing) and value-added (a proxy for productivity), asset



**Figure 16.** Firm trade share distributions. (a) Export shares and (b) import shares.

Notes: The colour-filled body in the boxplots represents the mass of firms between the lower 25% quantile and the upper 75% quantile of the distribution. The median of the distribution is marked by a horizontal black line in the middle of the coloured box. The vertical black lines outside of coloured boxes mark the range of 1.5 inter-quartile range above the 75th and below the 25th quantile. Black dots represent outliers.

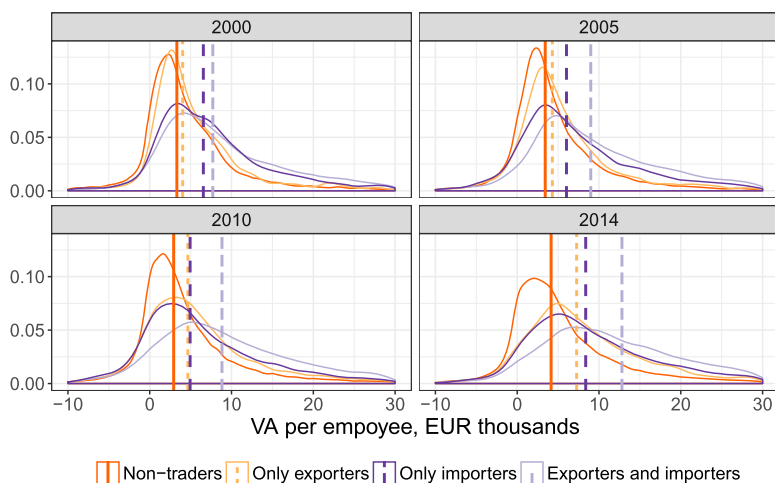
position, wages paid and growth over the years. We start by looking at [Figure 17](#) that depicts the number of firms according to their ‘export share’ (the share of exports to its sales revenue) and ‘import share’ (the share of imports to its total costs); the chosen share brackets are  $< 1\%$ ,  $1\text{--}20\%$ ,  $20\text{--}40\%$ ,  $40\text{--}60\%$ , etc. The figure reveals a number of tendencies. First, the largest number of firms is observed in sector  $(0, 0)$ , that is firms neither importing nor exporting (or having a very low share of both). Second, there is a substantial number of firms having a rather high import share but a very low export share. Third, over time, there has been an increasing number of firms concentrating in ‘high exports’ and ‘high imports’ area, revealing a tendency of firms’ participation in global value chains – a phenomenon widely discussed and analysed in recent literature (see, e.g. Amador & Cabral, 2015; Amador, Cappariello, & Stehrer, 2014; Kasahara & Lapham, 2013 for some overview studies on the topic) and elegantly complemented by a micro-founded multi-country sourcing model by Antràs, Fort, and Tintelnot (2017).



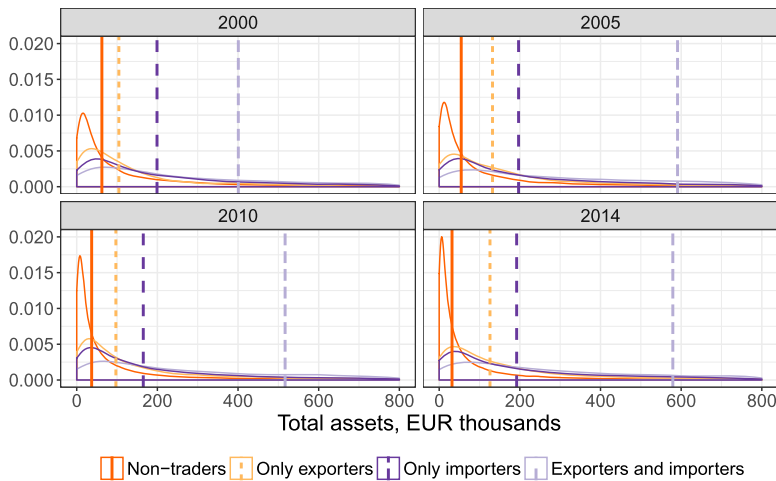
**Figure 17.** Firm export and import shares.

