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The Granular Origins of Macroeconomic Fluctuations in Europe

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Abstract

This paper investigates the microeconomic origins of aggregate economic fluctuations in Europe. It examines the relevance of idiosyncratic shocks at the top 100 large firms (the granular shocks) in explaining aggregate macroeconomic fluctuations. The paper also assesses the strength of spillovers from large firms onto SMEs. Using firm-level data covering over 14 million firms and eight european countries (Austria, Belgium, Finland, France, Germany, Italy, Portugal and Spain), we find that: (i) 40 percent of the variance in GDP in the sample can be explained by idiosyncratic shocks at large firms; (ii) positive granular shocks at large firms spill over to domestic SMEs' output, especially if SMEs' balance sheets are healthy and if SMEs belong to the services and manufacturing sectors.

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CONTENTS

I. INTRODUCTION

The euro area experienced a sharp decline in investment, productivity, and GDP growth after the 2008/9 economic crisis, followed by a slow recovery. This paper examines the origins of aggregate economic fluctuations in the euro area with a focus on the role of idiosyncratic shocks on firms. The paper tests the importance of idiosyncratic shocks at large firms on key macroeconomic aggregates and investigates the mechanisms at play in the euro area.

Large firms can affect aggregates through their size in some countries (e.g., Nokia revenues reached up to 20 percent of Finland's GDP, and 23 percent of corporate tax revenues).[2] Large firms can also affect aggregates indirectly via general equilibrium effects (spillovers onto other firms and sectors) and/or supply chain linkages.[3] The recent VW scandal provides an interesting example. According to the German Association of Supply Chain Management, Procurement and Logistics, quoted by Fortune Magazine, 500 companies that supply parts for VW's Golf model were forced to build up inventories because the German carmaker temporarily stopped buying.[4] Large businesses can be important drivers of SME growth via their involvement in big contracts, which SMEs may not be able to bid for.[5]

The traditional argument against the relevance of idiosyncratic shocks at large firms causing aggregate fluctuations relies on the law of large numbers: positive shocks at some firms are offset by negative shocks at others. Thus, in the presence of a very large numbers of firms, idiosyncratic shocks at firms are expected to die out in the aggregate. Therefore, given the millions of firms in the euro area, this would suggest that idiosyncratic shocks at large firms would have a negligible aggregate effect. Gabaix (2011) challenged this view and showed that when the firm size distribution is extremely fat tailed, the central limit theorem does not apply. He demonstrates that when the firm size distribution follows a power law distribution, idiosyncratic shocks do not cancel out and can therefore generate aggregate fluctuations. This

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[2] Accessed on August 17, 2016 (http://www.economist.com/node/21560867). Nokia's recent decline is also found to account for one-third of Finland's GDP decline and one-fifth of total employment decline between 2008–2014 (Suni and Vihriälä, 2016).

[3] A recent survey conducted in the U.S. by the Center for an Urban Future shows that 7 out of 10 small businesses increased revenues and size within two years as the result of them becoming part of a corporate supplier base.

[4] Accessed on August 17, 2016 (http://fortune.com/2016/08/23/vw-and-suppliers-settle-their-dispute-after-marathon-talks/).

[5] Major corporations spend billions of dollars annually seeking products and services from other companies, such as landscaping, cleaning services, logistics, software development, food services, and office supplies. When small companies interact with large corporations, these SMEs make changes that improve their organizational structures, management practices, and operations. These changes lead small companies to upgrade their technologies, increase their efficiency, and most importantly, become financially stable. As a result, revenue becomes greater, making it possible for these businesses to add new jobs. Having a large corporation as a customer also opens doors to easier credit and other business opportunities. The biggest upside is the spillover of new knowledge, innovation, and business models. When a few small businesses improve their systems or business models, other small businesses learn from that and raise their game to stay competitive, boosting the quality of the entire SME sector (see Gallup: http://www.gallup.com/businessjournal/160109/large-corporations-spur-small-business-growth.aspx).

is the concept of granularity. Granularity is the empirical economic regularity that the distribution of firm size is right skewed and can be described by a Zipf or power law probability density (Axtell, 2001 and Gatti et al., 2005).[6]

Our paper is closely related to the recent literature which emphasizes the role of individual firms in aggregate fluctuations. Gabaix (2011) showed that microeconomic shocks at the top 100 firms in the U.S. account for one-third of aggregate U.S. GDP fluctuations. He concluded that tracking the performance of top firms is crucial to understand the path of the U.S. economy. Di Giovanni et al. (2014) used French firms' data and found that the majority of the contribution of firm-specific shocks to aggregate fluctuations is accounted for by linkages between firms. In a similar vein, di Giovanni and Levchenko (2012) showed that idiosyncratic shocks at large firms have an impact on aggregate volatility. In addition, they showed that trade increases macroeconomic volatility by making large firms more important. Blank et al. (2009) applied the concept of granularity to the German banking sector, and investigated the implications of shocks at large banks on the stability of smaller banks. They found that positive shocks at large banks reduced the probability of distress at smaller banks. Finally, Freund and Pierola (2015) showed that the top five firms make up 30 percent of total non-oil exports in 32 countries, and that in many cases the total revealed comparative advantage can be created by a single firm.

This paper is also related to the literature on the importance of sectoral shocks in generating aggregate fluctuations pioneered by Long and Plosser (1983). For instance, Carvalho and Gabaix (2013) show that the fundamental volatility, that is the volatility that would arise from an economy made up entirely of idiosyncratic sectoral or firm-level shocks, accounts for the swings in macroeconomic volatility in most advanced economies. The central idea of this literature is that idiosyncratic shocks on a single sector can have important aggregate effects if the sector is strongly interconnected with others through input-output linkages (see for instance Horvath, 1998, 2000; Dupor, 1999; Shea, 2002; Acemoglu et al., 2012).

Our paper joins this literature and uses a firm-level database covering eight large euro area countries (Austria, Belgium, Finland, France, Germany, Italy, Portugal, and Spain) for the period 2000 to 2013. We start by investigating the "granular hypothesis," that is how strongly the granular residual (i.e., idiosyncratic shocks to large firms) explains aggregate macroeconomic fluctuations (GDP, investment, exports, unemployment). Then, we examine the strength of spillovers from large firms onto SMEs. The analysis is further deepened by testing for the existence of heterogeneous effects, to discover if these spillovers depend on SMEs' characteristics. We expect SMEs with healthy balance sheets to be more equipped to respond to positive idiosyncratic shocks coming from large firms. SMEs that are not facing debt problems can easily expand and meet the new orders from large corporations. We also examine to what extent SMEs belonging to specific sectors are more sensitive to granular shocks from large firms than others. Certain sectors, such as the services sector, are more likely to provide products or services that are not produced by large corporations (e.g., cleaning or accounting, and other services), helping to strengthen the magnitude of spillovers from large firms to smaller ones.

[6] Figure 1B in Appendix B shows that the distribution of firm size in our sample is extremely fat tailed.

Our main findings in this paper are threefold: (i) the top 100 large firms' sales account for a significant share of the euro area's GDP (29 percent on average); (ii) 40 percent of the variance in GDP in the sample can be explained by idiosyncratic shocks at large firms (which is greater than their share of GDP); (iii) positive granular shocks at large firms spill over to domestic SMEs' output, especially if SMEs' balance sheets are healthy and belong to the services or manufacturing sectors.

