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Working Paper

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Abstract

This paper provides a systematic cross-country investigation of the relation between a firm's growth volatility and its size. For the first time the analysis is carried out using comparable and representative sets of data sourced by official business registers of an important number of countries. We show that there exists a robust negative relation between growth volatility and size with an average elasticity equal to -0.18. We check the robustness of this result against a number of potential sources of bias and in particular against the inclusion of firm age. We then interpret the estimated elasticity in terms of the underlying diversification structure of firms and we conclude discussing the relevance of our result with respect to the recent literature on granularity and on the effects of economic policies with heterogeneous firms.

1 Introduction

Is the growth dynamics of business firms tied-up with their size? While the literature has largely focused on the relation between a firm's size and its average growth rate,[1] only a small number of studies have investigated if there exists a link between a firm's size and the volatility of its growth.[2] After the first evidence in Hymer and Pashigian (1962) recent estimates obtained on U.S. companies (Stanley et al., 1996) support the idea that larger firms tend to display a less volatile growth dynamics than smaller ones. However, these pieces of evidence remain to a large extent inconclusive. First, Gabaix (2011) suggests that these estimates may well be biased since they are obtained using large listed companies only.[3] Second, as recently discussed in Di Giovanni and Levchenko (2012), the extent to which results for the US economy can be also valid for other countries is unclear.[4]

This paper overcomes both of these limitations providing the first systematic cross-country investigation of the relation between a firm's growth volatility and its size, using an original data source containing comparable and representative data on business firms for 20 countries. We show that there exists a robust negative relation between the volatility of growth and size: averaging across countries, an increase by 10% of a firm's size is accompanied by a 1.8% decrease of its growth volatility. This relation appears quite homogeneous across countries, with 17 out of 20 countries characterized by an estimated elasticity lying in the interval $[-0.24, -0.16]$. We check the robustness of our result against a number of potential confounding factors and, in particular, we show that it is not entirely driven by firm's age.

Quantifying the elasticity between a firm's size and its growth volatility and assessing if and to what extent this relation is common across diverse countries is important for a number of reasons. On a micro level, it can help discriminating among different theories of firm growth generally grounded on the assumption that a firm can be seen as an aggregation of many elementary units. Indeed, the fact that we observe an elasticity close to -0.2 provides evidence against a simple model where these elementary units display similar size and that their growth dynamics are independent. On the contrary, it can be interpreted alternatively as supporting the existence of some correlation among sub-units (Mansfield, 1962 and Boeri, 1989), of a hierarchical structure among sub-units (Amaral et al., 1997) or of a fat-tailed distribution of the size of sub-units (Sutton, 2002; Fu et al., 2005; Riccaboni

[1] See Lotti et al., 2003 for a review of the literature originating from the pioneering work in Gibrat (1931).

[2] Conceptually, cross-sectional variance (or standard deviation) is a measure of between-firm dispersion of growth rates at a given time while volatility is a measure of within-firm variation of growth rates over time (rolling window). The two concepts are, however, very related. Empirically Davis et al. (2007), using Compustat data show that, while capturing different aspects of business dynamics, the two measures track each other well. Using a different data source Calvino et al. (2016) provides further support to the existence of a positive correlation between volatility and dispersion.

[3] Similarly Capasso and Cefis (2012) discusses the effects of the existence of natural and/or exogenously imposed thresholds in firm size distributions on estimations of the relation between firm size and the variance of firm growth rates.

[4] The elasticity between growth volatility and size has been found close to -0.1 with a sample of French manufacturing firms (Coad, 2008) and practically zero with a sample of Italian manufacturing firms (Bottazzi et al., 2007).

et al., 2008). Bottazzi and Secchi (2006) show that if the probability for a firm to diversify into a new sub-market (i.e., to generate a new sub-unit) increases with the number of existing sub-units, the negative relation between volatility and size can be traced back to a more fundamental positive correlation between a firm's size and the number of its sub-units.

On a macro level, assessing the existence of the scaling relation between growth volatility and size is important for those studies investigating the extent to which micro-level volatility is associated with aggregate fluctuations (see Comin and Mulani, 2006, Comin and Philippon, 2006 and Davis et al., 2007). In granular economies[5] Gabaix (2011) shows that the mechanism which transmits microeconomic shocks into aggregate fluctuations is limited by the extent to which large firms present less volatile growth patterns than smaller ones. In the same vein, Di Giovanni and Levchenko (2012) show that the increase in aggregate volatility due to trade opening is magnified when a firm's volatility scales down with its size. In their model, an elasticity of about -0.17 almost triplicates the contribution of trade to aggregate fluctuations.

Finally, clarifying the link between volatility of growth and size is important in light of recent policy analysis suggesting that more turbulent competitive environments are systematically more sensitive to the institutional framework and to its changes. Calvino et al. (2016) show, for example, that firms operating in more volatile markets are more reactive to national policies affecting credit availability and contract enforcement and that this effect is reinforced for new entrants vis-à-vis incumbents.

This paper is organized as follows. Section 2 describes the data and defines the variables used in the empirical investigation. Section 3 presents the main result together with an extensive set of robustness checks while Section 4 provides an economic interpretation of the coefficient of interest in term of firm diversification and its relevance in the transmission of micro-economic shocks into aggregate fluctuations. Section 5 concludes.

2 Data

The data in use come from a distributed data collection exercise aimed at creating a harmonized cross-country micro-aggregated database sourced from firm-level data collected in national business registers.[6] For example the data sources for France and the US are "Fichier Complet Unifié de SUSE" (FICUS) and Census Bureau's Business Dynamics Statistics (BDS) and Longitudinal Business Database (LBD) respectively, which are both built on administrative data with a quasi universal coverage. These are the typical data used for firm-level studies such as Garicano et al. (2016) and

[5]Granularity refers to the fact that if the firm size is distributed according to a power law with a sufficiently low exponent aggregate volatility is amplified by idiosyncratic shocks hitting the largest firms.

[6]Other sources include social security records, tax records, censuses or other administrative sources. See Calvino et al. (2016) for further details.

Haltiwanger et al. (2013). The high representativeness of the underlying data sources and the large country coverage are two of the key features that make our dataset unique and particularly suitable for the present investigation.

Our data are produced within the DynEmp project led by the OECD, with the support of national delegates and national experts of member and non-member economies. The DynEmp project builds upon the distributed micro-data methodology proposed by Bartelsman et al. (2004) for analysing and comparing harmonized firm demographics across countries.[7]

Data produced by the DynEmp routine include the "annual flow datasets" and the "transition matrices". The "flow datasets" contain annual statistics on gross job flows, such as gross job creation and gross job destruction and on several other statistical indicators of unit-level employment growth, such as mean, median, and standard deviation. "Transition matrices", which are used in this paper, summarize instead the growth trajectories of different cohorts of firms – defined according to their age class, size class, and macro sectors of activity – from year t to year $t+j$, where t takes by default the values 2001, 2004, and 2007 and j is equal to 3, 5, or 7.[8] The matrices contain a number of statistics, such as the number of units in the cell, median employment at t and at $t+j$, total employment at t and at $t+j$, mean growth rate, average size, and, most importantly, employment growth volatility.

The DynEmp v.2 database currently includes 20 countries, namely Australia, Austria, Belgium, Brazil, Costa Rica, Denmark, Finland, France, Hungary, Italy, Japan, Luxembourg, the Netherlands, Norway, New Zealand, Portugal, Spain, Sweden, Turkey, the United Kingdom and the United States and covers firms in manufacturing and non-financial business services.[9] Data from most countries cover the 2001-2011 period. A detailed coverage table is provided in the Appendix (see Table A2).

Variables of interest

In this subsection we provide details on how the main variables used in this study are built. In particular, we focus on how the DynEmp routine creates the measure of employment growth volatility, our proxy, using confidential firm-level data for 20 countries.

Following Davis and Haltiwanger (1999), annual employment growth $\gamma_{i,t}$ of firm i at time t is defined as

$$\gamma_{i,t} = \frac{S_{i,t} - S_{i,t-1}}{0.5(S_{i,t} + S_{i,t-1})} \quad , \tag{1}$$

where $S_{i,t}$ indicates employment of firm i at time t. Next we define firm-level employment growth volatility of firm i as the standard deviation of its employment growth rates over a time window of

[7] Details on the data collection and harmonisation procedure are discussed extensively in Criscuolo et al. (2015).

[8] Therefore, if data are available, transition matrices are calculated for the periods 2001-2004, 2001-2006, 2001-2008; 2004-2007, 2004-2009, 2004-2011; 2007-2010, 2007-2012, 2007-2014.

[9] Data for Japan are limited to the manufacturing sector only and Costa Rica is excluded from the sample due to the limited time coverage and unavailability of the transition matrix database.

length j

$$\sigma^j_{i,t} = \sqrt{\sum_{h=1}^{j} (\gamma_{i,t+h} - \overline{\gamma}^j_{i,t+1})^2} \quad , \tag{2}$$

where $\overline{\gamma}^j_{i,t+1}$ is the average employment growth rate of firm i over the period between $t+1$ and $t+j$. Firm-level data are then aggregated to avoid confidentiality issues. However, this aggregation is very detailed. Indeed, the DynEmp routine aggregates confidential microdata in cells on the basis of five dimensions: i) the starting year t, with $t = 2001, 2004$ or 2007; ii) the length of the time window j over which firms are followed, with $j = 3, 5, 7$; iii) firms' age classes a, with $a =$[entrants, $1-2$ years old, $3-5$ years old, $6-10$ years old, 11+ years old]; iv) firms' size classes s, with $s =$[less than 10 employees, $10-49$ employees, $50-99$ employees, $100-249$ employees, $250-499$ employees, 500+ employees]; v) macro sectors of economic activity m, with $m =$[manufacturing, non-financial business services]. Further details on the methodology and cleaning procedure are presented in Criscuolo et al. (2015). Accordingly, we define employment growth volatility $\sigma^j_{c,t}$ as the weighted average of firm-level volatilities of firms i in cell c, computed over a time window of length j

$$\sigma^j_{c,t} = \sum_{i \in c,t} w^j_{i,t} \sigma^j_{i,t} \quad , \tag{3}$$

where weights $w^j_{i,t}$ are average employment shares of firms i over the period between t and $t+j$ and the cell c is micro-aggregated according to age classes, size classes and macro-sectors, as previously discussed ($c = a, s, m$). At the same level of aggregation, for each detailed cell, the DynEmp v.2 database provides information on average size $S_{c,t}$, as the average of initial size (measured in terms of employment at time t) of all firms in the cell, as shown in the following[10]

$$S_{c,t} = \sum_{i \in c,t} \frac{S_i}{N_i} \quad , \tag{4}$$

where N_i is the number of firms in cell c.