We now come back to the analysis of firm's trade status, as defined in Section 5.2. We cross-reference it with a number of variables that could be either important determinants of firm's engagement into trade, or a result of firm's trading.

Figure 18 depicts the distributions and median values of value-added per employee across firms with different trade status. The vertical dashed lines show the median value-added values in each firm size group. There are several things to be noted in the figure. The value-added per employee for all the types of firms has been increasing over the years together with widening differences between the firms with different trade statuses. Firms that are only exporters ('pure exporters') did not seem to be drastically different from non-exporters in terms of value-added throughout 2000–2010 but in recent years they started diverging from each other with 'pure exporters' creating higher value-added per employee than 'non-traders'. This is in line with the strand of trade theory of Krugman (1980), further developed by Melitz (2003) and then applied and tested by many others (see, e.g. Berman, Berthou, & Héricourt, 2015; Fernandes & Tang, 2014; Johnson, 2012). Firms that are both importing and exporting have been creating larger volumes of value-added per employee compared to firms with other trade statuses. This stylized fact has been observed in the U.S. foreign trade data by Bernard, Jensen, Redding, and Schott (2007), Bernard, Jensen, Redding, and Schott (2009) and further explored and explained by Antràs et al. (2017). Furthermore, the differences of value-added per employee among firms of different trade types have considerably increased over the last five years in the sample (2010–2014). We hypothesize that this is a result of firms' participation in the global value chains as in Amador and Cabral (2014), DeBacker and Miroudot (2014), yet a deeper analysis is required to derive robust conclusions of it. Not that commonly, firms that are treated as 'only importers' in our sample seem to create higher value-added per employee than both 'non-traders' or 'pure exporters'. Another interesting observation is that the global financial crisis had a relatively stronger damaging effect on the value-added of 'pure importers' compared to firms with other trade statuses. A drastically shrinking value-added created by importing firms during the economic crisis itself is not a surprising feature for a small open economy,



**Figure 18.** Value-added by firm trade status.



**Figure 19.** Total assets by firm trade status.

it could be easily resulting from the internal devaluation (sizeable fiscal and nominal wage adjustments) as noted by e.g. Purfield and Rosenberg (2010), yet the relative effects on 'pure importers' and 'pure-exporters' and their timing is another interesting avenue for future research.

Another dimension we consider is the asset position of firms having different trade statuses (Figure 19). It reveals a clear distinction in asset volumes of firms that engage in international trade and the ones that only have direct linkages with the local market (i.e. neither import nor export). As in the previous figure, the dashed median asset lines indicate that the firms that engage in exporting and importing (possibly, firms involved in the global value chains) have the highest asset positions at all times. The global financial crisis had some detrimental effects on the assets of all firm types but did not change the relative positions of median assets in all four groups. While the relationship between different trade statuses and asset positions is quite strong, it is not clear what is the direction of a causal relationship between the two; this question is left for future research.

## 6. Growth

We start this section by looking at level and dynamics of firm growth. There is a number of growth measures widely used and applied in economic literature. We rely on a few of them and in this paper use the percentage increase in the number of employees, the growth rates of value-added and turnover, and the change in size class.<sup>12</sup> The following choice is the time span over which the growth rates of the companies should be tracked. While a common tradition is to rely on 3-year or 5-year changes we stick to the annual growth rates for a number of reasons: first, the longer the time span is chosen, the more companies are eliminated from the sample. In that case, the growth rate averages and other characteristics become conditional on the companies surviving at least the number of years used in the calculation of the multiple-period growth rate; yet the companies surviving 3+ or 5+ years might be very different from those dying at the age of 1 or 2 years. Second, multiple-year averages are usually taken on a 'rolling window' basis, i.e.