Our contribution is threefold. First, we show the potential of the granular residual in explaining GDP growth and other components of activity such as investment, exports, and unemployment.[7] Second, we document the existence of substantial spillovers from idiosyncratic shocks at large firms to SMEs' output performance. Third, we find a strong interconnection between idiosyncratic shocks at large firms and output fluctuations of SMEs operating in the nonfinancial services sector.

The remainder of the paper is organized as follows: Section II tests whether idiosyncratic shocks to large firms have the potential to generate aggregate shocks that affect GDP and other significant macroeconomic aggregates in the euro area (the 'granular hypothesis'). Section III investigates the spillovers from idiosyncratic shocks at large firms onto SMEs' performance. Section IV concludes with policy discussions.

II. Investigating the Granular Hypothesis in the Euro Area

A. Econometric Specification

The empirical approach closely follows Gabaix (2011). The only difference comes from the fact that we use panel data while Gabaix (2011) used time series for the U.S. Let Y_{ct} be a measure of aggregate fluctuations (real GDP growth, real export growth, real investment growth, or the annual change in the unemployment rate) of country *c* in year *t*. Consider the following equation:

$$Y_{ct} = \beta_1 \Gamma_{ct} + \beta_2 X_{ct} + \beta_3 X'_t + D_c + trend_c + \vartheta_{ct} \quad (1)$$

Where Γ_{ct} represents the granular residual (from the top 100 large firms) of country *c* in year *t*. D_c is a country-fixed effect, $trend_c$ is a country-specific linear trend and ϑ_{ct} is the error term.

Country-fixed effects help to remove all time-invariant or slow-moving unobserved characteristics of countries, such as structural differences in productivity or institutions, the importance of SMEs or large firms in the economy, or the structure of the financial system. The country-specific trends are included to control for time-varying omitted factors such as policy changes in a country, and for autocorrelation. They also allow to control for country-

[7] As the euro area stands out compared to other advanced economies (e.g., U.S.) in terms of its SME-dominated economic structure (SMEs account for about 60 percent of euro area value-added and are mostly significant in sectors such as construction and service sectors), we make sure that SMEs are not included in our computation of the granular residual of the top 100 firms ranked by sales. This helps better separate large firms from SMEs and investigate the spillovers from the former to the latter.

specific disturbances that are common to all firms in a country. This allows us to "partial-out" the effect of the granular residual from the correlation with these common shocks, and therefore to limit the potential problem of omitted variable bias. Finally, to control for common shocks for all countries, we include global oil price, and the euro area interest rate (X'_t).[8] Finally, X_{ct} is a country-specific policy control (fiscal policy). We estimate equation (1) by the within estimator with clustered standard errors at the country level.

B. Data Description

Constructing the Granular Residual

This section defines and details how the so-called granular residual following Gabaix (2011) is calculated.

We start with a measure of firm-level productivity growth. We use alternatively two measures of productivity: (i) the logarithm of firm-level real labor productivity (based on sales), or (ii) the measure of TFP, which comes from the firm-level database used by Gal and Hijzen (2016).[9] Productivity growth is computed as the log difference. Mathematically, this is equivalent to:

$$g_{isct} = \ln(\text{productivity})_{isct} - \ln(\text{productivity})_{isct-1},$$

where g_{isct} is the productivity growth of firm *i*, belonging to sector *s*, in country *c*, at time *t*.

Now, consider that the firm's productivity growth is a function of present and past characteristics (X_{isct}) as follows: $g_{isct} = \theta X_{isct} + \varepsilon_{isct}$ where ε_{it} is the idiosyncratic component productivity growth of the top 100 firms in each country. The "granular residual" for a given country *c* in a given year *t* is the sum of the idiosyncratic firm-level productivity shocks, weighted by firm size:

$$\Gamma^*_{ct} = \sum_{i=1}^{N} \frac{S_{isc,t-1}}{GDP_{ct-1}} \widehat{\varepsilon_{isct}},$$

where the weight is the lagged ratio of the firms' sales divided by the country's GDP (the so-called Domar weights), and $\widehat{\varepsilon_{isct}}$ are residuals ($\widehat{\varepsilon_{isct}} = g_{isct} - \hat{\theta} X_{isct}$). Please note that the weights *S*/GDP do not add up to one. These are the so-called "Domar weights" that research in productivity studies has identified as the proper weights to study the impact of microeconomic shocks (see Carvalho and Gabaix, 2013).

Following an approach similar to Gabaix (2011), we first use a simple specification to obtain the granular residual for each country.

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[8] Because of the small size of our sample and time period, we did not include year fixed effects in order to control for common shocks (as we would lose degrees of freedom).

[9] Please refer to Gal and Hijzen (2016) for complete details on how the firm-level data and variables (deflators, capital stock, productivity, total factor productivity, etc.) are constructed from the original Orbis, BvD database.

- Our first measure of granular residual uses firm-level real productivity growth centered on the country-specific average productivity growth: $\Gamma_{ct} = \sum_{i=1}^{N} \frac{S_{isc,t-1}}{GDP_{ct-1}} (g_{isct} - \bar{g}_{cs})$ with $\bar{g}_{cs}$ the average productivity growth rate of country *c* and sector *s*. Centering around the sector/country average productivity growth allows removal of the effects of the structural sectoral productivity growth differences between countries. This measure of granular residual is calculated based on the deviation of the firm-specific productivity growth from the sector/country long-term productivity growth.

- Second, we use $\Gamma_{ct} = \sum_{i=1}^{N} \frac{S_{isc,t-1}}{GDP_{ct-1}} (g_{isct} - \bar{g}_{s})$ with $\bar{g}_{s}$ the average productivity growth in the sector *s* in the sample. This granular residual is based on the deviation of the firm-specific productivity growth rate relative to the long-term average productivity growth rate of the sector worldwide. This allows us to control for structural differences in productivity growth across sectors that may arise because of specific technological shocks that are more likely to have been observed in some sectors than others. In other words, certain sectors may have grown faster than others because of supply-side innovations.

- *Third, we use* $\Gamma_{ct} = \sum_{i=1}^{N} \frac{S_{isc,t-1}}{GDP_{ct-1}} (g_{isct} - \bar{g}_{st})$ with $\bar{g}_{st}$ the time-varying average productivity growth in sector *s* in year *t* worldwide. This granular residual is based on the deviation of the firm-specific productivity growth rate relative to the average productivity growth in the sector in a given year. This measure is an improvement over the previous one by allowing for a time-varying demeaning process. More specifically, the adjustment helps to control for time-varying worldwide technological shocks that occur in each sector at any point in time.

- Fourth, we use $\Gamma_{ct} = \sum_{i=1}^{N} \frac{S_{isc,t-1}}{GDP_{ct-1}} (g_{isct} - \bar{g}_{ct})$ with $\bar{g}_{ct}$ the average firm-level productivity growth in country *c* in year *t*. This granular residual is based on the deviation of the firm-specific productivity growth relative to the average productivity growth of all firms in the same country in a given year. This adjustment allows the purging of the effects of common shocks to all firms and sector in each country every year. These include among others, aggregate demand policy shocks (fiscal and/or monetary policies, or major structural reforms).

- *Finally, we also use* $\Gamma_{ct} = \sum_{i=1}^{N} \frac{S_{isc,t-1}}{GDP_{ct-1}} (g_{isct} - \bar{g}_{cst})$ with $\bar{g}_{cst}$ the average firm productivity growth in country *c*, sector *s*, in year *t*. This granular residual is based on the deviation of the firm-specific productivity growth relative to the average productivity growth of all firms in the same sector, in the same country, in a given year *t*. The granular residual calculated this way removes significant variability and possible confounding factors. It implies the examination of idiosyncratic shocks to large firms that are not driven by shocks which are specific to sector, country and year. For example, a tax reform or a product market reform in a given country that is targeting firms operating in a specific sector would be controlled for.