3 Empirical results

This work focuses on the analysis of the relation between firms' growth volatility and size. As a baseline test we estimate, using OLS, the following regression model

$$\log \sigma^j_{c,t} = \alpha + \beta \ \log S_{c,t} + \epsilon_{c,t} \quad , \tag{5}$$

[10]Different countries record zero employment units in non-homogeneous ways. This caveat shall be taken into account when interpreting the results in the light of this definition of cell average size.

Table 1: BASELINE REGRESSION MODEL

	AT	AU	BE	BR	DK	ES	FI	FR	GB	HU
log size	-0.260***	-0.226***	-0.222***	-0.150***	-0.187***	-0.217***	-0.222***	-0.271***	-0.0594***	-0.173***
	(0.0195)	(0.0127)	(0.0276)	(0.00989)	(0.0212)	(0.0191)	(0.0160)	(0.0180)	(0.0170)	(0.0178)
constant	-1.038***	-0.307***	-1.060***	-0.804***	-1.087***	-0.796***	-0.965***	-0.884***	-1.387***	-0.979***
	(0.0647)	(0.0386)	(0.0997)	(0.0406)	(0.0826)	(0.0766)	(0.0643)	(0.0672)	(0.0702)	(0.0691)
Obs	89	49	89	102	84	59	85	60	60	90
Adj. R^2	0.662	0.837	0.391	0.650	0.538	0.724	0.632	0.821	0.177	0.499

	IT	JP	LU	NL	NO	NZ	PT	SE	TR	US
log size	-0.167***	-0.0336	-0.223***	-0.137***	-0.172***	-0.191***	-0.240***	-0.182***	-0.0924***	-0.126***
	(0.0194)	(0.0206)	(0.0317)	(0.0196)	(0.0300)	(0.0255)	(0.0485)	(0.0232)	(0.0183)	(0.0148)
constant	-1.225***	-1.858***	-1.501***	-1.216***	-1.116***	-1.105***	-0.919***	-1.030***	-0.807***	-0.860***
	(0.0807)	(0.0686)	(0.115)	(0.0789)	(0.0933)	(0.0780)	(0.201)	(0.0920)	(0.0688)	(0.0577)
Obs	90	58	62	63	72	80	36	90	30	98
Adj. R^2	0.449	0.064	0.385	0.349	0.430	0.492	0.339	0.441	0.454	0.464

Notes: Regression of the log volatility of growth $\sigma^j_{c,t}$ on log of firms size $S_{c,t}$. Manufacturing firms only over a 3 years time window and pooling together observations from 2001, 2004 and 2007. Robust standard error in parenthesis with *** p<0.01, ** p<0.05, * p<0.1.

where $\sigma^j_{c,t}$ is the growth volatility between t and $t+j$, $S_{c,t}$ cell-level average size at initial time t of all firms in cell c and $\epsilon_{c,t}$ is an error term. We estimate this regression for each country in our data-set separately. The coefficient of interest β is identified from the variation across firms and we interpret its sign as the sign of a conditional correlation that does not reflect causality. The double log transformation implies that growth volatility scales with size according to a power law $\sigma_{c,t} \sim S^\beta$, with β measuring the correlation between size and growth volatility as an elasticity. In this baseline test we focus on the manufacturing sector and on a time window of length equal to three years ($j = 3$). We estimate Equation 5 separately for each country pooling cells corresponding to all size classes, age classes and available years ($t = 2001, 2004, 2007$ conditional on availability).[11]

Table 1 presents results from the OLS estimation of the baseline model. The results highlight a negative and significant relation between volatility and average size in almost all the countries considered. The average estimate is -0.18 and, since β is an elasticity, this means that if a firm's size increases by 10% the volatility of its growth tends to decrease by 1.8%. Unreported estimates on the pooled sample including country dummies result in a scaling coefficient equal to -0.18 significant at 1% level, with standard errors clustered at country-year level.

Two main features emerge from these results. First, the estimated β seems homogeneous across countries: most elasticities in the manufacturing sector (for 17 out of 20 countries) lie with a 95% significance level in the interval $[-0.24, -0.16]$, with their mean and median values equal to -0.18. This is a surprising result. Economies that are very different in terms of size, industrial structure and institutional framework show very similar estimated βs, suggesting the existence of an underlying mechanism common across them. Second, at the same time, few countries seem to display a lower

[11] Note that this excludes from the sample cells that have zero volatility. We will return to this issue in the following.

(higher) than average β. This aspect and its implications deserve to be further investigated.

Validating the result using source data for France

As a first important exercise to validate our main result, we compare the estimates presented in Table 1 with those obtained using microdata, in a country for which direct access to the underlying confidential firm-level data source is possible for the authors, i.e. France. The data source for France is FICUS (Fichier Complet Unifié de SUSE), which is constructed from administrative (fiscal) data with almost universal coverage.[12] As confirmed in Garicano et al. (2016) this is the most appropriate database to study firm size distribution in France.

In line with what we have done in the previous section, we define $S_{i,t}$ as firm i's size in term of employees at time t and $\sigma^j_{i,t}$ as firm-level growth volatility built over a j years time window. We focus on manufacturing firms and we pool together observations for 2001 and 2004. Even with these precautions the two datasets are not directly comparable. Indeed while average cell volatility (as defined in Equation 3) includes into the computation firms with zero volatility, this is not the case when we estimate the relation on individual data where these zero volatility firms are dropped by the log transformation. Since firms with zero volatility tend to be micro firms, using individual data would then underestimate β. To deal with this source of bias in the comparison we adopt two strategies. First, we follow the procedure used in the DynEmp v.2 routine and we weight individual data by the average firm-level employment, calculated over the moving window on which volatility is computed. Second, we estimate the regression model using exclusively unweighted observations regarding firms that have 10 or more employees.

Results are reported in Table 2. For the sake of comparison, column (1) reports the estimated coefficient for France obtained with micro-aggregated data as reported in Table 1 and column (2) reports the same coefficient focusing on cells that include firms with 10 or more employees. Columns (3) and (4) report results for the regressions on weighted observation and on firms with 10 or more employees, respectively. Estimates are very similar across the 4 different specifications confirming that our micro-aggregated setting is well suited for investigating the volatility-size relation. Moreover the procedure based on micro-aggregated data allows also to preserve information on zero volatility firms that in a simple individual data setting would be lost.[13] Availability of microdata allows us to further test whether the results are driven by the growth rate definition (see Equation 1), by the measure of volatility, or by the size proxy (employment versus other size measures) chosen in the DynEmp v.2 routine. Unreported estimates[14] on the French manufacturing sector suggest that similar results hold

[12]FICUS is based on the mandatory reporting of firms' income to the tax authority. It excludes micro-enterprises and enterprises that are subject to *bénéfices agricoles* (tax regime dedicated to the agricultural sector).

[13]Due to the log-transformation of volatility.

[14]These estimates are available upon request.

Table 2: REGRESSION USING FIRM-LEVEL FRENCH DATA

	(1)	(2)	(3)	(4)
Sample	All	10+	All	10+
Aggregation	Cell-level	Cell-level	Firm-level	Firm-level
log size	-0.271***	-0.232***	-0.260***	-0.295***
	(0.018)	(0.0249)	(0.012)	(0.004)
constant	-0.884***	-1.074***	-1.344***	-1.410***
	(0.0672)	(0.105)	(0.041)	(0.014)
Obs.	60	50	173,120	64,543
Adj. R^2	0.821	0.665		
R^2			0.205	0.095

Notes: Regression of the log volatility of growth $\sigma^j_{c,t}$ on log of firms size $S_{c,t}$. In column (1) we use all observations at the cell level, in column (2) we use observations at cell level focusing only on cells including firms with 10 or more employees, in column (3) we use observations at the firm level weighted by their relative size and in column (4) observations at the firm level focusing only on those with 10 or more employees. In all 4 columns we consider manufacturing firms over a 3 years time window and pooling together observations from 2001 and 2004. Robust standard error in parenthesis with *** p<0.01, ** p<0.05, * p<0.1.

when using a definition of employment growth based on log-differences, even with coefficients slightly lower in absolute value both on microdata and on micro-aggregated data. Finally, using the standard deviation of employment growth instead of volatility[15] and using turnover as a size proxy also result in negative statistically significant coefficients.

Robustness checks

In this section we further test the robustness of our main finding along a number of dimensions. First we run a set of basic checks by extending j (the length of the time window over which volatility is computed) from 3 to 5 and 7 years, conditional on availability, and by including in the baseline regression a set of year dummies to control for common macroeconomic factors. Results for these regressions are reported in Appendix B (Table B1, B2 and B3) and they all show that our result emerges as very stable with only a minor reduction (in absolute value) of the estimated coefficient. The median estimated β is -0.17 and -0.16 when j is equal to 5 and j is equal to 7 respectively and -0.18 when we include year fixed effects.

Second, we examine the robustness of our finding by estimating Equation 5 using a technique more robust than OLS to the presence of extreme observations to be sure that they are not driving our result. The first column of Table 3 reports the results when Equation 5 is estimated using a Least Absolute Deviations approach (see also Table B4 in Appendix B for further details). Again findings are in line with the baseline result with only minor changes in the coefficients. Estimates report a cross-country mean and median value of -0.18 and -0.20. Interestingly, in this case the negative

[15] This volatility is computed on a pooled dataset with 25 bins with the same number of observations.