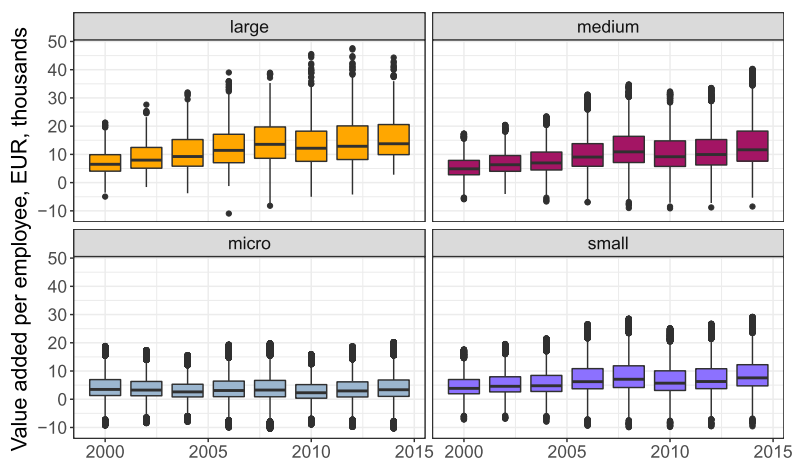
the same annual change is considered multiple times into calculations. However, if the company ‘dies’ during the crisis, it is removed from the sample. Finally, Lithuanian companies are rather young and very dynamic. Thus, taking long time spans into calculation would reveal the company’s average lifetime characteristics abstracting from and hiding away shorter-term movements. With these considerations in mind we choose to track the year-on-year growth measures of companies.

The growth rates of companies are known to be independent of their size—the regularity known as Gibrat’s law and described thoroughly by Sutton (1997). While a number of papers confirm this result with firm-level data (Banerjee & Jesenko, 2016; Davis et al., 1998; Haltiwanger, Jarmin, & Miranda, 2013; Luttmer, 2011), some other studies find contradicting evidence (Angelini & Generale, 2008; Cabral & Mata, 2003; Evans, 1987). The stylized facts in our case are ambiguous, as the following analysis reveals.

First, we take a look at the distributions of value-added per employee over time in four size groups of the firms (Figure 20). It is clear that the medians of value added per employee are positively correlated with the firm size. Also, the spreads of the distributions are wider and increase faster over time, the larger is the firm. Finally, the medians, 25th and 75th percentiles of the distributions of value-added per employee are increasing over years in all size categories, except for the crisis period of 2009–2010.

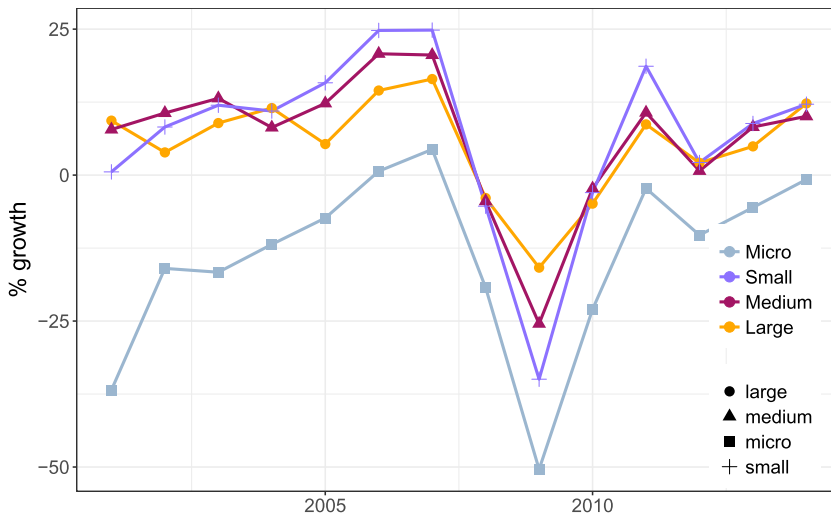
Once we split the population of firms by their size and growth in value-added over time, the results are sensitive to the outlier elimination procedure. If outliers are removed using a standard procedure, where growth rates below the first quartile less 1.5 inter-quartile range and above the third quartile plus 1.5 inter-quartile range have been eliminated, simple averages of firms’ value-added growth by size over years are depicted in Figure 21.