Firm-Level Data

Computing the granular residual requires high-quality firm-level data. We use panel data for eight euro area countries (Austria, Belgium, Finland, France, Germany, Italy, Portugal, and Spain) for the period 2000–2013. The firm-level data come from the Orbis database compiled by Bureau van Dijk Electronic Publishing.[10] The Orbis database includes information collected from census and regulatory filings in a number of countries for both listed and unlisted firms; it covers all sectors of the economy, and all sizes of firms. It includes several millions of firms, and has observations at an annual frequency. We use a version of the database (see IMF, 2016a), with data converted into local currency and the nominal variable expressed in real terms using sector-specific deflators.[11] This is a crucial requirement because we are interested in firm-specific productivity shocks.

Following Gabaix (2011) we only use nonfinancial private firms which are not engaged in mining, nor other resource extraction activities, nor in energy markets.[12] The full list of sectors included is: agriculture, manufacturing, water utilities, construction, wholesale and retail, transportation and storage, information and communication, real estate activities, and professional and administrative services. We follow the NACE Revision 2 classification. Four sectors (manufacturing, construction, wholesales and retails, professional and administrative services) dominate the sample as they represent 84 percent of the total number of observations.

Firms Sales in Percentage of GDP

Based on a sample of over 14 million firms, we rank firms by lagged real sales (real operating revenue) in each year and for each country. We use the period 1998–2013. For all the countries in our sample, 1998 is the first year with at least 100 firms. As our ranking is based on the lagged sales we use only observations without missing lagged sales, therefore we use data for the period 1999–2013.

Finally, we group firms as either SMEs or large firms following the definition of the National Institute of Statistics and Economic Studies (INSEE) of France, and following Eurostat definitions. We define SMEs as firms with less than 250 employees, and with an annual turnover of maximum $50 million. Any company in our sample that does not fit this

[10] Orbis includes firm-level data from around 100 countries (both developed and emerging market economies) worldwide.

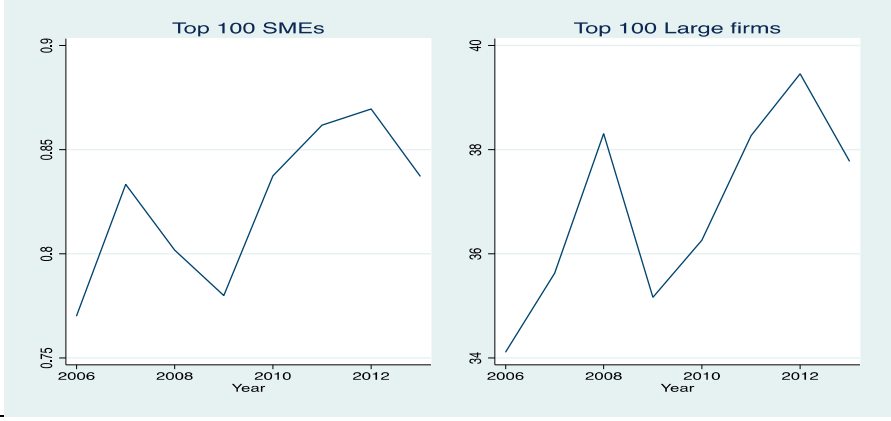
[11] These deflators are country/industry purchasing power parity indices taken from the OECD's Structural Analysis (STAN) database. The database consists of firms with non-missing values, positive revenue, at least three employees, and at least three consecutive observations (see IMF, 2016a).

[12] In our investigations of productivity shocks at firm level, it is theoretically more appropriate to exclude these sectors because extractive firms may experience swings in the global price, and because of the fact that sales are a poor proxy for the output of finance companies (Gabaix, 2011).

description is classified as a large firm.[13] SMEs dominate the sample with 99.2 percent of the observations.

Figure 1 below shows the movements in the sales of the top 100 large firms and those of the top 100 SMEs, expressed in percent of GDP across the eight euro area countries. The figure presents an upward trend, which suggests that the contribution of these firms to GDP may have increased over the period. Figure 1 shows that the sales of the top 100 large firms and top 100 SMEs as shares of GDP have moved in a similar way. For instance, we note a drop in the ratio of sales over GDP during the global financial crisis. Figure 1 shows that the top 100 large firms represent a sizable share of GDP in the euro area over the period 2006–2013. After 2006, the top 100 large firms accounted for more than 30 percent of GDP. On average over the period 1999–2013, the top 100 large firms accounted for 28.5 percent of GDP, while the top 100 SMEs accounted for 0.8 percent as shown in Table 1. The share of the top 100 large firms in our sample is close to the share of the top 100 firms in the U.S. (Gabaix, 2011).[14]

Figure 1. Top 100 Firms' Sales as Percentage of GDP in the Sample



Notes: This figure represents the average share of top 100 firms' sales in GDP in each year across the eight euro area countries. First, we compute for each country-year, the share of the top 100 firms' sales in GDP. Second, for each year, we take the average of these shares across countries.
Source: Authors' calculations based on Orbis data.

There is a significant variation in the share of sales in GDP across countries. For instance, the top 100 large firms in Belgium have the highest share of GDP over the period (40 percent), while in Portugal large firms' sales is 17.4 percent.

[13] We drop firms with less than 250 employees and with a turnover more than $50 million, and firms with less than $50 million and more than 250 employees.

[14] Gabaix (2011) finds that the sales of the top 100 firms in the U.S. represent 30 percent of GDP.

Table 1. Average Sales as Percentage of GDP		
Country	Top 100 Large Firms	Top 100 SMEs
Austria	25.721	0.905
Belgium	40.735	1.065
Finland	37.720	1.826
France	22.877	0.181
Germany	37.019	0.137
Italy	20.794	0.209
Portugal	17.361	1.307
Spain	25.789	0.357
Overall	28.502	0.748
Source: Authors' calculations based on Orbis data.		

Macroeconomic Data

Our macroeconomic data consist mainly of proxies for aggregate fluctuations. Real GDP is from the World Development Indicators (WDI). Real investment and the real export data come from the World Economic Outlook (WEO). We take the first difference of the logarithm of these variables to obtain their growth rates. Finally, we use the annual change in the unemployment rate from the labor force statistics of the OECD. As controls for common shocks, we use the real global oil price, and the euro area interest rate (as a control for monetary policy) taken from International Financial Statistics (IFS). We also control for country-specific policies such as fiscal policy (real public expenditure growth from WDI, and the change in the cyclically adjusted primary fiscal balance by country from the WEO) and trade (ratios of exports and imports of goods and services to GDP from WDI).

C. Results: Granular Residual and Aggregate Fluctuations

In Table A1 in Appendix A, we present the results of the test for the empirical relevance of the granular residual (based on firm labor productivity) in explaining aggregate fluctuations in the euro area. Columns (1) – (3) show estimates using the non-demeaned version of granular residuals, and columns (4) – (9) show estimates using granular residuals based on the various demeaning schemes discussed above.