Table 3: ROBUSTNESS: LAD - NON-PARAMETRIC - WEIGHTED - SERVICES

	LAD				NP					WEIGHTED				SERVICES			
	log size	s.e.	Obs.	R^2	Mean	Mode	av. s.e.	Obs.	R^2	log size	s.e.	Obs.	Adj. R^2	log size	s.e.	Obs.	Adj. R^2
AT	-0.241***	(0.0164)	89	0.487	-0.260***	-0.260	(0.0000)	89	0.6662	-0.269***	(0.0140)	89	0.872	-0.177***	(0.0185)	90	0.547
AU	-0.234***	(0.0199)	49	0.612	-0.240***	-0.228	(0.0366)	49	0.8693	-0.258***	(0.0160)	49	0.915	-0.154***	(0.0227)	55	0.600
BE	-0.236***	(0.0307)	89	0.334	-0.182***	-0.170	(0.0662)	89	0.4069	-0.275***	(0.0243)	89	0.736	-0.187***	(0.0265)	90	0.380
BR	-0.153***	(0.0169)	102	0.392	-0.112***	-0.136	(0.0268)	102	0.6684	-0.190***	(0.0127)	102	0.727	-0.119***	(0.0123)	102	0.551
DK	-0.189***	(0.0287)	84	0.279	-0.199*	-0.124	(0.0510)	84	0.6206	-0.234***	(0.0262)	84	0.616	-0.177***	(0.0198)	86	0.611
ES	-0.229***	(0.0237)	59	0.474	-0.161***	-0.192	(0.0493)	59	0.7261	-0.271***	(0.0281)	59	0.708	-0.108***	(0.0188)	60	0.396
FI	-0.208***	(0.0224)	85	0.442	-0.222***	-0.217	(0.0113)	85	0.6438	-0.261***	(0.0277)	85	0.635	-0.128***	(0.0165)	85	0.384
FR	-0.301***	(0.0201)	60	0.592	-0.269***	-0.268	(0.0252)	60	0.8419	-0.331***	(0.0255)	60	0.832	-0.163***	(0.0245)	60	0.513
GB	-0.0609***	(0.0212)	60	0.105	-0.056***	-0.0396	(0.0100)	60	0.2231	-0.138***	(0.0288)	60	0.454	-0.0309**	(0.0149)	60	0.048
HU	-0.167***	(0.0202)	90	0.342	-0.137***	-0.172	(0.0437)	90	0.5243	-0.225***	(0.0154)	90	0.749	-0.132***	(0.0209)	90	0.364
IT	-0.163***	(0.0229)	90	0.229	-0.078***	-0.0952	(0.0154)	90	0.4754	-0.175***	(0.0287)	90	0.329	-0.0360	(0.0226)	90	0.022
JP	-0.0443**	(0.0190)	58	0.0819	-0.0261***	-0.046	(0.0259)	58	0.1692	-0.0549***	(0.0164)	58	0.270	-	-	-	-
LU	-0.263***	(0.0476)	62	0.242	-0.223***	-0.223	(0.0000)	62	0.395	-0.260***	(0.0272)	62	0.635	-0.102***	(0.0290)	84	0.104
NL	-0.129***	(0.0279)	63	0.220	-0.148***	-0.184	(0.0298)	63	0.4036	-0.110***	(0.0317)	63	0.167	-0.0691***	(0.0190)	69	0.156
NO	-0.211***	(0.0274)	72	0.352	-0.175***	-0.180	(0.0114)	72	0.4492	-0.207***	(0.0254)	72	0.670	-0.109***	(0.0228)	72	0.359
NZ	-0.205***	(0.0226)	80	0.366	-0.191***	-0.191	(0.0000)	80	0.4983	-0.228***	(0.0193)	80	0.586	-0.204***	(0.0172)	85	0.539
PT	-0.203***	(0.0637)	36	0.227	-0.238***	-0.237	(0.0094)	36	0.3615	-0.321***	(0.0462)	36	0.687	-0.236***	(0.0446)	36	0.451
SE	-0.186***	(0.0211)	90	0.294	-0.0884***	-0.0809	(0.0179)	90	0.4594	-0.235***	(0.0360)	90	0.440	-0.112***	(0.0158)	90	0.428
TR	-0.0801***	(0.0260)	30	0.238	-0.102***	-0.103	(0.0173)	30	0.5919	-0.0763***	(0.0185)	30	0.367	0.0141	(0.0260)	30	-0.022
US	-0.140***	(0.0141)	98	0.311	-0.107***	-0.147	(0.0332)	98	0.5404	-0.177***	(0.0175)	98	0.697	-0.107***	(0.0145)	99	0.370
Pooled	-0.180***	(0.00963)	1,446	0.411	-	-	-	-	-	-0.190***	(0.00912)	1,446	0.789	-0.124***	(0.00860)	1,433	0.477
Mean	-0.1822	-	-	-	-0.1608	-	-	-	-	-0.2148	-	-	-	-0.1230	-	-	-
Median	-0.1960	-	-	-	-0.1683	-	-	-	-	-0.2310	-	-	-	-0.1190	-	-	-

Notes: i) Least Absolute Deviations regression of the log volatility of growth $\sigma^j_{c,t}$ on log of firms size $S_{c,t}$. Manufacturing sector.; ii) Non-parametric local linear regression of the log volatility of growth $\sigma^j_{c,t}$ on log of firms size $S_{c,t}$. Average gradient, mode of the gradient estimates and average standard errors of the gradient estimates are reported. Significance of the average gradient is assessed via kernel regression significance test; iii) Regression of the log volatility of growth $\sigma^j_{c,t}$ on log of firms size $S_{c,t}$ with observation weighted by the number of firms in each cell. Manufacturing sector.; iv) Regression of the log volatility of growth $\sigma^j_{c,t}$ on log of firms size $S_{c,t}$. Services sector. All regressions include a constant. Volatility is calculated over a 3 years time window and pooling together observations from 2001, 2004 and 2007. Robust standard error in parenthesis with *** p<0.01, ** p<0.05, * p<0.1. The Pooled regressions include country dummies and standard errors are clustered at country-year level.

coefficient for Japan becomes statistically significant.

Third, we adopt a fully non-parametric approach to test whether the estimates are somehow driven by the particular functional form estimated. We follow the approach proposed by Li and Racine (2004) and report the results in the second column of Table 3 (see also Table B5 and Figure B1 in Appendix B).[16] Estimates are qualitatively similar to the main result, with some coefficients (including Belgium, Spain and Sweden) that have a tendency to decrease in absolute value. The cross-country mean is -0.16 and the median -0.17.

Then, we adopt a grouped data approach to regression to further test whether the estimates are somehow driven by the micro-aggregated setting. In particular, Angrist (1998) and Angrist and Pischke (2008) suggest that a regression where individual data are averaged by group and weighted by the number of individuals in each group produces coefficients identical to those generated using original individual level observations (Angrist, 1998; Angrist and Pischke, 2008). In our case, however, cell averages are themselves employment weighted averages and the regression is estimated on a logarithmic transformation of the variables, therefore the coefficients will not be perfectly equal to those we would obtain with individual data. Still, since the number of firms in each cell is an information available in our data set, we re-estimate the main model weighting the observations using this number.[17] The estimates, reported in the third column of Table 3, show that there are no radical changes with respect to the baseline (see also Table B6 in Appendix B for further details). Indeed, even if there is a tendency for the coefficients to increase in absolute value, the mean and the median estimated β remains -0.21 and -0.23, respectively which are very close to the original values obtained above. The highest changes occur for Portugal, where the coefficient becomes -0.32, and for the United Kingdom, where it becomes equal to about -0.14.

So far, the main focus has been on the manufacturing sector. However, sectoral specificities may induce different patterns in the extent to which volatility scales with size. We tackle the issue presenting the estimation of the baseline model for firms operating in non-financial business services.

Results are reported in the fourth column of Table 3 (see also Table B7 in Appendix B for further details). Two main messages emerge. First, once again the estimated β for almost all countries is negative and statistically significant, the two exceptions being Italy and Turkey.[18] Second the mean and median estimated values are -0.12 and the standard deviation 0.04. With respect to firms in the manufacturing sector, the scaling relation in services tends therefore to be flatter and less dispersed

[16] For the cross-validate bandwidth selection we used in most cases the method described in Hurvich et al. (1998).

[17] Note however that the standard errors from this regression do not measure the asymptotic sampling variance of the slope estimate in the microdata, which would actually depend on the microdata themselves. See Angrist and Pischke (2008) for further discussion.

[18] Notably Turkey is the country for which we have the lowest number of observations due to the limited time period available. Its number of observations is lower than Portugal because no firm reports missing age, and therefore the "missing" age class is not defined in the micro-aggregated data.

across countries. This is an interesting result since it is consistent with the economic interpretation of the β coefficient we will discuss below.

Finally we check that our main result is not entirely driven by an age effect by controlling for firm age. The sample is restricted to the manufacturing sector in Table B8 and shifts to non-financial business services in Table B9 in Appendix B. When including age dummies, estimates of the β coefficients in the manufacturing and non-financial business services sectors remain consistent with the baseline specification, with older firms significantly less volatile than younger ones in most cases. The mean and median values of the coefficient estimates are both equal to -0.17 in the manufacturing sector and to -0.12 in non-financial business services. This confirms that the scaling relation robustly holds also when controlling for age.[19] A more flexible specification that includes age class dummies and interactions of age class dummies with average size is also reported in Appendix B (see Table B10). In this case the estimated mean and median of the β coefficients is equal to -0.20 and -0.21, respectively, even though older firms tend to be less volatile than younger ones in their growth dynamics.

4 Discussion

In this section we provide an interpretation of the elasticity between a firm's size and the volatility of its growth, as captured by the parameter β, and we discuss the relevance of our empirical result particularly focusing on its role for aggregate fluctuations.

