Deep Financial Integration and Volatility*

Sebnem Kalemli-Ozcan
University of Houston and NBER

Bent Sorensen
University of Houston and CEPR

Vadym Volosovych
Florida Atlantic University

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PRELIMINARY

Abstract

Theoretical predictions regarding the effect of financial integration on output fluctuations are ambiguous. The empirical studies, using different sources of variation, find mixed results. We argue that the key to understanding the relationship between international financial integration and volatility is to study the effect of foreign ownership on firm-level volatility and then examine if the firm-level patterns carry over to aggregate data. We investigate the relationship between financial integration, firm-level volatility, and aggregate output fluctuations. Using micro data from the AMADEUS database, we construct a measure of "deep" financial integration based on *direct* observations of foreign ownership at the firm level. We measure domestic financial development as the extent of firm-level cross-ownership within the same country. We find a significant positive effect of deep financial integration on the volatility of firms' outcomes. This effect survives aggregation (both by us and by Eurostat) and carries over to regional output, conditional on the extent of regulation. Although a high level of domestic cross-ownership is associated negatively with firm-level volatility, there is no robust effect of domestic financial development on regional output volatility. We also show that the level of volatility is lower in the countries that are highly regulated.

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1 Introduction

Theoretical predictions regarding the effect of financial integration on output volatility are ambigious. There are (at least) four different channels at work:[1] First, Obstfeld (1994) argues that financial integration enables firms to diversify their capital ownership allowing them to invest in more risky projects that would otherwise demand large risk premiums. This mechanism will imply higher firm-level volatility. If certain regions (or countries) have comparative advantage in certain high risk/high return sectors, the firm level pattern will carry over to the aggregate level through increased sectoral specialization, leading to higher macroeconomic volatility. On the other hand, if a higher level of sectoral specialization lowers the co-movement between sectors, then aggregate volatility might be lower, as argued by Koren and Tenreyro (2007).

Second, starting with Arrow (1971), many argue that financial integration may lower barriers to entry, leading to more risk taking, and enhance competition. This will result in an increase in the number of smaller firms, who may be more volatile, as shown by Acemoglu and Zilibotti (1997). Aggregate output, on the other hand, may become less volatile through averaging across a larger number of firms.

Third, the standard real business cycle models predict that, under full integration, when countries are hit by positive (negative) permanent productivity shocks, firms receive more (less) foreign investment, as shown by Baxter and Crucini (1995). As a result, the effect of productivity shocks gets amplified, leading to higher aggregate volatility.

Finally, corporate finance models with moral hazard in the spirit of Holmstrom and Tirole (1997) can predict several outcomes: i) If negative shocks are associated with loss of collateral, foreign lenders may contract capital provision in bad times, exacerbating downturns and vice versa in good times; ii) if negative shocks affect the supply of credit, while having little effect on collateral, then foreign lenders will supply scarce capital in bad times, smoothing downturns and vice versa in good times. If these effects are pervasive across firms, making firm outcomes correlated, or if some firms are extremely large relative to the rest of the economy, they will carry over to regions and countries.

The models mentioned so far imply the association between finance and volatility results from

[1]Regardless of the effects on output volatility, theory suggests that financial integration should reduce consumption volatility relative to output volatility because capital income, and possibly wage income, gets smoothed via diversification. Since output fluctuations are not perfectly correlated across countries, trade in financial assets can be used to de-link national consumption levels from the country-specific components of these output fluctuations; see Obstfeld and Rogoff (1995).

the causal effect of financial integration on fluctuations. It can also be the case that foreign firms choose to locate in regions that are a priori (prior to foreign investment) more or less volatile. For example, higher (lower) volatility increases (decrease) the demand for diversification as shown by Heatcote and Perri (2004). Surprisingly, the empirical literature so far fails to deliver a robust relationship—positive or negative—between financial integration and volatility both at the firm- and at the aggregate-level, as a systematic regularity.[2]

We employ a novel approach to study these questions in an empirical framework. The key factor that underlines the above theories is whether or not *firms* take more risk as a result of financial integration or foreigners are more willing to invest in *firms* with high volatility.[3] Hence, our empirical exercise starts from the micro level, where we have direct observations on foreign ownership at the firm-level. By combining a very large firm-level dataset (public and private firms) with macroeconomic data, we examine the effect of financial integration on volatility both at the firm-level and at the regional-level. Focusing on firms and regions within countries is essential for two reasons. First, we can control for country-wide shocks and investigate whether various forms of aggregation "averages away" firm-level volatility. Second, by using macro data on regions within countries, we can still account for the general equilibrium effects due to changes in financial structure that firm- or sectoral-level data will miss. To the best of our knowledge, this is the first paper that investigates the relationship between finance and volatility both at the micro and macro levels.