We find that productivity shocks at the top 100 large firms (i.e., the granular residual) are positively correlated with real GDP growth. Column (1) shows that the granular residual explains about 40 percent of the variation in real GDP growth in the euro area. This is more than the 29 percent of GDP of the average sales-to-GDP ratio of the top 100 large firms in the eight countries. In other words, the top 100 large firms are responsible for more variation in real GDP growth than their average share of GDP. These results are robust to various demeaning schemes aimed at purging the granular residual from confounding factors. Overall, our findings are similar to Gabaix (2011), who focused on the U.S., and who found an explanatory power of about 30 percent.

We carried out various additional robustness checks which go further than the various demeaning procedures discussed above. First, instead of labor productivity growth, we use a granular residual based on firm level TFP growth (see Table A2 in Appendix A). This is to

ensure that the granular residual is derived from "supply-side shocks," such as TFP, instead of shocks based on labor productivity which may still be influenced by demand-side shocks which affect capital intensity. We also show that our results are robust to controlling directly for aggregate demand shocks by including the output gap in our empirical analysis (see Table A1.1 and Table A2.1) using a granular residual based on labor productivity growth and TFP growth respectively (Appendix A).

Second, we tested for, and confirmed that the granular residual does affect macro aggregates other than GDP, such as real investment growth, real export growth, and the change in unemployment (see Tables A3 to A5 in Appendix A).

Third, we added additional controls such as country-specific SME value-added growth (from the BACH-Banque de France database, in order to isolate the direct effect of the granular residual on real GDP growth), trade openness (ratio of exports and imports to GDP), the fiscal policy stance (change in cyclically adjusted primary balance) in Tables A6 and A7 (Appendix A).[15]

Finally, we resort to our more sophisticated measures of granular residuals which use time-varying demeaning strategies to isolate more precisely idiosyncratic shocks (see Table A8 in Appendix A). As shown in the aforementioned tables, the results remain qualitatively similar: idiosyncratic shocks to large firms are drivers of aggregate fluctuations in the euro area.

III. Investigating the Spillovers from the Top 100 Large Firms onto SMEs

A. Econometric Specification

We test the hypothesis that idiosyncratic shocks at the top 100 large firms can drive fluctuations in SME output. This may represent one channel through which shocks at large firms may drive aggregate fluctuations in the euro area, in addition to their direct effect on the macroeconomy. To ensure that we isolate better this indirect effect in the data, we exploit sector-level data following Rajan and Zingales (1998) and Aghion et al. (2014). We regress sectoral-median SME value-added growth on the lagged granular residual and additional control variables.[16] Let VA_{sct} be the median growth rate of SME value added of sector *s* in country *c* in year *t*:

$$VA_{sct} = \mu_1 \Gamma_{ct-1} + \mu_2 \Gamma_{ct-1} * X_{sct-1} + \mu_3 X_{sct-1} + D_s + D_c + D_t + trend_c + \vartheta'_{sct} \quad (2)$$

Where Γ_{ct} represents the granular residual from the top 100 large firms in country *c* and in year *t*, X_{sct-1} is a lagged time-varying sector characteristic for each country, such as a SME leverage ratio (debt-to-assets or debt-to-EBITDA), D_s is a sector-fixed effect. The latter allows us to account for time-invariant differences across sectors such as sector-specific technologies. Country-specific intercepts D_c are also added to control for disturbances that are common to all sectors within the same country. D_t is a time trend.

[15] The BACH database contains annual balance sheet, profit and loss data for European companies.

[16] SMEs sectoral-median values of variables of interest are derived from the Orbis dataset.

Equation (2) allows us to test the strength of outward spillovers from large firms onto SME value-added growth. The model is specified to also account for possible nonlinearities in the spillovers which may depend on SMEs' specific characteristics.

B. Results: Granular Residual and Spillovers to SMEs

Column 1 of Table A9 in Appendix A shows the effect of the granular residual of the top 100 large firms on SMEs' sectoral value-added growth. It shows a positive and statistically significant effect. This implies that SMEs tend to benefit from positive idiosyncratic shocks at large firms. This result is robust to alternative specifications. Strong structural links between large firms and SMEs in Europe suggest that expansion of large firms may translate into more business opportunities for SMEs.

Non Linearities: The Role of Balance Sheets

Next we examine whether SMEs operating in certain sectors or SMEs with a strong balance sheet would benefit disproportionally from positive spillovers from idiosyncratic shocks at large firms. We expect SMEs with a strong balance sheet to be likely to take advantage of business opportunities from large firms. In contrast, a high degree of debt may constrain SMEs' abilities to obtain external financing for new investments and or incentivize shareholders to decide on new investments (Myers,1977; Lang et al., 1996 Aivazian et al., 2005; Kalemli-Özcan et al., 2015). We therefore investigate the effect of granular shocks on SME performance, conditional on the level of SME debt ratio, by sector.

Table A9 and columns 3/4, 5/6, and 8/9 show a negative and statistically significant effect of the interaction between the granular residual of the top 100 large firms and the debt ratios of SMEs by sector. These results imply that SMEs with a low debt ratio tend to react more to positive granular shocks, than those with a high debt ratio. The results are robust to the use of alternative measures of granular residuals, such as those derived from time-varying demeaning strategies presented in Table A10.

Non Linearities: Asymmetric Effects

An interesting question is whether the magnitude of spillovers from large firms onto SMEs varies depending on the type of granular shock (positive versus negative granular shocks). In the results presented in column 1 of Table A11, we find that both positive and negative shocks seem to be significant.

After conditioning the effects of positive and negative granular shocks on SME balance sheet health (debt ratio) in columns 2 and 5 of Table A10, we find evidence of an asymmetric effect. The results show that higher SME debt ratios tend to amplify the effects of the negative granular shocks at large firms on SME performance.

Non Linearities: Sectoral Characteristics

Finally, we investigate whether there is any heterogeneity in the sensitivity of SME growth by sector to the granular residuals by focusing on sectoral heterogeneous responses. The

results in Table A12 show that the SMEs operating in the services and the manufacturing sectors are more sensitive to granular shocks at the large firms than SMEs in other sectors.

These results are economically plausible. In our sample, the large firms are mostly in the manufacturing sector (Figure 2A in AppendixA). SMEs in the manufacturing sector could be suppliers to large firms in the same sector. Also, SMEs in the professional and administrative services sectors have significant business relationships with large firms (e.g., cleaning or accounting, and other services), and strong links with large firms.[17] The performance of SMEs operating in these two sectors is likely to be significantly correlated with the performance of the large firms.

IV. CONCLUSION

This paper investigates the microeconomic origins of aggregate economic fluctuations in Europe. It examines the relevance of idiosyncratic shocks at the top 100 large firms in explaining aggregate macroeconomic fluctuations (GDP, investment, exports, unemployment) in the euro area. Furthermore, it assesses the strength of spillovers from large firms onto SME performance.

Our main findings are threefold: (i) about 40 percent of GDP fluctuations in the euro area are explained by idiosyncratic shocks at large firms (granular shocks); (ii) positive granular shocks spillover onto SMEs' output performance; (iii) these spillovers are bigger in the absence of SME debt problems, and for those SMEs operating in the services and manufacturing sectors.

Our findings suggest that in countries with elevated SMEs leverage ratios, SMEs benefit less from positive productivity shocks at large firms. We also find that structural links between SMEs and large firms (e.g., supply-chain relations between large firms and SMEs in the manufacturing or services sectors) are one channel through which granular shocks at large firms propagate to the entire economy.

In terms of policy implications, the complex structural interactions between firms and the relevance of idiosyncratic granular shocks, increase the need to give more consideration to sectoral policies as important supplements to traditional demand-side policies.