Interpretation of β. We interpret the emergence of this scaling relation between size and growth volatility in terms of the diversification structures of business firms. The basic intuition underlying this interpretation is that a firm is active in different sub-markets and that, as a consequence, it can be seen as composed by a large number of different sub-units. In this framework, a simple argument based on the Central Limit Theorem suggests that if a firm's sub-units are not too different[20] and are independent, the standard deviation of a firm's growth decreases proportionally to the inverse of the $\sqrt{N}$ where N is the number of units. This would imply an elasticity β equal to -0.5. In this case, the firm is nothing more than the simple sum of its sub-units. Conversely, if a firm is composed by perfectly correlated sub-units which are similar in size, β equals zero. Our empirical evidence suggests that typical values of β are not far from -0.18 suggesting that firms do not diversify following a pure risk minimization strategy, since in this case they should have been present in a much higher number of sub-markets.

In this framework Bottazzi and Secchi (2006) show that, in presence of a self-reinforcing mechanism for which the probability for a firm to diversify into a new sub-market (i.e., to generate a new sub-unit)

[19]This is also consistent with the analysis by Garda and Ziemann (2014) based on Orbis data.
[20]This means that the number of sub-markets in which a firm is active is approximately proportional to its size.

increases with the number of existing sub-units, the Central Limit Theorem is able to justify a value of the elasticity higher than -0.5 without making any additional assumption on the internal structure of the firm. The central idea of the model by Bottazzi and Secchi (2006) is that the number of sub-units $N_{i,t}$ composing firm i at time t is not proportional to the size of the firm itself. On the contrary, $N_{i,t}$ is the outcome of a diversification process featuring a self-reinforcing mechanism as the main driver behind proliferation of sub-markets in which a firm operates. More formally, let us assume that a firm's probability of diversifying into a new sub-market while growing from S to $S + \Delta S$ depends on the number of already active sub-markets N, that is

$$P(N, S; N + 1, S + \Delta S) = N\lambda\Delta S + o(\Delta S) \quad , \tag{6}$$

where λ is the instantaneous rate of arrival of a diversification event and where the possibility of multiple instantaneous diversification events is excluded. Then, it can be shown that the number of sub-markets scales with size $N(S) \sim S^{\lambda}$ and that, by the Central Limit Theorem, $\beta = -\lambda/2$. This means that the observed relation between size and growth volatility reflects a simple diversification pattern in a world where the probability to diversify is an increasing function of the number of already active sub-markets.[21] The pattern we observe empirically is consistent with the idea that diversification strategies are shaped and limited by what a firm is already able to do (i.e. the number of sub-markets a firm is already active in). In this sense, our result provide support to the traditional resource-based view of the firm and of its dynamics (Penrose, 1959; Teece et al., 1997). And in this perspective, the evidence that the scaling of volatility seems milder among firms operating in services, where the scope of diversification is lower, appears consistent with the proposed interpretation.

Relevance. Knowing the true value of β is particularly important in granular economies, that is in those economies where the firm size distribution is fat tailed. In this context, Gabaix (2011) shows that the relation between microeconomic shocks and macroeconomic fluctuations is mediated by the extent to which micro-level volatility scales with size. More precisely, if firm size is distributed according to a Power Law with characteristic exponent γ, $P(S > s) = (S_{min}/s)^{\gamma}$ with $1 \leq \gamma < 2$, $\sigma^{firm} \sim S^{\beta}$ and $-0.5 < \beta \leq 0$, then it can be shown that

$$\sigma^{GDP} \propto (GDP)^{\alpha'} \quad , \tag{7}$$

with $\alpha' = 1 - (1 + \beta)/\gamma$. This means that GDP volatility, conditional on the level of GDP, depends on two factors: the extent to which the firm size distribution is fat-tailed (γ closer to 1) and the extent to which micro-level volatility scales with size. This result has important consequences. Conditional on

[21] To obtain this result one needs also to assume that sub-markets growth dynamics and the structure of the diversification process – in terms of relative weights of different sub-markets – are both independent from firm size.

size and on the shape of the firm size distribution a country tends to be more risky, hence generating more dramatic fluctuations, the higher its β, i.e. the less diversified its firms conditional on size. In presence of full diversification, that is when $\beta = -0,5$, even with $\gamma = 1$, any granular effects would disappear. In order to quantify at least as a first approximation the role of β, consider an economy whose firm size distribution is a Zipf's law, so that $\gamma = 1$ and $\alpha' = \beta$. Without any scaling relation among firms of different size, that is when $\beta = 0$, doubling the size of the economy will result in a proportional increase (100%) of aggregate volatility σ^{GDP}. If instead the economy is characterized by a mild scaling, for example $\beta = -0.18$, the same doubling of the size of the economy will be accompanied by an increase in σ^{GDP} of about 87%, which reduces to 80% in case of $\beta = -0.3$ and to 76% when $\beta = -0.4$. The intuition behind this result is simple. Aggregate volatility in an economy where firm size is distributed according to a Zipf's law is driven by the shocks hitting the largest firms. In a bigger economy largest firms tend to be larger and in absence of any scaling, that is when a firm's growth volatility does not depend on its size, this amplifies aggregate fluctuations. This transmission mechanism of microeconomic shocks to aggregate fluctuations is instead limited when large firms present less volatile growth patterns, that is when large firms show at least a certain degree of diversification. The same kind of mechanism has been shown to influence the impact of a trade opening on aggregate fluctuations (Di Giovanni and Levchenko, 2012).

Finally, clarifying the link between volatility of growth and size is important in light of recent policy analysis suggesting that more turbulent competitive environments are systematically more sensitive to the institutional framework and to its changes. Calvino et al. (2016) show, for example, that firms operating in more volatile markets are more reactive to national policies affecting credit availability and contract enforcement and that this effect is reinforced for new entrants vis-à-vis incumbents.

In particular, sub-optimal policy settings that increase uncertainty and impose an extra cost of risk, like poor contract enforcement or frequent policy reversals, are likely to be specifically detrimental for volatile firms (Calvino et al., 2016). Understanding which types of firms are characterised by more volatile growth patterns appears therefore relevant for policy-making, as this can help evaluating the heterogeneous effects of policies that can affect firms differently depending on their volatility.

5 Conclusions

This paper is the first study that, using comparable and representative data from a significant number of diverse countries, provides robust evidence on the existence of a negative relation between a firm's growth volatility and its size. We estimate an average elasticity of -0.18 with a remarkable homogeneity across countries. We check that this result is robust to a number of potential confounding factors showing, in particular, that it holds true when one controls for firm age. We interpret the emergence of this scaling relation between size and growth volatility in terms of the underlying diversification structures of business firms. Providing a precise estimate of the associated elasticity helps to better characterize the mechanism that in a granular economy translates idiosyncratic shocks at the firm level into aggregate fluctuations and to quantify more precisely how much a trade opening episode would increase GDP fluctuations.

Our finding raises questions for future research. First, the result of a flatter elasticity estimated in the services sector seems interesting and stimulates additional investigations on the drivers of the observed relation. Second, estimating the Pareto coefficients of countries' firm-size distributions and appropriately taking into account the scaling relation of growth volatility with firm size would allow to directly link a country's productive structure and its resilience to economic shocks.

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Appendix A

Contributors to the DynEmp v.2 data collection

In this subsection the contributors to the DynEmp v.2 data collection are reported.

Table A1: CONTRIBUTORS TO THE DYNEMP v.2 DATA COLLECTION

Country	**National representative**	**Institution**
Australia	Antonio Balaguer, Diane Braskic David Hansell	Department of Industry, Innovation and Science and Australian Bureau of Statistics
Austria	Werner Hoelzl	WIFO Institute (Austrian Institute of Economic Research)
Belgium	Michel Dumont, Chantal Kegels, Hilde Spinnewyn	Federal Planning Bureau
Brazil	Carlos Henrique Leite Corseuil, Gabriel Lopes de Ulyssea	IPEA - Instituto de Pesquisa Econômica Aplicada
Costa Rica	David Bullon Patton and Tayutic Mena	Ministry for Foreign Trade
Denmark	Dorte Hoeg Koch, Morten Skov Poulsen	Ministry for Business and Growth
Finland	Mika Maliranta	The Research Institute of the Finnish Economy (ETLA) and Statistics Finland
France	DynEmp and MultiProd teams	OECD
Hungary	Adrienn Szep Szollosine, Erzsebet Eperjesi Lindnerne, Gabor Katay, Peter Harasztosi	Central Bank of Hungary, Hungarian Central Statistical Office
Italy	Stefano Costa	Italian National Institute of Statistics (ISTAT)
Japan	Kyoji Fukao and Kenta Ikeuchi	Hitotsubashi University and National Institute of Science and Technology Policy
Luxembourg	Leila Peltier - Ben Aoun, Chiara Peroni, Umut Kilinc	STATEC
The Netherlands	Michael Polder	Statistics Netherlands (Centraal Bureau voor de Statistiek)
New Zealand	Lynda Sanderson, Richard Fabling	New Zealand Treasury, Motu Economic and Public Policy Research and Statistics New Zealand
Norway	Arvid Raknerud, Diana-Cristina Iancu	Statistics Norway and Ministry of Trade and Industry
Portugal	Jorge Portugal	Presidencia da Republica
Spain	Valentin Llorente Garcia	Spanish Statistical Office
Sweden	Eva Hagsten	Statistics Sweden
Turkey	Faik Yücel Günaydin	Ministry of Science, Industry, and Technology
United Kingdom	Michael Anyadike-Danes	Aston Business School
United States	Javier Miranda	Center for Economic Studies, US Census Bureau

Notes: Countries included in the dataset used for this paper.

Methodological notes and cleaning

In this subsection we provide further details on the methodology that we apply to create the database used for estimation, including cleaning details. Starting from the aggregate Transition Matrix provided by the DynEmp database, we exclude the cells corresponding to all macro sectors, to avoid double counting. We further exclude cells where employment growth volatility is missing. The strictness of the blanking procedures – aimed at avoiding primary or secondary disclosure – applied on the micro-aggregated data differs from country to country. These differences (that involve a limited number of cells including few units, generally between 5 and 10) may influence cross-country comparability of the estimates. Countries that implement blanking are Australia, Denmark, Spain, Finland, France, Japan, Luxembourg, the Netherlands, New Zealand, Turkey, the United Kingdom and the United States.