The investigation of the effect of financial integration on aggregate volatility must wrestle with the following three issues, which might explain why empirical results in the literature are ambiguous. First, as highlighted by the theory, one cannot assume that firm-level volatility and aggregate

[2]At the firm/industry level, Black and Strahan (2002), Kerr and Nanda (2007), and Cetorelli and Strahan (2006), who show an increase number of firms and a decrease in the average size of the firm (decrease in monopoly power) as a result of various financial innovations. Correa and Suarez (2007) find firm sales and employment are less volatile after the bank deregulation in the U.S. Thesmar and Thoenig (2004) find that, among French firms, volatility increased more for publicly traded companies following financial deregulation. Braun and Larrain (2004) show that industries that rely on external finance are more sensitive to aggregate shocks and this effect is stronger in countries that are less financially developed. Using state level data Morgan, Rime, and Strahan (2004) find that bank deregulation decreases the state cycles. At the country level, using cross-country data, Kose, Prasad, and Terrones (2004) find that increasing financial openness is associated with rising relative volatility of consumption and output. Similarly, Bekaert, Harvey, and Lundblad (2006) find increased volatility of both output and consumption growth as a result of trade and financial openness. They find, however, that in a subset of their countries equity market liberalizations are followed by a decrease in output and consumption volatility. di Giovanni and Levchenko (2007), using industry level data, decompose aggregate volatility into components of volatility of sectors, co-movement between sectors, and specialization at sectoral level. They find that openness effects all these components, where the biggest effect on aggregate volatility comes from the specialization resulting in higher output volatility.

[3]Kalemli-Ozcan, Sorensen, and Yosha (2003) provides indirect evidence by showing a positive effect of risk sharing on industrial specialization, which implies firms specializing as a result of increased diversification.

fluctuations move together. In fact, as documented by many authors, there has been a significant decline in aggregate volatility in the United States and in most other industrial countries over the last thirty years.[4] Others have shown that there has been a large increase of the U.S. firm-level volatility during the same time period.[5] One reason for this difference can be the lower intensity of aggregate monetary policy shocks relative to the other shocks, but this appears not to be the full explanation. For example, Davis and Kahn (2008) and Davis et al. (2006) find declining firm-level volatility within the U.S. If firm-level shocks are caused by, say, firm-level innovations or vagaries of CEOs, then the law-of-large numbers would make such shocks irrelevant in the aggregate as long as the economy consists of a large number of small firms. Firm-level shocks may carry over to the aggregate data, however, if the firm-size distribution is fat-tailed, such that a few large firms can drive aggregate volatility.[6] Averaging firm level shocks may also not smooth them away if firms are subject to common shocks and/or might be affected differentially from such shocks (as the case in Holmstrom and Tirole (1997)). In each of these cases the assumption of i.i.d shocks will be violated. Therefore, understanding of the effect of financial integration on firm-level volatility is necessary in order to fully understand the effect of integration on the aggregate volatility.

The second issue is the difficulty in pinning down the effect of financial integration on aggregate volatility using cross-country data alone. Using data from Lane and Milesi-Ferretti (2004), Figure 1 shows that the relationship between volatility, measured as the standard deviation of real GDP per capita growth between 1995 and 2005, and financial integration, measured as assets and liabilities divided by GDP and averaged over 1995–2005, changes depending on the sample. The figure suggests that there is no relation between volatility and financial integration in the largest sample of EU25. However, if we omit small, open and volatile countries from this sample, such as Ireland, Malta, and Cyprus then it seems that there is a strong negative relation between volatility and integration. If we focus only on EU15 then the relationship between the two turns to positive again. In fact, these findings are consistent with the ambiguous results found in different studies that use different samples. Different patterns must be capturing difference in industrial structure, financial markets, policy, and so on. Therefore, it is hard to know exactly what these patterns are capturing.