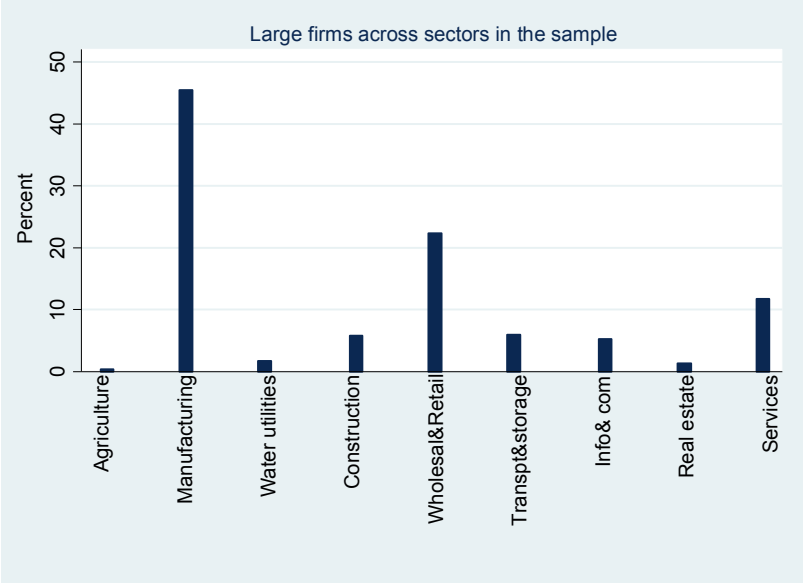
[17] Firms in the services sector are those in sections M and N of the statistical classification of economic activities in the European Community (NACE Rev. 2). For instance, SMEs operating in cleaning activities, private security activities, advertising, and market research are likely to be subcontractors to large firms.

Appendix A. Sales as Share of GDP

Figure 1A. Top 100 Large Firms' Sales in Percent of GDP

Source: Authors' calculations based on Orbis data over the period 1999–2013

Figure 2A. Sectoral Composition of Large Firms in the Sample



Note: Agriculture, manufacturing, water utilities, construction, wholesale and retails, transportation and storage, information and communication, real estate activities and professional and administrative services

Source: Authors' calculations based on Orbis data over the period 1999–2013

Table A1. The Granularity of the Euro Area (Labor Productivity Growth)									
Dependent variable:	Not demeaned			Demeaned (sector)			Demeaned (country sector)		
Real GDP growth	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Granular residual	1.028***	0.891***	0.863***	1.057***	0.906***	0.861***	1.002***	0.842***	0.706***
	(5.94)	(5.39)	(5.15)	(6.10)	(5.55)	(4.87)	(6.50)	(6.03)	(7.43)
Real oil price		-0.032***	-0.005		-0.027***	0.004		-0.026***	0.006
		(-4.85)	(-0.85)		(-4.21)	(0.85)		(-3.87)	(0.81)
Euro area interest rate		1.004***	0.725***		1.024***	0.708***		1.053***	0.774***
		(7.27)	(7.86)		(7.46)	(7.96)		(8.41)	(8.33)
Real public expenditures (growth)		-0.043	0.133		-0.057	0.136		-0.092	0.186**
		(-0.35)	(1.49)		(-0.45)	(1.51)		(-0.66)	(2.17)
Observations	112	112	112	112	112	112	112	112	112
Adjusted R-squared	0.340	0.511	0.562	0.356	0.526	0.569	0.322	0.492	0.526
R-squared	0.434	0.594	0.609	0.448	0.607	0.615	0.419	0.578	0.577
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-specific trends	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No

Notes: Dependent variable is real GDP growth. The granular residual is based on firm-level real labor productivity growth.
Standard errors are clustered at country level. Robust t-statistic in parentheses. * p < 0:10, ** p < 0:05, *** p < 0:01.

Table A1_1. The Granularity of the Euro Area (Labor Productivity Growth)—Controlling for Output Gap									
Dependent variable:	Not demeaned			Demeaned (sector)			Demeaned (country sector)		
Real GDP growth	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Granular residual	0.754***	0.758***	0.729***	0.791***	0.779***	0.736***	0.739***	0.727***	0.593***
	(4.84)	(5.05)	(4.97)	(4.99)	(5.24)	(4.81)	(5.31)	(5.74)	(7.63)
Output gap	0.459***	0.465***	0.517***	0.462***	0.472***	0.525***	0.474***	0.514***	0.551***
	(8.93)	(6.82)	(7.47)	(11.04)	(7.40)	(7.98)	(15.05)	(6.14)	(8.79)
Real oil price		-0.040***	-0.020***		-0.036***	-0.013**		-0.036***	-0.013***
		(-6.18)	(-2.90)		(-6.30)	(-2.25)		(-6.76)	(-3.03)
Euro area interest rate		0.417***	0.133		0.422***	0.104		0.388***	0.133
		(2.97)	(1.15)		(3.09)	(0.90)		(2.85)	(1.10)
Real public expenditures (growth)		-0.298**	-0.171*		-0.313***	-0.173**		-0.365***	-0.147
		(-2.57)	(-1.91)		(-2.75)	(-2.10)		(-2.97)	(-1.33)
Observations	112	112	112	112	112	112	112	112	112
Adjusted R-squared	0.534	0.584	0.640	0.555	0.602	0.650	0.533	0.585	0.616
R-squared	0.605	0.658	0.682	0.623	0.673	0.690	0.604	0.659	0.660
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-specific trends	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No

Notes: Dependent variable is real GDP growth. The granular residual is based on firm-level real labor productivity growth.
Standard errors are clustered at country level. Robust t-statistic in parentheses. * p < 0:10, ** p < 0:05, *** p < 0:01.

Table A2. The Granularity of the Euro Area (TFP Growth)

Dependent variable:	Not demeaned			Demeaned (sector)			Demeaned (country sector)		
Real GDP growth	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Granular residual	0.829***	0.697***	0.697***	0.773***	0.767***	0.685***	0.800***	0.793***	0.737***
	(7.97)	(6.02)	(6.02)	(8.18)	(8.21)	(5.87)	(7.58)	(6.83)	(5.08)
Real oil price		0.010	0.010		-0.019	0.009		-0.020*	0.009
		(1.42)	(1.42)		(-1.56)	(1.32)		(-1.73)	(1.31)
Euro area interest rate		1.110***	1.110***		1.430***	1.118***		1.432***	1.112***
		(7.32)	(7.32)		(8.64)	(7.32)		(8.39)	(7.78)
Real public expenditures (growth)		0.077	0.077		-0.150	0.076		-0.157	0.084
		(0.83)	(0.83)		(-1.28)	(0.83)		(-1.30)	(0.96)
Observations	112	112	112	112	112	112	112	112	112
Adjusted R-squared	0.081	0.436	0.436	0.017	0.359	0.431	0.026	0.367	0.449
R-squared	0.155	0.496	0.496	0.157	0.467	0.492	0.165	0.474	0.508
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-specific trends	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No

Notes: Dependent variable is real GDP growth. The granular residual is based on firm-level TFP growth.

Standard errors are clustered at country level. Robust t-statistic in parentheses. * p < 0:10, ** p < 0:05, *** p < 0:01.