Since the level of disaggregation for entering units (in terms of their size class at time $t + j$) produced by the DynEmp routine is more detailed with respect to other cells in the transition matrix, we re-aggregate them. We therefore proceed collapsing the dimension related to size class at time $t + j$, in order to obtain a cell that includes all surviving entrants together, as for the other age classes. Weights used for the aggregation of employment growth volatility in this case are cell average employment shares, calculated using cell-level employment at time t and $t + j$. Note that, in order to implement this aggregation, cells for which average employment for entrants is missing, are dropped (this involves a limited number of cells, mostly in the United Kingdom and New Zealand). Before collapsing, we also drop cells for which the number of entering units is not available due to blanking (United Kingdom only), otherwise the subsequent average size calculation would be influenced by these cells, as well. This re-aggregation does not seem to qualitatively affect the nature of findings proposed.

As highlighted in the paper, the focus is restricted to surviving units for which a window to calculate volatility is available.

Since the relation between volatility and average size is assessed in log terms, cells for which volatility and average size equal zero are dropped. Further details on and robustness linked to this issue have been provided in Section 3 of the paper.

Coverage table

In this subsection the coverage table of the DynEmp v.2 database is presented. Costa Rica has been excluded due to the limited time coverage and unavailability of the transition matrix database. Data for Japan are limited to the manufacturing sector only. Data for Norway are restricted up to 2001 and 2004+3 due to unusual patterns in the data from 2009. Data related to 2004 in the Netherlands are excluded from the sample due to a redesign of the Dutch business register. Data for the United Kingdom in 2001 are excluded from the sample due to censoring issues related to the age class calculation. Data for France are restricted up to 2007 due to a redesign of the French statistical systems of data collection on firms (from FICUS to FARE).

Table A2: Temporal coverage DynEmp v.2 over time by country

	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Australia						green	green	green	green	green	green	green	green	green	green	green		
Austria					green	green	green	green	green	green	green	green	green	green	green	green	green	
Belgium						green	green	green	green	green	green	green	green	green	green	green		
Brasil	green	green	green	green	green	green	green	green	green	green	green	green	green	green	green	green	green	
Costa Rica													gray	gray	green	green	green	
Denmark					green	green	green	green	green	green	green	green	green	green	green	green	green	
Finland						green	green	green	green	green	green	green	green	green	green	green		
France				green	green	green	green	green	green	green	green	green	gray	gray	gray	gray		
Hungary						green	green	green	green	green	green	green	green	green	green	green		
Italy				green	green	green	green	green	green	green	green	green	green	green	green			
Japan			green	green	green	green	green	green	green	green	green	green	green	green				
Luxembourg					green	green	green	green	green	green	green	green	green	green	green	green	green	
The Netherlands					green	green	green	green	green	green	gray	green	green	green	green	green	green	
New Zealand						green	green	green	green	green	green	green	green	green	green	green		
Norway			green	green	green	green	green	green	green	green	green	green	green	green	gray	gray		
Portugal											green	green	green	green	green	green	green	
Spain								green	green	green	green	green	green	green	green	green	green	green
Sweden						green	green	green	green	green	green	green	green	green	green	green	green	
Turkey											green	green	green	green	green	green	green	green
United Kingdom						gray	gray	green	green	green	green	green	green	green	green	gray		
United States			green	green	green	green	green	green	green	green	green	green	green	green	green	green	green	green

Notes: temporal coverage by country of the database used for the analysis. Years for which annual flow data are available are colored. Analysis based on flow data excludes the first available year, since most job flows statistics require two consecutive periods to be computed. For Costa Rica no transition matrix is available due to the limited time extension of the source data. For Japan data refer to the manufacturing sector only. Gray boxes correspond to years that have been excluded from the analysis due to data issues. Data for some countries are still preliminary.

Source: OECD DynEmp v.2 database.

Appendix B

Additional Tables and Figures

In this subsection we report the estimates of a number of robustness checks.

First we estimate the main equation extending the length of the time window over which volatility is computed from 3 to 5 and 7 years and including in the baseline regression a set of year dummies to control for common macroeconomic factors. Results of these regressions are reported in Table B1, B2 and B3, respectively.

Second, we estimate the main equation using a Least Absolute Deviation estimator, more robust to extreme observations. Results are reported in Table B4.

Third, we adopt a fully non-parametric approach (Li and Racine, 2004). Results are available in Table B5. We also plot micro-aggregated OLS and non-parametric regression lines, non-parametric regression gradient with error bars, kernel density of the betas of the non-parametric regression with and without bootstrapped error bands for France (FigureB1).

Fourth, we adopt a grouped data approach to regression (discussed in Angrist, 1998 and Angrist and Pischke, 2008). Results are reported in Table B6.

Fifth, we estimate the baseline model focusing on firms operating in non-financial business services. Results are reported in Table B7.

Finally we control that our main result is not entirely driven by an age effect. In particular, we control for firm age focusing on the manufacturing sector in Table B8, on non-financial business services in Table B9 and we include age class dummies and interactions of age class dummies with average size in Table B10.

Table B1: MAIN REGRESSION - $j = 5$

	AT	AU	BE	BR	DK	ES	FI	FR	GB	HU
log size	-0.266***	-0.219***	-0.217***	-0.136***	-0.153***	-0.228***	-0.224***	-0.244***	-0.0720***	-0.152***
	(0.0200)	(0.0133)	(0.0331)	(0.00888)	(0.0203)	(0.0139)	(0.0151)	(0.0183)	(0.0243)	(0.0211)
constant	-0.910***	-0.337***	-1.058***	-0.773***	-1.079***	-0.701***	-0.888***	-0.875***	-1.266***	-0.968***
	(0.0673)	(0.0451)	(0.110)	(0.0374)	(0.0754)	(0.0597)	(0.0669)	(0.0766)	(0.0879)	(0.0765)
Obs.	90	47	59	102	82	59	56	30	30	60
Adj. R^2	0.673	0.789	0.438	0.635	0.461	0.797	0.678	0.867	0.289	0.473

	IT	JP	LU	NL	NO	NZ	PT	SE	TR	US
log size	-0.146***	-0.0328**	-0.214***	-0.169***	-0.172***	-0.170***	-0.265***	-0.162***	-0.0850***	-0.116***
	(0.0197)	(0.0148)	(0.0293)	(0.0136)	(0.0263)	(0.0312)	(0.0413)	(0.0204)	(0.0163)	(0.0155)
constant	-1.209***	-1.772***	-1.411***	-1.075***	-1.051***	-1.091***	-0.858***	-0.983***	-0.795***	-0.887***
	(0.0780)	(0.0515)	(0.105)	(0.0488)	(0.0835)	(0.0894)	(0.170)	(0.0799)	(0.0524)	(0.0596)
Obs.	60	58	60	62	72	52	35	90	30	94
Adj. R^2	0.491	0.112	0.402	0.681	0.479	0.490	0.425	0.461	0.535	0.478

Notes: Regression of the log volatility of growth $\sigma^j_{c,t}$ on log of firms size $S_{c,t}$. Manufacturing firms only over a 5 years time window and pooling together observations from 2001, 2004 and 2007. Robust standard error in parenthesis with *** p<0.01, ** p<0.05, * p<0.1.

Table B2: MAIN REGRESSION - $j = 7$

	AT	AU	BE	BR	DK	ES	FI	FR	GB	HU
log size	-0.278***	-0.211***	-0.203***	-0.139***	-0.149***	-0.212***	-0.198***	-	-0.0602***	-0.159***
	(0.0181)	(0.0152)	(0.0279)	(0.00982)	(0.0289)	(0.0161)	(0.0155)	-	(0.0177)	(0.0205)
constant	-0.865***	-0.275***	-1.119***	-0.748***	-1.126***	-0.750***	-0.953***	-	-1.274***	-0.925***
	(0.0652)	(0.0444)	(0.0968)	(0.0422)	(0.103)	(0.0696)	(0.0615)	-	(0.0721)	(0.0754)
Obs.	59	23	59	66	55	29	56	-	28	59
Adj. R^2	0.736	0.838	0.488	0.683	0.452	0.830	0.689	-	0.283	0.471

	IT	JP	LU	NL	NO	NZ	PT	SE	TR	US
log size	-0.132***	-0.0168	-0.233***	-0.165***	-0.105**	-0.168***	-	-0.161***	-	-0.109***
	(0.0239)	(0.0200)	(0.0307)	(0.0219)	(0.0488)	(0.0291)	-	(0.0281)	-	(0.0215)
constant	-1.218***	-1.789***	-1.275***	-0.946***	-1.164***	-1.121***	-	-0.942***	-	-0.908***
	(0.0971)	(0.0708)	(0.120)	(0.0638)	(0.160)	(0.0827)	-	(0.107)	-	(0.0817)
Obs	30	30	39	29	36	51	-	60	-	61
Adj. R^2	0.489	0.002	0.513	0.641	0.214	0.563	-	0.377	-	0.447

Notes: Regression of the log volatility of growth $\sigma^j_{c,t}$ on log of firms size $S_{c,t}$. Manufacturing firms only over a 7 years time window and pooling together observations from 2001, 2004 and 2007. Robust standard error in parenthesis with *** p<0.01, ** p<0.05, * p<0.1.