The figure shows that small and especially micro firms have the most volatile value-added growth while large- and medium-sized firms are the more stable ones throughout the economic cycle. Moreover, small and micro firms exhibit large pro-cyclicality during



**Figure 20.** Value-added distributions by firm size.

Notes: The colour-filled body in the boxplots represents the mass of firms between the lower 25% quantile and the upper 75% quantile of the distribution. The median of the distribution is marked by a horizontal black line in the middle of the colored box. The vertical black lines outside of colored boxes mark the range of 1.5 inter-quartile range above the 75th and below the 25th quantile. Black dots represent outliers.



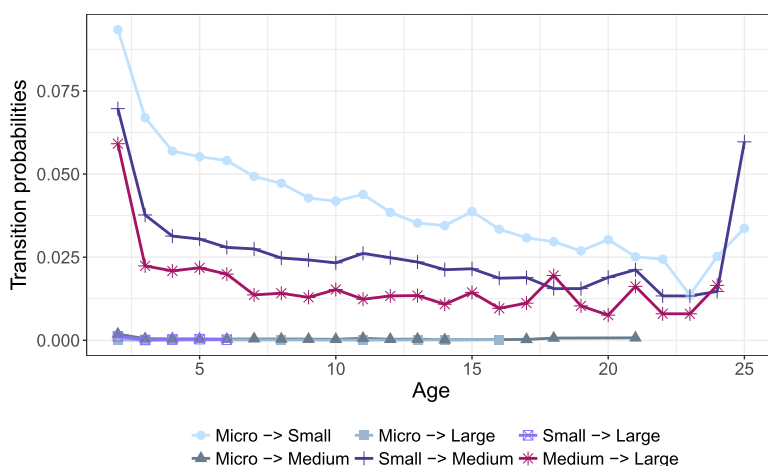
**Figure 21.** Value-added growth by firm size.

economic downturns but have lower growth rates during economic boom periods; this asymmetry creates an increasing gap between the largest and smallest firms with cumulative effects creating an even larger divide than the difference between growth rates. On the other hand, since most value-added, employment and output is generated by medium and large firms, the relative stability of medium and large firms is a plausible feature of the economy. However, the asymmetric reaction of small and micro firms to economic cycle almost disappears if, instead of applying a standard outlier elimination procedure, we calculate averages on the data within 1%–99% quantiles in each size class. Thus, depending on how we handle the data, the situation evaluation and policy implications might be rather different.

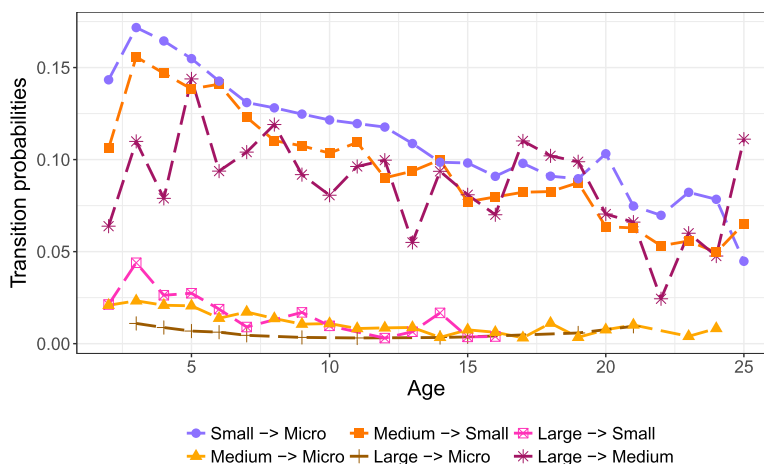
Next, we assess the likelihood of firms transiting from one size category to another one at different ages (Figure 22). Since we use the European Commission definition here, size class change reflects not only the change in the number of employees but also the changes in turnover or assets of firms.