Table A2_1. The Granularity of the Euro Area (TFP Growth)—Controlling for Output Gap									
Dependent variable:	Not demeaned			Demeaned (sector)			Demeaned (country sector)		
Real GDP growth	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Granular residual	0.657***	0.658***	0.658***	0.653***	0.714***	0.646***	0.668***	0.733***	0.668***
	(5.83)	(6.46)	(6.46)	(5.50)	(7.30)	(6.24)	(5.20)	(6.29)	(5.78)
Output gap	0.670***	0.680***	0.680***	0.618***	0.656***	0.681***	0.614***	0.649***	0.657***
	(10.49)	(7.57)	(7.57)	(12.45)	(7.11)	(7.31)	(12.44)	(6.95)	(7.92)
Real oil price		-0.013*	-0.013*		-0.034***	-0.014*		-0.034***	-0.013**
		(-1.74)	(-1.74)		(-3.29)	(-1.82)		(-3.39)	(-2.07)
Euro area interest rate		0.246***	0.246***		0.519***	0.254***		0.529***	0.280***
		(2.67)	(2.67)		(3.85)	(2.75)		(4.12)	(3.19)
Real public expenditures (growth)		-0.319***	-0.319***		-0.498***	-0.320***		-0.500***	-0.297**
		(-2.66)	(-2.66)		(-3.62)	(-2.63)		(-3.50)	(-2.51)
Observations	112	112	112	112	112	112	112	112	112
Adjusted R-squared	0.528	0.582	0.582	0.432	0.520	0.578	0.434	0.524	0.584
R-squared	0.570	0.631	0.631	0.518	0.606	0.627	0.520	0.609	0.633
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-specific trends	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No

Notes: Dependent variable is real GDP growth. The granular residual is based on firm-level TFP growth.

Standard errors are clustered at country level. Robust t-statistic in parentheses. * p < 0:10, ** p < 0:05, *** p < 0:01.

Table A3. The Granularity of the Euro Area (Real Investment Growth)

Dependent variable:	Not demeaned			Demeaned (sector)			Demeaned (country sector)		
Real investment growth	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Granular residual	3.518***	3.684***	3.627***	3.474***	3.516***	3.404***	3.191***	3.166***	2.562***
	(5.17)	(4.20)	(4.32)	(4.85)	(4.08)	(4.04)	(4.67)	(4.02)	(4.38)
Real oil price		-0.046	-0.052***		-0.023	-0.013		-0.016	-0.007
		(-1.32)	(-2.84)		(-0.66)	(-0.83)		(-0.48)	(-0.30)
Euro area interest rate		-0.259	-0.190		-0.080	-0.152		0.074	0.231
		(-0.32)	(-0.29)		(-0.11)	(-0.23)		(0.11)	(0.38)
Real public expenditures (growth)		0.725	0.893*		0.667	0.901*		0.535	1.075**
		(0.98)	(1.78)		(0.91)	(1.81)		(0.71)	(2.27)
Observations	112	112	112	112	112	112	112	112	112
Adjusted R-squared	0.041	0.026	0.122	0.031	0.010	0.106	0.007	-0.018	0.058
R-squared	0.178	0.191	0.216	0.169	0.178	0.202	0.148	0.154	0.159
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-specific trends	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No

Notes: Dependent variable is real investment growth. The granular residual is based on firm-level real labor productivity growth.

Standard errors are clustered at country level. Robust t-statistic in parentheses. * p < 0:10, ** p < 0:05, *** p < 0:01.

Table A4. The Granularity of the Euro Area (Real Export Growth)

Dependent variable:	Not demeaned			Demeaned (sector)			Demeaned (country sector)		
Real export growth	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Granular residual	3.257***	3.273***	3.237***	3.201***	3.169***	3.136***	2.890***	2.855***	2.490***
	(5.07)	(4.38)	(4.51)	(4.78)	(4.33)	(4.42)	(4.42)	(4.16)	(4.40)
Real oil price		0.019	-0.044***		0.039	-0.010		0.045	-0.005
		(0.51)	(-4.03)		(1.06)	(-0.94)		(1.19)	(-0.19)
Euro area interest rate		-0.296	0.397		-0.155	0.381		-0.017	0.665
		(-0.43)	(0.66)		(-0.24)	(0.65)		(-0.03)	(1.13)
Real public expenditures (growth)		-0.391	-0.684		-0.442	-0.675		-0.562	-0.502
		(-0.42)	(-0.95)		(-0.48)	(-0.93)		(-0.58)	(-0.80)
Observations	112	112	112	112	112	112	112	112	112
Adjusted R-squared	0.069	0.046	0.126	0.055	0.035	0.120	0.021	0.005	0.080
R-squared	0.202	0.208	0.220	0.190	0.199	0.214	0.161	0.174	0.179
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-specific trends	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No

Notes: Dependent variable is real export growth. The granular residual is based on firm-level real labor productivity growth.

Standard errors are clustered at country level. Robust t-statistic in parentheses. * p < 0:10, ** p < 0:05, *** p < 0:01.

Table A5. The Granularity of the Euro Area (Change in Unemployment)

Dependent variable:	Not demeaned			Demeaned (sector)			Demeaned (country sector)		
Change in unemployment rate	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Granular residual	-0.349***	-0.269***	-0.250***	-0.358***	-0.270***	-0.227***	-0.357***	-0.265***	-0.179***
	(-4.97)	(-4.38)	(-3.93)	(-4.46)	(-4.56)	(-4.27)	(-4.07)	(-4.30)	(-3.21)
Real oil price		0.023*	-0.005		0.022*	-0.007		0.022*	-0.008
		(1.80)	(-0.72)		(1.74)	(-1.20)		(1.78)	(-1.26)
Euro area interest rate		-0.641***	-0.356***		-0.649***	-0.363***		-0.652***	-0.384***
		(-5.06)	(-8.55)		(-5.07)	(-8.44)		(-5.35)	(-10.15)
Real public expenditures (growth)		0.006	-0.142***		0.010	-0.142***		0.021	-0.155***
		(0.08)	(-3.90)		(0.13)	(-3.92)		(0.28)	(-3.96)
Observations	112	112	112	112	112	112	112	112	112
Adjusted R-squared	0.060	0.362	0.320	0.065	0.364	0.307	0.073	0.364	0.290
R-squared	0.195	0.470	0.393	0.199	0.472	0.381	0.206	0.472	0.366
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-specific trends	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No

Notes: Dependent variable is the change in unemployment rate. The granular residual is based on firm-level real labor productivity growth. Standard errors are clustered at country level. Robust t-statistic in parentheses. * p < 0:10, ** p < 0:05, *** p < 0:01.

Table A6. The Granularity of the Euro Area (Labor Productivity Growth and Other Controls)

Dependent variable:	Not demeaned			Demeaned (sector)			Demeaned (country sector)		
Real GDP growth	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Granular residual	1.028***	0.809***	0.654***	1.057***	0.836***	0.672***	1.002***	0.816***	0.624***
	(5.94)	(8.60)	(5.85)	(6.10)	(8.87)	(6.30)	(6.50)	(8.71)	(5.96)
Value-added growth (SMEs)		2.773*	0.694		2.500*	0.433		2.990**	0.939
		(1.81)	(1.09)		(1.67)	(0.66)		(2.30)	(1.40)
Real oil price			-0.053***			-0.051***			-0.047***
			(-6.43)			(-6.81)			(-6.05)
Euro area interest rate			0.828***			0.842***			0.826***
			(4.01)			(4.13)			(3.89)
Change in CAPB			-0.113*			-0.101			-0.085
			(-1.69)			(-1.42)			(-1.29)
Trade			0.137			0.142*			0.131
			(1.51)			(1.64)			(1.40)
Observations	112	91	91	112	91	91	112	91	91
Adjusted R-squared	0.340	0.250	0.489	0.356	0.259	0.504	0.322	0.264	0.477
R-squared	0.434	0.374	0.596	0.448	0.381	0.608	0.419	0.386	0.586
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-specific trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Dependent variable is real GDP growth. The granular residual is based on firm-level real labor productivity growth. CAP is the cyclically adjusted primary fiscal balance. Trade is the ratio of export and import over GDP. Standard errors are clustered at country level. Robust t-statistic in parentheses. * p < 0:10, ** p < 0:05, *** p < 0:01.