Table B3: MAIN REGRESSION - YEAR DUMMIES

	AT	AU	BE	BR	DK	ES	FI	FR	GB	HU
log size	-0.260***	-0.226***	-0.222***	-0.150***	-0.183***	-0.217***	-0.223***	-0.271***	-0.0594***	-0.172***
	(0.0189)	(0.0129)	(0.0278)	(0.0100)	(0.0218)	(0.0194)	(0.0158)	(0.0182)	(0.0171)	(0.0172)
year dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
constant	-1.059***	-0.306***	-1.017***	-0.801***	-1.175***	-0.820***	-1.055***	-0.865***	-1.400***	-1.079***
	(0.0645)	(0.0479)	(0.120)	(0.0498)	(0.0912)	(0.0846)	(0.0883)	(0.0730)	(0.0688)	(0.0897)
Obs.	89	49	89	102	84	59	85	60	60	90
Adj. R^2	0.678	0.834	0.379	0.643	0.637	0.723	0.656	0.819	0.165	0.541

	IT	JP	LU	NL	NO	NZ	PT	SE	TR	US
log size	-0.167***	-0.0352*	-0.223***	-0.140***	-0.172***	-0.191***	-0.240***	-0.182***	-0.0924***	-0.125***
	(0.0197)	(0.0196)	(0.0316)	(0.0174)	(0.0300)	(0.0257)	(0.0485)	(0.0236)	(0.0183)	(0.0147)
year dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
constant	-1.238***	-1.811***	-1.495***	-1.411***	-1.050***	-1.052***	-0.919***	-1.048***	-0.807***	-0.793***
	(0.0940)	(0.0627)	(0.138)	(0.0722)	(0.101)	(0.0904)	(0.201)	(0.123)	(0.0688)	(0.0666)
Obs	90	58	62	63	72	80	36	90	30	98
Adj. R^2	0.439	0.108	0.371	0.597	0.444	0.485	0.339	0.434	0.454	0.487

Notes: Regression of the log volatility of growth $\sigma^j_{c,t}$ on log of firms size $S_{c,t}$ including year fixed effects. Manufacturing firms only over a 3 years time window and pooling together observations from 2001, 2004 and 2007. Robust standard error in parenthesis with *** p<0.01, ** p<0.05, * p<0.1.

Table B4: LAD REGRESSION

	AT	AU	BE	BR	DK	ES	FI	FR	GB	HU
log size	-0.241***	-0.234***	-0.236***	-0.153***	-0.189***	-0.229***	-0.208***	-0.301***	-0.0609***	-0.167***
	(0.0164)	(0.0199)	(0.0307)	(0.0169)	(0.0287)	(0.0237)	(0.0224)	(0.0201)	(0.0212)	(0.0202)
constant	-1.121***	-0.305***	-1.140***	-0.805***	-1.142***	-0.738***	-1.058***	-0.807***	-1.394***	-1.073***
	(0.0551)	(0.0506)	(0.119)	(0.0634)	(0.110)	(0.0946)	(0.0840)	(0.0692)	(0.0930)	(0.0681)
Obs.	89	49	89	102	84	59	85	60	60	90
Pseudo R^2	0.487	0.612	0.334	0.392	0.279	0.474	0.442	0.592	0.105	0.342

	IT	JP	LU	NL	NO	NZ	PT	SE	TR	US
log size	-0.163***	-0.0443**	-0.263***	-0.129***	-0.211***	-0.205***	-0.203***	-0.186***	-0.0801***	-0.140***
	(0.0229)	(0.0190)	(0.0476)	(0.0279)	(0.0274)	(0.0226)	(0.0637)	(0.0211)	(0.0260)	(0.0141)
constant	-1.269***	-1.831***	-1.352***	-1.232***	-1.003***	-1.095***	-1.094***	-1.078***	-0.874***	-0.814***
	(0.0869)	(0.0620)	(0.155)	(0.105)	(0.0950)	(0.0699)	(0.238)	(0.0912)	(0.0997)	(0.0618)
Obs.	90	58	62	63	72	80	36	90	30	98
Pseudo R^2	0.229	0.0819	0.242	0.220	0.352	0.366	0.227	0.294	0.238	0.311

Notes: Least Absolute Deviations regression of the log volatility of growth $\sigma^j_{c,t}$ on log of firms size $S_{c,t}$. Manufacturing firms only over a 3 years time window and pooling together observations from 2001, 2004 and 2007. Robust standard error in parenthesis with *** p<0.01, ** p<0.05, * p<0.1.

Table B5: NON PARAMETRIC REGRESSION

	AT	AU	BE	BR	DK	ES	FI	FR	GB	HU
Mean	-0.260	-0.240	-0.182	-0.112	-0.199	-0.161	-0.222	-0.269	-0.056	-0.137
Mode	-0.260	-0.228	-0.170	-0.136	-0.124	-0.192	-0.217	-0.268	-0.0396	-0.172
av. s.e.	(0.0000)	(0.0366)	(0.0662)	(0.0268)	(0.0510)	(0.0493)	(0.0113)	(0.0252)	(0.0100)	(0.0437)
Obs.	89	49	89	102	84	59	85	60	60	90
R^2	0.6662	0.8693	0.4069	0.6684	0.6206	0.7261	0.6438	0.8419	0.2231	0.5243

	IT	JP	LU	NL	NO	NZ	PT	SE	TR	US
Mean	-0.078	-0.0261	-0.223	-0.148	-0.175	-0.191	-0.238	-0.0884	-0.102	-0.107
Mode	-0.0952	-0.046	-0.223	-0.184	-0.180	-0.191	-0.237	-0.0809	-0.103	-0.147
av. s.e.	(0.0154)	(0.0259)	(0.0000)	(0.0298)	(0.0114)	(0.0000)	(0.0094)	(0.0179)	(0.0173)	(0.0332)
Obs.	90	58	62	63	72	80	36	90	30	98
R^2	0.4754	0.1692	0.395	0.4036	0.4492	0.4983	0.3615	0.4594	0.5919	0.5404

Notes: Non-parametric local linear regression of the log volatility of growth $\sigma^j_{c,t}$ on log of firms size $S_{c,t}$. Average gradient, mode of the gradient estimates and average standard errors of the gradient estimates are reported. Volatility is calculated over a 3 years time.

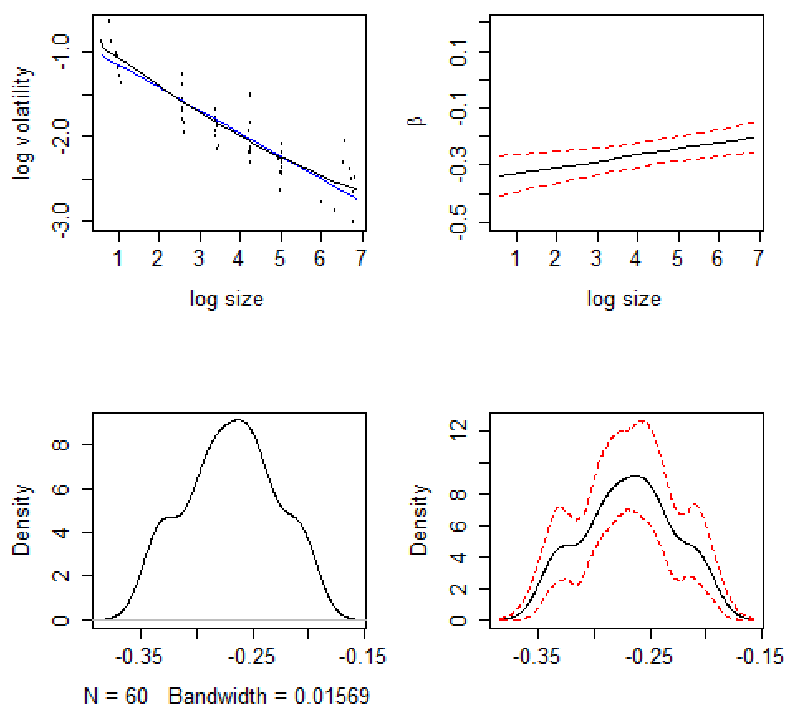

Figure B1: Non-parametric estimates - France

Table B6: WEIGHTED REGRESSION

	AT	AU	BE	BR	DK	ES	FI	FR	GB	HU
log size	-0.269***	-0.258***	-0.275***	-0.190***	-0.234***	-0.271***	-0.261***	-0.331***	-0.138***	-0.225***
	(0.0140)	(0.0160)	(0.0243)	(0.0127)	(0.0262)	(0.0281)	(0.0277)	(0.0255)	(0.0288)	(0.0154)
constant	-1.155***	-0.290***	-1.205***	-0.762***	-1.051***	-0.869***	-0.972***	-0.838***	-1.350***	-0.954***
	(0.0420)	(0.0296)	(0.0711)	(0.0399)	(0.0806)	(0.0784)	(0.0883)	(0.0766)	(0.0896)	(0.0480)
Obs.	89	49	89	102	84	59	85	60	60	90
Adj. R^2	0.872	0.915	0.736	0.727	0.616	0.708	0.635	0.832	0.454	0.749

	IT	JP	LU	NL	NO	NZ	PT	SE	TR	US
log size	-0.175***	-0.0549***	-0.260***	-0.110***	-0.207***	-0.228***	-0.321***	-0.235***	-0.0763***	-0.177***
	(0.0287)	(0.0164)	(0.0272)	(0.0317)	(0.0254)	(0.0193)	(0.0462)	(0.0360)	(0.0185)	(0.0175)
constant	-1.536***	-1.933***	-1.476***	-1.398***	-1.078***	-1.173***	-0.942***	-1.093***	-0.948***	-0.850***
	(0.0919)	(0.0605)	(0.0961)	(0.123)	(0.0819)	(0.0580)	(0.129)	(0.117)	(0.0504)	(0.0501)
Obs.	90	58	62	63	72	80	36	90	30	98
Adj. R^2	0.329	0.270	0.635	0.167	0.670	0.586	0.687	0.440	0.367	0.697

Notes: Regression of the log volatility of growth $\sigma^j_{c,t}$ on log of firms size $S_{c,t}$ with observation weighted by the number of firms in each cell. Manufacturing firms only over a 3 years time window and pooling together observations from 2001, 2004 and 2007. Robust standard error in parenthesis with *** p<0.01, ** p<0.05, * p<0.1.