Noticeably, irrespective of their initial size, firms are most likely to change their size category at an early age; at an older age the firm's probability of moving from one size category to another diminishes. As a result, the probability of staying in the same size category increases with the firm's age. Another regularity that we observe is the gradual change in size label, the size category usually changes to an adjacent size class. Drastic size changes, moving from a micro to a large or from a large to a small size category, are very rare. Moreover, micro firms are the ones that are least likely to move to another size class, followed by large firms. Most dynamic firms in terms of size categories are small firms that are very likely to shrink to micro firms or turn medium-sized as they grow older. Finally, for all size classes there is a higher probability for a firm to downsize than to reach a higher size class over a year (with an exception of micro firms that do not have a 'lower' size category to move to).

Figure 23 depicts the scatter plots of firm employment growth and the growth rates of firm value-added per employee split by company size. With this we target two questions:



(a)

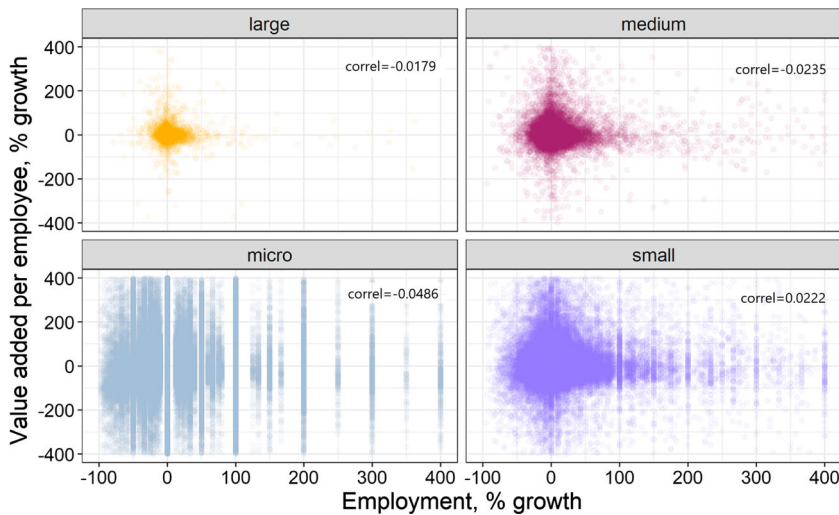


(b)

**Figure 22.** Firm size class changes by firm age. (a) Firm size class upgrades and (b) firm size class downgrades.

do the companies that hire more people are also more productive (in terms of value-added per employee) and are the growth rates of employment and value-added growth dependent on firm size. Two things emerge from the figure. First, there is no clear relationship between the growth rates of value-added per employee and employment growth rates in neither of the size categories of firm population. Second, the spread of both growth rates is much higher for micro and small companies than for medium and large ones, at least partially explaining the sensitivity of the business cycle asymmetry result by micro companies described above.

Figure 23 combined with the evidence provided in Figure 20 uncovers the ‘dichotomy’ of firm sizes in the Lithuanian economy: while firms of all sizes grow at roughly similar growth rate on average, the levels of value-added per employee created are much higher in large and medium firms. Of course, for a robust and complete analysis, one



**Figure 23.** Employment and value-added growth by firm size.

Notes: Since employment can only be a positive number, the minimum value employment growth can obtain is bounded at  $-100\%$ . This is not the case for value-added per employee growth rates; since value-added (and thus value-added per employee can also be a negative number) its growth rates are not bounded from above or below. The correlation coefficients in the figures are simple averages of correlation rates between the two variables calculated separately for each firm over time and then averaged for each size group.

should look at the total factor productivity estimates and compare those across industries and different firm sizes, yet even this very simple yet stark difference showing up across the firms of different sizes reveals the mechanics behind the broadening gap between micro-small and medium-large firms.