Table A7. The Granularity of the Euro Area (TFP Growth and Other Controls)

Dependent variable:	Not demeaned			Demeaned (sector)			Demeaned (country sector)		
Real GDP growth	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Granular residual	0.790***	0.656***	0.636***	0.773***	0.645***	0.631***	0.800***	0.651***	0.624***
	(8.59)	(5.85)	(15.48)	(8.18)	(5.47)	(15.17)	(7.58)	(5.53)	(14.20)
Value-added growth (SMEs)		2.856**	-0.002		2.899**	0.022		2.963**	0.123
		(2.01)	(-0.00)		(2.02)	(0.03)		(2.14)	(0.18)
Real oil price			-0.050***			-0.051***			-0.050***
			(-4.56)			(-4.55)			(-4.57)
Euro area interest rate			0.994***			0.994***			0.985***
			(5.19)			(5.09)			(4.98)
Change in CAPB			-0.017			-0.017			-0.018
			(-0.16)			(-0.16)			(-0.17)
Trade			0.195**			0.197**			0.196**
			(2.39)			(2.38)			(2.38)
Observations	112	91	91	112	91	91	112	91	91
Adjusted R-squared	0.025	0.039	0.440	0.017	0.033	0.438	0.026	0.035	0.433
R-squared	0.164	0.197	0.557	0.157	0.193	0.555	0.165	0.194	0.552
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-specific trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Dependent variable is real GDP growth. The granular residual is based on firm-level TFP growth. CAP is the cyclically adjusted primary balance. Trade is the ratio of export and import over GDP. Standard errors are clustered at country level. Robust t-statistic in parentheses. * p < 0:10, ** p < 0:05, *** p < 0:01.

Table A8. The Granularity of the Euro Area (Time-Varying Demeaning)

Dependent variable:	Demeaned (sector time)		Demeaned (country time)		Demeaned (country-sector time)	
Real GDP growth	(1)	(2)	(3)	(4)	(5)	(6)
Granular residual	0.187***	0.206***	0.124**	0.119**	0.116**	0.113**
	(3.10)	(3.46)	(2.50)	(2.53)	(2.28)	(2.25)
Real oil price	-0.041***	-0.035***	-0.038***	-0.032***	-0.038***	-0.032***
	(-6.21)	(-6.36)	(-7.74)	(-7.08)	(-7.65)	(-7.11)
Euro area interest rate	0.924***	1.047***	0.948***	1.052***	0.949***	1.056***
	(11.07)	(9.07)	(13.61)	(9.55)	(13.83)	(9.59)
Real public expenditures (growth)	0.173**	0.157**	0.196***	0.186***	0.194***	0.184***
	(2.31)	(2.40)	(2.98)	(2.96)	(2.95)	(2.92)
Trade		-0.073*		-0.062		-0.064
		(-1.86)		(-1.58)		(-1.61)
Observations	98	98	98	98	98	98
Adjusted R-squared	0.685	0.690	0.682	0.685	0.681	0.684
R-squared	0.743	0.750	0.741	0.746	0.740	0.746
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	No	No	No	No	No	No
Country-specific trends	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Dependent variable is real GDP growth. The granular residual is based on firm-level real TFP growth.
Trade is the ratio of export and import over GDP. Standard errors are clustered at country level. Robust t-statistic in parentheses. * p < 0:10, ** p < 0:05, *** p < 0:01.

Table A9. Spillover to SMEs and the Role of Leverage

Dependent variable:	Not demeaned			Demeaned (sector)			Demeaned (country sector)		
SMEs' value-added growth	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Granular residual (t-1)	3.276***	5.941***	6.436***	3.101***	5.952***	6.120***	2.753***	4.522***	4.335***
	(4.51)	(4.37)	(5.25)	(4.10)	(4.19)	(4.95)	(3.44)	(3.23)	(3.31)
Granular residual (t-1) x (Debt/Assets) (t-1)		-0.267***			-0.282***			-0.186**	
		(-3.27)			(-3.39)			(-2.02)	
(Debt/Assets) (t-1)		-0.239			-0.226			-0.213	
		(-0.61)			(-0.57)			(-0.53)	
Granular residual (t-1) x (Debt/EBIDTA) (t-1)			-0.072***			-0.069***			-0.039*
			(-4.27)			(-4.17)			(-1.92)
(Debt/EBIDTA) (t-1)			-0.074			-0.067			-0.057
			(-0.66)			(-0.60)			(-0.52)
Observations	930	915	918	930	915	918	930	915	918
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-specific trends	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Dependent variable is SMEs' sectoral value-added growth. The granular residual is based on firm-level TFP growth.
EBIDTA is Earning Before Interest Depreciation, Taxes and Amortization. Standard errors are clustered at sector level.
Robust t-statistic in parentheses. * p < 0.10, ** p < 0.05, *** p < 0.01.

Table A10. Spillover to SMEs and the Role of Leverage (Time-Varying Demeaning)

Dependent variable:	Demeaned (sector time)		Demeaned (country time)		Demeaned (country-sector time)	
SMEs' value-added growth	(1)	(2)	(3)	(4)	(5)	(6)
Granular residual (t-1)	5.425***	7.395***	0.846**	4.155**	1.089**	4.271**
	(8.20)	(5.17)	(2.04)	(2.13)	(2.26)	(2.23)
Granular residual (t-1) + x (Debt/Assets) (t-1)		-0.168**		-0.684***		-0.603***
		(-2.02)		(-4.35)		(-3.91)
(Debt/Assets) (t-1)		-0.318		0.089		0.068
		(-0.86)		(0.53)		(0.40)
Observations	929	914	929	914	929	914
Country fixed effects	Yes	Yes	Yes	No	Yes	No
Sector fixed effects	Yes	Yes	Yes	Yes	No	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes
Country-specific trends	Yes	Yes	Yes	No	Yes	No

Notes: Dependent variable is SMEs' sectoral value-added growth. The granular residual is based on firm-level TFP growth.
Standard errors are clustered at sector level. Robust t-statistic in parentheses. * p < 0.10, ** p < 0.05, *** p < 0.01.