Table B7: MAIN REGRESSION - SERVICE SECTOR

	AT	AU	BE	BR	DK	ES	FI	FR	GB	HU
log size	-0.177***	-0.154***	-0.187***	-0.119***	-0.177***	-0.108***	-0.128***	-0.163***	-0.0309**	-0.132***
	(0.0185)	(0.0227)	(0.0265)	(0.0123)	(0.0198)	(0.0188)	(0.0165)	(0.0245)	(0.0149)	(0.0209)
constant	-1.187***	-0.499***	-1.055***	-1.061***	-1.076***	-0.930***	-1.135***	-0.913***	-1.263***	-1.049***
	(0.0565)	(0.0634)	(0.0903)	(0.0456)	(0.0710)	(0.0732)	(0.0585)	(0.0722)	(0.0602)	(0.0692)
Obs.	90	55	90	102	86	60	85	60	60	90
Adj. R^2	0.547	0.600	0.380	0.551	0.611	0.396	0.384	0.513	0.048	0.364

	IT	JP	LU	NL	NO	NZ	PT	SE	TR	US
log size	-0.0360	-	-0.102***	-0.0691***	-0.109***	-0.204***	-0.236***	-0.112***	0.0141	-0.107***
	(0.0226)	-	(0.0290)	(0.0190)	(0.0228)	(0.0172)	(0.0446)	(0.0158)	(0.0260)	(0.0145)
constant	-1.494***	-	-1.619***	-1.088***	-1.129***	-1.013***	-0.815***	-1.053***	-1.117***	-0.901***
	(0.0901)	-	(0.0809)	(0.0759)	(0.0708)	(0.0639)	(0.138)	(0.0622)	(0.0918)	(0.0612)
Obs.	90	-	84	69	72	85	36	90	30	99
Adj. R^2	0.022	-	0.104	0.156	0.359	0.539	0.451	0.428	-0.022	0.370

Notes: Regression of the log volatility of growth $\sigma^j_{c,t}$ on log of firms size $S_{c,t}$. Services firms only over a 3 years time window and pooling together observations from 2001, 2004 and 2007. Robust standard error in parenthesis with *** p<0.01, ** p<0.05, * p<0.1.

Table B8: AGE DUMMIES - MANUFACTURING SECTOR

	AT	AU	BE	BR	DK	ES	FI	FR	GB	HU
log size	-0.257***	-0.215***	-0.206***	-0.148***	-0.177***	-0.212***	-0.217***	-0.270***	-0.0570***	-0.169***
	(0.0197)	(0.0129)	(0.0201)	(0.00704)	(0.0184)	(0.0162)	(0.0145)	(0.0176)	(0.0137)	(0.0162)
ageclass 1-2	0.123	-0.160**	-0.717***	-0.0965**	-0.202*	-0.00114	-0.107	0.112	-0.102	-0.0497
	(0.146)	(0.0651)	(0.132)	(0.0378)	(0.114)	(0.118)	(0.133)	(0.104)	(0.0709)	(0.103)
ageclass 3-5	0.0530	-0.130*	-0.895***	-0.202***	-0.257**	-0.0824	-0.337***	0.0866	-0.226***	-0.159
	(0.153)	(0.0679)	(0.125)	(0.0372)	(0.121)	(0.119)	(0.103)	(0.0984)	(0.0706)	(0.108)
ageclass 6-10	-0.0575	-0.185**	-0.928***	-0.289***	-0.391***	-0.192	-0.224*	-0.0443	-0.429***	-0.343***
	(0.143)	(0.0710)	(0.124)	(0.0394)	(0.120)	(0.117)	(0.117)	(0.0886)	(0.0630)	(0.0980)
ageclass 11+	-0.198	-0.224***	-1.085***	-0.396***	-0.380***	-0.385***	-0.286**	-0.179*	-	-0.451***
	(0.146)	(0.0621)	(0.124)	(0.0374)	(0.107)	(0.116)	(0.128)	(0.0895)	-	(0.0939)
ageclass missing	-	-	-	-0.451***	-	-	-	-	-0.240***	-
	-	-	-	(0.0368)	-	-	-	-	(0.0844)	-
constant	-1.030***	-0.193***	-0.386***	-0.580***	-0.861***	-0.676***	-0.783***	-0.882***	-1.197***	-0.791***
	(0.121)	(0.0519)	(0.0785)	(0.0262)	(0.108)	(0.103)	(0.0929)	(0.0877)	(0.0761)	(0.0969)
Obs.	89	49	89	102	84	59	85	60	60	90
Adj. R^2	0.692	0.856	0.792	0.907	0.600	0.811	0.662	0.848	0.500	0.653

	IT	JP	LU	NL	NO	NZ	PT	SE	TR	US
log size	-0.164***	-0.0302**	-0.176***	-0.141***	-0.172***	-0.161***	-0.238***	-0.179***	-0.0907***	-0.125***
	(0.0148)	(0.0141)	(0.0248)	(0.0212)	(0.0274)	(0.0209)	(0.0544)	(0.0207)	(0.0163)	(0.0140)
ageclass 1-2	-0.343***	-0.0971	-0.136	0.191	-0.0478	-0.487***	0.126	-0.356***	-0.0321	-0.0826
	(0.0909)	(0.0710)	(0.144)	(0.243)	(0.185)	(0.147)	(0.297)	(0.125)	(0.0960)	(0.0660)
ageclass 3-5	-0.410***	-0.108	-0.351***	0.111	-0.307**	-0.739***	-0.168	-0.334***	-0.195*	-0.112*
	(0.0972)	(0.0664)	(0.110)	(0.252)	(0.142)	(0.149)	(0.247)	(0.120)	(0.109)	(0.0633)
ageclass 6-10	-0.528***	-0.195***	-0.576***	0.159	-0.252*	-0.739***	-0.276	-0.401***	-0.237**	-0.185***
	(0.0944)	(0.0673)	(0.0866)	(0.241)	(0.141)	(0.147)	(0.247)	(0.136)	(0.0873)	(0.0600)
ageclass 11+	-0.787***	-0.342***	-0.773***	0.00783	-0.250	-0.850***	-0.425	-0.580***	-0.345***	-0.364***
	(0.0878)	(0.0689)	(0.0846)	(0.245)	(0.150)	(0.142)	(0.254)	(0.108)	(0.0881)	(0.0564)
ageclass missing	-	-	-1.138***	0.282	-0.351**	-	-0.0301	-	-	-0.0390
	-	-	(0.192)	(0.237)	(0.159)	-	(0.527)	-	-	(0.170)
constant	-0.822***	-1.721***	-1.095***	-1.332***	-0.916***	-0.586***	-0.798**	-0.709***	-0.652***	-0.725***
	(0.0714)	(0.0489)	(0.0538)	(0.207)	(0.135)	(0.0973)	(0.293)	(0.104)	(0.0828)	(0.0654)
Obs.	90	58	62	63	72	80	36	90	30	98
Adj. R^2	0.773	0.480	0.676	0.357	0.481	0.739	0.314	0.555	0.696	0.588

Notes: Regression of the log volatility of growth $\sigma^j_{c,t}$ on log of firms size $S_{c,t}$. Manufacturing firms only over a 3 years time window and pooling together observations from 2001, 2004 and 2007. The baseline age category is entering firms. Robust standard error in parenthesis with *** p<0.01, ** p<0.05, * p<0.1.

Table B9: AGE DUMMIES - SERVICE SECTOR

	AT	AU	BE	BR	DK	ES	FI	FR	GB	HU
log size	-0.174***	-0.150***	-0.176***	-0.116***	-0.173***	-0.105***	-0.123***	-0.160***	-0.0275***	-0.128***
	(0.0178)	(0.0212)	(0.0238)	(0.00835)	(0.0199)	(0.0144)	(0.0177)	(0.0254)	(0.0101)	(0.0147)
ageclass 1-2	0.0216	0.118	-0.441***	-0.102**	-0.0972	0.0837	0.0582	-0.186	-0.182**	-0.219**
	(0.114)	(0.112)	(0.147)	(0.0470)	(0.146)	(0.105)	(0.160)	(0.161)	(0.0716)	(0.0863)
ageclass 3-5	-0.0767	-0.00148	-0.567***	-0.180***	-0.162	-0.0280	-0.125	-0.186	-0.252***	-0.384***
	(0.103)	(0.118)	(0.145)	(0.0273)	(0.144)	(0.112)	(0.151)	(0.165)	(0.0572)	(0.0762)
ageclass 6-10	-0.0804	-0.131	-0.643***	-0.264***	-0.277**	-0.150	-0.258	-0.383**	-0.591***	-0.566***
	(0.105)	(0.106)	(0.154)	(0.0260)	(0.137)	(0.110)	(0.157)	(0.167)	(0.0552)	(0.0730)
ageclass 11+	-0.375***	-0.201*	-0.886***	-0.323***	-0.323**	-0.489***	-0.422***	-0.499***	-	-0.696***
	(0.0970)	(0.102)	(0.145)	(0.0324)	(0.138)	(0.106)	(0.151)	(0.161)	-	(0.0702)
ageclass missing	-	-	-	-0.471***	-	-	-	-	-0.363***	-
	-	-	-	(0.0385)	-	-	-	-	(0.0583)	-
constant	-1.095***	-0.467***	-0.586***	-0.853***	-0.911***	-0.823***	-0.996***	-0.674***	-0.998***	-0.692***
	(0.0765)	(0.102)	(0.0821)	(0.0340)	(0.117)	(0.0923)	(0.112)	(0.107)	(0.0527)	(0.0561)
Obs.	90	55	90	102	86	60	85	60	60	90
Adj. R^2	0.650	0.664	0.660	0.847	0.654	0.705	0.551	0.628	0.710	0.730