## 7. Conclusions

This is an overview paper of the firm-level structure, its developments and trends in Lithuania over the period of 2000–2014. While our analysis is concentrated on the investigation of the firm-level heterogeneity, conditioning and slicing data based on a few observable firm characteristics: age, industry, size, foreign trade status, etc., a few tendencies emerge even when conducting this simple descriptive analysis.

The study of the data reveals a large discrepancy across the size groups : large and medium vs. small and micro. The former ones are more often engaged in international trade (the shares of exporters and importers are much higher), have higher life expectancy (and lower death rates), have less disperse growth rates (yet, employ more people and create more value-added in absolute terms), exhibit less volatility in the job market (smaller employment flows, both via hiring/firing channels within the existing companies and job creation/destruction rates brought by the newly created or dying firms), and on average are more productive (in terms of value-added per employee). It also seems that in most cases polarization has been taking place with the smaller firms stagnating at lower productivity levels, turnover and value-added being much lower, suffering more during the crisis but growing at approximately the same speed afterwards (thus, the gap is not closing down).

Job creation and job destruction analysis reveals that firms react to crisis episodes in different ways according to their size, age and industry. While micro and small firms are relatively more likely to adjust to the business cycle via new firm creation or firm deaths (i.e. extensive margin), a relatively more important channel for larger companies is the internal margin, i.e. adjustment via controlling their number of employees. More recently, this is done not only over number of jobs but also over the number of hours. Full employment, the norm until the 2008 crisis, gave way to a more fragmented employment intensity characterized by the increase in part-time employment particularly in the micro and small size categories (details available from authors). Overall, the annual ratios of gross job creation and destruction to total employment (either because of firm's birth/death or employee turnover within existing firms) correlate negatively with firm size. Thus, employees of larger companies experience lower hiring and firing probabilities in general. Moreover, we document an increasing importance of employee turnover in the overall economy generated by micro and small firms.

When it comes to the asset-liability structure of firms based on their age, economic activity and size, we are presented with a real kaleidoscope of empirical regularities (results available from authors). Recently established firms (1–2 years of age) have lower levels of fixed assets as a proportion of total assets when compared to mature firms. Average values of fixed assets have been decreasing over time across all size groups. Of notable importance is the structural difference in the level of the ratio of fixed assets to total assets. Micro firms have the lowest ratios of current assets (average 25% in 2014) with the fraction increasing with the size category (reaching an average of 50% in 2014 for large companies). Second moments reveal also some interesting dynamics specific only to certain size categories. For example, variance in the ratio of current assets to total assets among large firms has been increasing robustly over time with the increase being driven by the right tail of the distribution. Considering liabilities for example, we observe a rather stable share of long-term liabilities to total liabilities for mature firms (at roughly 20%), slightly decreasing after the crisis.

Tracking firms over time, we observe a general tendency of increasing fractions of current assets to total assets. This tendency has been established prior to the 2008 crisis. With the exception of Transportation, where a notable acceleration of this process is observed in 2010, for most industries the process evolves according to the path established in the pre-crisis period. Differences in the composition of assets and liabilities of the firms differ most starkly between the manufacturing industries and services, but this is almost a natural distinction between the two. The connection between more detailed economic activities and the structure of assets/liabilities is far less clear. Firm average age (and exit rates) by economic activities is seemingly positively related to the fixed costs of industries. Thus, the average age of manufacturing, provision of utilities and mining industries is higher than the one of services. The relationships between economic activities and international trade intensity, average birth rates or value-added are less clear.