Table A11. Spillover to SMEs and Asymmetric Effects

Dependent variable:	Not demeaned			Demeaned (sector)		
SMEs' value-added growth	(1)	(2)	(3)	(4)	(5)	(6)
Granular residual (t-1) +	4.606*	18.644***	15.625***	4.480*	18.833***	15.542***
	(1.76)	(3.75)	(2.78)	(1.72)	(3.77)	(2.82)
Granular residual (t-1) -	2.558**	-1.185	1.114	2.251*	-2.586	-0.089
	(2.29)	(-0.71)	(0.47)	(1.81)	(-1.29)	(-0.03)
Granular residual (t-1) + x (Debt/Assets) (t-1)		-1.154***			-1.164***	
		(-5.06)			(-5.32)	
Granular residual (t-1)- x (Debt/Assets) (t-1)		0.406**			0.492**	
		(2.16)			(2.49)	
(Debt/Assets) (t-1)		0.282			0.324	
		(0.82)			(0.95)	
Granular residual (t-1) + x (Debt/EBIDTA) (t-1)			-0.219***			-0.219***
			(-3.16)			(-3.29)
Granular residual (t-1)- x (Debt/EBIDTA) (t-1)			0.025			0.044
			(0.56)			(0.90)
(Debt/EBIDTA) (t-1)			0.022			0.039
			(0.23)			(0.40)
Observations	930	915	918	930	915	918
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Sector fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes
Country-specific trends	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Dependent variable is SMEs' sectoral value-added growth. The granular residual is based on firm-level TFP growth. Granular residual (t-1) + represents a positive granular residual while granular residual (t-1)- represents a negative granular residual. Standard errors are clustered at sector level. EBIDTA is Earning Before Interest Depreciation, Taxes and Amortization. Robust t-statistic in parentheses. * p < 0:10, ** p < 0:05, *** p < 0:01.

Table A12. Spillover to SMEs and the Role of Leverage (Demeaned Sector Time)				
Dependent variable: SMEs' value-added growth	(1)	(2)	(3)	(4)
Granular residual (t-1)	5.015***	5.564***	5.483***	5.229***
	(7.72)	(7.68)	(7.82)	(6.64)
Granular residual (t-1) x Manufacturing	3.924***			
	(5.99)			
Granular residual (t-1) x Construction		-1.021		
		(-1.29)		
Granular residual (t-1) x Retail			-0.294	
			(-0.37)	
Granular residual (t-1) x Services				1.995***
				(2.61)
Observations	929	929	929	929
Country fixed effects	Yes	Yes	Yes	Yes
Sector fixed effects	No	No	No	No
Year effects	Yes	Yes	Yes	Yes
Country-specific trends	Yes	Yes	Yes	Yes

Notes: Dependent variable is SMEs' sectoral value-added growth. The granular residual is based on firm-level TFP growth. Standard errors are clustered at sector level. Robust t-statistic in parentheses. * p < 0.10, ** p < 0.05, *** p < 0.01.

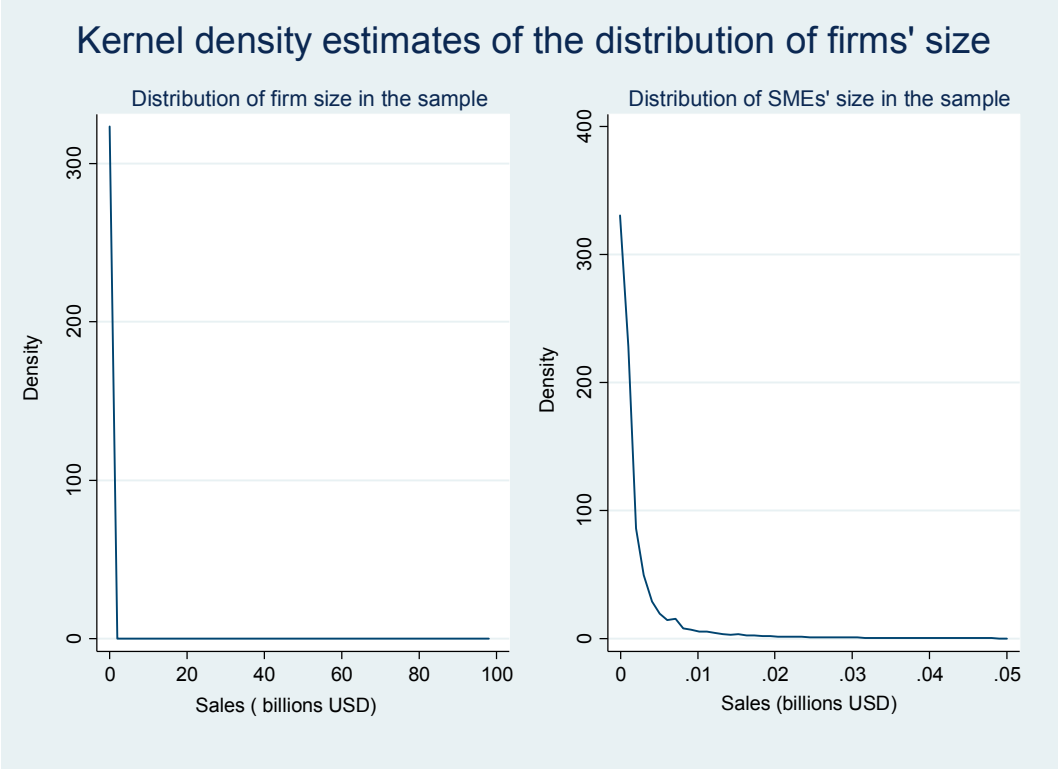
Appendix B. Additional Data Information

In order to reduce the impact of extreme observations, we winsorized some firm-level variables. In computing the granular residual, following Gabaix (2011) we winsorize the productivity growth and the demeaned productivity depending on the case at 20 percent. We replace productivity growth by 20 percent if it is higher than 20 percent and we replace by -20 percent if the productivity growth is negative and such that its absolute value is higher than 20 percent. Also, in computing the weight (lagged sales over GDP ratio) we replace by 0.3 if the ratio is larger than 0.3. We winsorize also leverage to 100 percent (0 percent) if it is greater (less) than 100 percent (0 percent). Finally, value-added growth is set 200 percent (-200 percent) if it is greater (less) than 200 percent (-200 percent). We winsorize leverage following Aivazian et al. (2005).

Table 1B. Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Sectoral-Level Data					
Value-added growth	1,002	105.076	92.841	-156.340	200
Asset tangibility (lagged)	930	35.689	31.015	2.032	100
Leverage (lagged)	915	13.370	12.320	0	75.163
Macroeconomic-Level Data					
Real GDP growth	112	1.154	2.395	-8.631	5.482
Real export growth	112	5.147	10.046	-27.938	21.377
Real investment growth	112	1.512	11.714	-28.692	24.340
Change in unemployment rate	112	0.176	1.204	-3.324	6.636
Real public expenditure growth	112	1.391884	1.833547	-4.62513	6.148148
Real oil price	112	65.45487	24.8152	31.80049	98.13294
Euro area interest rate	112	2.214286	1.293982	0.25	4.75
Change in CAPB	111	-0.05504	1.645676	-5.97789	5.566082
Trade	112	77.63755	30.39194	45.60911	164.0175
Value-added growth (SMEs)	91	0.062513	0.141517	-0.14484	1.069296
Output gap	112	-0.005	2.345	-6.604	6.09

Figure 1B. Firm Size Distribution



The granular hypothesis rests on the fact that when firms' size follow a power law distribution, idiosyncratic shocks do not cancel out in the aggregate. Idiosyncratic shocks would die out in the aggregate if all firms were of equal size. These figures show that the data resemble a power law distribution quite closely even when we focus on SMEs and the distribution of firm size is extremely fat tailed in our sample.

Note: We measure firm size by the sales following Gabaix (2011). These figures are obtained using Epanechnikov kernel with optimal bandwidth (0.00004). Note that the density exceeds one because the probability density of a continuous variable has the units and dimensions of its reciprocal. (The density is not measured on a probability scale.)

Source: Authors' calculations.

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