[4]See McConnell and Perez-Quiros (2000), Blanchard and Simon (2001), and Stock and Watson (2002) among others.

[5]See Campbell, Lettau, Malkiel, and Xu (2001) for increased volatility of stock returns and Chaney, Gabaix, and Philippon (2002) and Comin and Philippon (2005) for increased volatility of sales and employment.

[6]Gabaix (2005) shows that when the distribution of firms sizes follows a power law, then idiosyncratic shocks to large firms can have a big impact on aggregate volatility. He also provides evidence of fat-tail distributions of firms sizes. di Giovanni and Levchenko (2008), using industry level data, show that trade increases aggregate volatility 30 times more in a small country compared to a large country.

Third, the degree of financial market integration *within* countries may not be the same for different countries. There is mounting evidence that capital is not efficiently allocated within many developed and developing countries.[7] In this case, any analysis conducted at the country level, based on a representative agent framework, will be misleading. Plus, given the different degrees of domestic financial development, it is important to separate the effects of domestic financial development/integration from international financial integration since they might be complements or substitutes depending on the country.[8]

We use firm-level data from AMADEUS and regional-level data from Eurostat. Both databases are for Europe. Although the data comes for 41 countries from Europe for 14 million firms, we focus on the 12 long-EU countries, with over 180 regions and 7 million firms to have a homogenous sample. Europe provides an ideal "laboratory" for our study because financial integration there has dramatically increased cross-country ownership over the last fifteen years. Our approach has several advantages. First, we have a direct measure of foreign ownership at the firm level. We use this measure to study firm-level volatility. Second, we aggregate this data to the regional level in order to examine if financial integration, measured as average level of foreign ownership, is correlated with average and median regional volatility. We also use regional data from Eurostat to compare different forms of aggregation. Third, our firm-level data allows us to distinguish between domestic financial development and international financial integration because the AMADEUS dataset gives information on direct ownership by domestic as well as by foreign residents for each firm.

We find a significant positive effect of international financial integration on the volatility of firm outcomes. We also find that this effect carries over to regional output, especially for the regions that are located in highly regulated countries. We interpret this reflecting foreign investors ability to take more risk in regulated environments relative to domestic investors. We also show that aggregate volatility is lower in highly regulated countries. Interestingly, a higher level of domestic financial development has no robust effect on regional output volatility, although firms with more diversified domestic ownership structure seems to be less volatile.

We are concerned less about the endogeneity since we control for country and industry level factors, but our results can still be driven by omitted firm and region level factors and also by reverse causality, as argued before. Foreign investors might invest in volatile firms more than

[7] See Ekinci, Kalemli-Ozcan, and Sorensen (2007), Hsieh and Klenow (2007), and Banerjee and Duflo (2005).

[8] Recently Caballero, Fahri, and Gourinchas (2008), and Mendoza, Quadrini, and Rios-Rull (2007), emphasize the role of domestic financial development for determining the patterns of external borrowing and lending and hence for volatility. Domestic financial frictions might also lead to a complementarity between trade in assets and specialization as recently emphasized by Antras and Caballero (2008).

domestic ones given the fact that foreign investors are more hedged and less risk averse. Or given the higher volatility there will be more demand for foreign diversification. Both of these will lead to a positive association between financial integration and volatility. We pursue different identification strategies. We instrument foreign ownership at the regional level with indicators of social capital such as confidence and trust. These variables have shown to be predictors of many financial decisions at the regional level, as shown by Guiso et al. (2007). This exercise seem to suggest that causality runs from integration to volatility, both in the case of our aggregation to regions and also the aggregation done by Eurostat. However our instruments are not very strong. The reason for this is probably the fact that volatility might be correlated with other unobserved regional factors that are also correlated with social capital in general. Currently we are working on alternative identification strategies.

The rest of the paper proceeds as follows. Section 2 presents our conceptual framework. Section 3 describes our data and the construction of the variables used. Section 4 discusses our empirical specification and presents results. Section 5 concludes.