	IT	JP	LU	NL	NO	NZ	PT	SE	TR	US
log size	-0.0338	-	-0.0915***	-0.0675***	-0.109***	-0.179***	-0.233***	-0.109***	0.0155	-0.104***
	(0.0220)	-	(0.0239)	(0.0206)	(0.0235)	(0.0128)	(0.0490)	(0.0115)	(0.0263)	(0.0119)
ageclass 1-2	-0.257*	-	0.0827	0.00509	-0.0377	-0.461***	-0.111	-0.167**	0.0265	-0.154***
	(0.137)	-	(0.146)	(0.151)	(0.129)	(0.115)	(0.420)	(0.0745)	(0.163)	(0.0460)
ageclass 3-5	-0.405***	-	-0.0114	0.0884	0.0821	-0.567***	-0.0335	-0.289***	-0.0506	-0.215***
	(0.136)	-	(0.153)	(0.150)	(0.0991)	(0.118)	(0.430)	(0.0704)	(0.151)	(0.0491)
ageclass 6-10	-0.509***	-	-0.154	-0.0289	-0.139	-0.737***	-0.329	-0.415***	-0.147	-0.303***
	(0.134)	-	(0.150)	(0.157)	(0.0860)	(0.108)	(0.435)	(0.0694)	(0.144)	(0.0460)
ageclass 11+	-0.799***	-	-0.569***	-0.234	-0.272***	-0.849***	-0.281	-0.589***	-0.342**	-0.484***
	(0.132)	-	(0.144)	(0.141)	(0.0970)	(0.111)	(0.432)	(0.0683)	(0.159)	(0.0437)
ageclass missing	-	-	-0.805***	0.0412	-0.0751	-	-0.193	-	-	-0.113
	-	-	(0.220)	(0.135)	(0.0847)	-	(0.453)	-	-	(0.181)
constant	-1.108***	-	-1.406***	-1.071***	-1.056***	-0.549***	-0.670**	-0.772***	-1.019***	-0.691***
	(0.0974)	-	(0.125)	(0.129)	(0.0999)	(0.0910)	(0.313)	(0.0517)	(0.137)	(0.0519)
Obs.	90	-	84	69	72	85	36	90	30	99
Adj. R^2	0.442	-	0.498	0.196	0.432	0.819	0.402	0.766	0.189	0.602

Notes: Regression of the log volatility of growth $\sigma^j_{c,t}$ on log of firms size $S_{c,t}$. Services firms only over a 3 years time window and pooling together observations from 2001, 2004 and 2007. The baseline age category is entering firms. Robust standard error in parenthesis with *** p<0.01, ** p<0.05, * p<0.1.

Table B10: MAIN REGRESSION - AGE DUMMIES AND INTERACTION

	AT	AU	BE	BR	DK	ES	FI	FR	GB	HU
log size	-0.345***	-0.248***	-0.157*	-0.186***	-0.227***	-0.295***	-0.221***	-0.350***	-0.0999***	-0.299***
	(0.0829)	(0.0152)	(0.0859)	(0.0215)	(0.0561)	(0.0636)	(0.0372)	(0.0212)	(0.0208)	(0.0340)
ageclass 1-2 # log size	0.0805	-0.00728	-0.0878	0.0589**	0.0853	0.0859	-0.0677	0.0189	0.0472	0.161***
	(0.0848)	(0.0323)	(0.0891)	(0.0254)	(0.0703)	(0.0696)	(0.0472)	(0.0407)	(0.0285)	(0.0500)
ageclass 3-5 # log size	0.148*	0.0265	-0.0926	0.0549**	0.0446	0.0906	-0.0269	0.145***	-0.000560	0.196***
	(0.0879)	(0.0358)	(0.0904)	(0.0257)	(0.0666)	(0.0706)	(0.0434)	(0.0420)	(0.0380)	(0.0475)
ageclass 6-10 # log size	0.0965	0.0654**	-0.0566	0.0408	0.0243	0.119*	0.0486	0.109***	0.0818***	0.177***
	(0.0842)	(0.0295)	(0.0884)	(0.0267)	(0.0690)	(0.0669)	(0.0417)	(0.0384)	(0.0266)	(0.0436)
ageclass 11+ # log size	0.121	0.0503	-0.0115	0.0246	0.0791	0.121*	0.0699	0.131***	-	0.123***
	(0.0858)	(0.0309)	(0.0890)	(0.0245)	(0.0642)	(0.0654)	(0.0552)	(0.0350)	-	(0.0387)
ageclass missing # log size	-	-	-	0.0468*	-	-	-	-	0.0998**	-
	-	-	-	(0.0253)	-	-	-	-	(0.0466)	-
ageclass 1-2	-0.170	-0.119*	-0.395*	-0.322***	-0.481**	-0.296*	0.149	0.0513	-0.280**	-0.652***
	(0.250)	(0.0673)	(0.218)	(0.0732)	(0.200)	(0.154)	(0.175)	(0.135)	(0.108)	(0.172)
ageclass 3-5	-0.492**	-0.197***	-0.554**	-0.412***	-0.387*	-0.395**	-0.233*	-0.458***	-0.221*	-0.895***
	(0.247)	(0.0610)	(0.222)	(0.0761)	(0.223)	(0.160)	(0.119)	(0.158)	(0.116)	(0.170)
ageclass 6-10	-0.411*	-0.382***	-0.725***	-0.445***	-0.445*	-0.612***	-0.405***	-0.449***	-0.743***	-1.007***
	(0.242)	(0.0873)	(0.215)	(0.0778)	(0.240)	(0.151)	(0.116)	(0.138)	(0.110)	(0.165)
ageclass 11+	-0.647**	-0.375***	-1.058***	-0.489***	-0.641***	-0.812***	-0.552***	-0.671***	-	-0.907***
	(0.247)	(0.108)	(0.227)	(0.0727)	(0.185)	(0.153)	(0.204)	(0.132)	-	(0.156)
ageclass missing	-	-	-	-0.630***	-	-	-	-	-0.619***	-
	-	-	-	(0.0855)	-	-	-	-	(0.155)	-
constant	-0.709***	-0.108***	-0.562***	-0.435***	-0.712***	-0.395***	-0.768***	-0.587***	-1.035***	-0.308**
	(0.237)	(0.0282)	(0.206)	(0.0626)	(0.155)	(0.137)	(0.101)	(0.0644)	(0.0760)	(0.136)
Obs.	89	49	89	102	84	59	85	60	60	90
Adj. R^2	0.704	0.856	0.795	0.916	0.594	0.832	0.680	0.883	0.566	0.729

	IT	JP	LU	NL	NO	NZ	PT	SE	TR	US
log size	-0.213***	-0.00660	-0.131***	-0.222	-0.162*	-0.0148	-0.387***	-0.199***	-0.115**	-0.185***
	(0.0480)	(0.0500)	(0.0250)	(0.144)	(0.0901)	(0.0693)	(0.131)	(0.0426)	(0.0542)	(0.0337)
ageclass 1-2 # log size	0.0435	-0.0168	0.0270	0.126	0.0679	-0.113	0.137	0.0306	0.0601	0.0346
	(0.0511)	(0.0588)	(0.0557)	(0.147)	(0.133)	(0.0812)	(0.154)	(0.0793)	(0.0576)	(0.0495)
ageclass 3-5 # log size	0.0570	-0.000707	-0.0863	0.0422	-0.0674	-0.216***	0.180	-0.0506	0.0150	0.111**
	(0.0594)	(0.0522)	(0.0917)	(0.158)	(0.0921)	(0.0786)	(0.135)	(0.0609)	(0.0758)	(0.0443)
ageclass 6-10 # log size	0.0690	-0.0346	-0.0170	0.122	-0.0243	-0.158**	0.215	0.0232	0.0398	0.113***
	(0.0582)	(0.0515)	(0.0658)	(0.149)	(0.0937)	(0.0725)	(0.132)	(0.0482)	(0.0571)	(0.0387)
ageclass 11+ # log size	0.0832*	-0.0539	-0.0665*	0.0771	0.0478	-0.148*	0.203	0.108**	0.00938	0.0822**
	(0.0491)	(0.0510)	(0.0345)	(0.151)	(0.0973)	(0.0748)	(0.146)	(0.0483)	(0.0572)	(0.0364)
ageclass missing # log size	-	-	-0.0256	0.0730	-0.0872	-	0.160	-	-	-0.0370
	-	-	(0.292)	(0.147)	(0.104)	-	(0.265)	-	-	(0.0682)
ageclass 1-2	-0.504***	-0.0299	-0.251*	-0.149	-0.312	-0.242	-0.371	-0.470*	-0.253	-0.213
	(0.161)	(0.182)	(0.140)	(0.304)	(0.395)	(0.190)	(0.359)	(0.238)	(0.217)	(0.134)
ageclass 3-5	-0.622***	-0.0988	-0.180	0.0504	-0.0506	-0.117	-0.825**	-0.137	-0.250	-0.533***
	(0.184)	(0.161)	(0.195)	(0.374)	(0.252)	(0.178)	(0.325)	(0.215)	(0.269)	(0.138)
ageclass 6-10	-0.786***	-0.0605	-0.611***	-0.179	-0.160	-0.334**	-1.071***	-0.487**	-0.384*	-0.616***
	(0.181)	(0.161)	(0.195)	(0.333)	(0.270)	(0.150)	(0.324)	(0.194)	(0.216)	(0.125)
ageclass 11+	-1.100***	-0.129	-0.630***	-0.171	-0.438	-0.485***	-1.174***	-0.996***	-0.377*	-0.682***
	(0.153)	(0.161)	(0.108)	(0.367)	(0.272)	(0.169)	(0.407)	(0.148)	(0.218)	(0.117)
ageclass missing	-	-	-1.119*	0.118	-0.0204	-	-0.614	-	-	0.196
	-	-	(0.573)	(0.319)	(0.286)	-	(1.063)	-	-	(0.282)
constant	-0.642***	-1.813***	-1.153***	-1.138***	-0.951***	-0.944***	-0.255	-0.634***	-0.562**	-0.500***
	(0.149)	(0.153)	(0.0704)	(0.283)	(0.241)	(0.146)	(0.316)	(0.123)	(0.203)	(0.0939)
Obs	90	58	62	63	72	80	36	90	30	98
Adj. R^2	0.777	0.476	0.652	0.324	0.495	0.777	0.215	0.571	0.674	0.646

Notes: Regression of the log volatility of growth $\sigma^j_{c,t}$ on log of firms size $S_{c,t}$ including age dummies and age dummies interacted with the log volatility of growth $\sigma^j_{c,t}$. The baseline age category is entering firms. Manufacturing firms only over a 3 years time window and pooling together observations from 2001, 2004 and 2007. Robust standard error in parenthesis with *** p<0.01, ** p<0.05, * p<0.1.