We also document stark differences between firms not engaged in international trade and firms that trade internationally (the latter group is further split into 'pure importers', 'pure exporters' and 'both'). These groups feature quite a few differences in terms of their value-added-per-employee, assets and employment sizes. Especially different are firms engaged in global value chains (those exporting and importing) with considerably

higher value-added per employee, higher assets and the highest resistance to the global economic recession.

In line with previous findings for other countries we also document procyclical birth rates and counter-cyclical death rates of firms, hump-shaped firm survival rates by age, the inverse relationship between firm size and the magnitude of labour flows generated, a negative correlation between job creation and destruction rates over time (and by firm size groups, with the exception of micro firms), and counter-cyclical trade-balance to output ratio. We also provide some evidence that is compatible with the existing literature on the presence of Gibrat's law, cleansing effect of crises and multi-country sourcing model. We collect some new evidence of higher birth rates than growth rates in a country over time (a likely feature of emerging markets), firm age and size structure particularities of a newly created economy, persistent differences in birth rates across industries over time, an increasing proportion of micro firms in the economy (by far the strongest increase when compared to other EU countries) and procyclicality of the share of long-term liabilities in total liabilities among firms of different age, size and economic activities. Interestingly, asset structure does not feature analogous cyclical behaviour among different firm types. Finally, our data findings on exporting firm productivity and asset size stand in contrast with some of the theoretical literature.

Since our analysis is only descriptive at this stage, a very natural extension would be to engage into causal analysis and try to explain deeper underlying reasons of the data facts observed. Already mentioned in the paper are the questions about firm international trade determinants, firm entry-exit vs. job creation and job destruction decisions, underlying firm growth reasons, firm productivity determinants and some others that call for further investigation of the forces that produce the observed firm heterogeneity. Another important piece of analysis that needs to be developed further is the role of compositional features of firm population in defining the impact of domestic and foreign shocks on the Lithuanian economy: not only on the magnitude of shocks on the macro-economic outcomes but also on their distribution across firms and over time. This is in itself extremely important for economic policy conduct, policy tool selection and structural reform recommendations regarding fiscal, monetary and competitiveness policy decisions.

## Notes

1. We would like to thank the Lithuanian Statistical Office for their continuous support.
2. For example, industrial classification NACE Rev.2 is only available from 2000; it is not directly comparable to NACE rev. 1.2 which classifies firms according to their main economic activity in 1995–1999.
3. Since 2004 there are reporting exemptions to trade within the European Union. While these exemptions do not exceed 3% of total import or export value at the aggregate country level, the absolute thresholds of several (hundred) thousand Euros might be underestimating the trade by micro and small firms.
4. [http://ec.europa.eu/growth/smes/business-friendly-environment/sme-definition\\_en](http://ec.europa.eu/growth/smes/business-friendly-environment/sme-definition_en)
5. The main factors determining the size of the firm is its headcount and either turnover or balance sheet total (assets). Thus the thresholds indicated in the table have a relation 'Headcount' AND 'Turnover' OR 'Assets' in a particular range.
6. Deflators used are industry-specific value-added deflators, source: Eurostat, nama\_10\_a64 series

7. Reminder: some of the largest firms are eliminated from the sample due to confidentiality concerns; while the eliminated firms could add a couple of percentage points to the share of employment by large firms, we do not expect their dynamics to be different from the sample covered
8. Given that the Statistical Survey is compulsory for all firms, a firm's complete disappearance from the dataset is considered as a factual firm death.
9. Average age in electricity sector has been relatively high until 2010 after which it dropped drastically. This is due to a major energy sector reorganization in 2010.
10. Here exporters and non-exporters are defined using the loosest definition as presented in Section 2.2.
11. Here we also use the loosest definition of exporters and importers, see Section 2.2.
12. Size classes are defined using the European Commission definition, see Section 2.2.

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## Disclosure statement

No potential conflict of interest was reported by the authors.

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