2 Conceptual Framework

Consider the case where the growth rate of output of firm i in country (or region) a is given by:

$$x_t^i = \sum_{s=1}^{S} b^{is} u_t^s + c^i \nu_t^a + \epsilon_t^i \tag{1}$$

where u_t^s is a **sector-specific** i.i.d shock, ν_t^a is a **country-specific** productivity shock and ϵ_i is a shock that is idiosyncratic to firm i.[9]

Aggregate volatility is given by,

$$Var(x_t^a) = \sum_{i}^{n} (\alpha^i)^2 Var(x_i) + 2 \sum_{j>i}^{n} \alpha^i \alpha^j Cov(x^i, x^j) \tag{2}$$

where $x_t^a = \sum_i^n \alpha^i x^i$ is the growth rate of aggregate output, and α^i is the share of value added of firm i in aggregate output.[10] It is clear that a decline in aggregate volatility can be due to a decline

[9]Note that the assumption of sectoral shocks being i.i.d implies sectors being equally risky. This assumption may not hold in the data if there are different levels of sectoral risk.

[10]Note that the sum of the growth rates of firms is not exactly equal to the aggregate growth rate. This is an approximation for expositional reasons. Also $\sum_i^n \alpha^i = 1$

in firm-level volatility, a decline in co-movement between firms, an increase in the share of the firm in aggregate production (α), or an increase in the number of firms, n.[11] From equation (1), the co-movement between firms can come from sector and/or country specific shocks.

The growth rate of output in country (or region) a and b will be:[12]

$$\begin{aligned} x_t^a &= \Sigma_s \, \gamma_s^a \, u_t^s + \beta^a \, \nu_t^a + \epsilon_t^a \\ x_t^b &= \Sigma_s \, \gamma_s^b \, u_t^s + \beta^b \, \nu_t^b + \epsilon_t^b \end{aligned} \tag{3}$$

where γ_s^a and γ_s^b are the weights of sector s in the total output of countries a and b, and ϵ_t^a and ϵ_t^b are the average of the idiosyncratic firm shocks with mean zero. Note that these shocks will not average away in the aggregated data if the size distribution of firms is fat-tailed as argued by Gabaix (2005). An idiosyncratic shock to Wal-Mart or to Microsoft can affect the U.S. output substantially, for example. In this case, the assumption of i.i.d will be violated due to no independent shocks. Averaging firm level shocks may also not smooth them away if firms are subject to common shocks and/or might be affected differentially from such shocks, again violating the assumption of i.i.d due to non-identical shocks.

If a region has a comparative advantage in sector s then firms in region a will ideally prefer to specialize in sector s. If finance has to be raised within the region the investors in the region will demand risk premia in order to absorb the higher variance in their returns that results from specialized production of the firms and this higher cost of capital will dampen the specialization desire of firms. If firms within this region can get finance from other regions in the country or from other countries this damping effect will not be as strong because diversified investors will not demand risk premia due to specialized production. It is clear from the above equations that sectoral specialization can take place both via a higher number of firms specializing and producing in the sector (more firms with large b_i) or certain sectors growing large (higher γ_s).

These consideration deliver two testable implications: domestic cross-ownership will increase sectoral specialization and sectoral specialization will increase aggregate volatility.[13] The same effect can also be obtained via foreign ownership. Hence it is essential to investigate the effect of

[11] Most of the literature typically interprets i as indexing sectors.

[12] This is based on Kalemli-Ozcan, Sørensen, and Yosha (2001) which is an extension of the model proposed by Frankel and Rose (1998).

[13] Kalemli-Ozcan, Sørensen, and Yosha (2003) show that domestic financial integration (measured as risk sharing) is associated with more sectoral specialization (more dissimilar sector shares in different regions).

both simultaneously. This is a hard task to undertake in the cross-country data due to the high correlation between domestic financial development and international financial integration.

The role of foreign ownership can be non-trivial as far as firms' production decisions are concerned. A domestic firm will be subject to sector, country, and idiosyncratic shocks as highlighted in equation (1). If the firm holds a diversified portfolio within its own country, the effect of sectoral shocks will be diversified. For many companies, the idiosyncratic shocks may be much larger than sector-level shocks. The impact of idiosyncratic shocks on owner's income may be fully diversified if a company is owned by hundreds of thousands of diversified owners but diversification usually stops well short of this.[14] The impact of country-level shocks cannot be diversified by domestic owners with no foreign diversification. For a given level of sectoral specialization, a firm often has the option to choose between a well-known safe mode of operation and a higher return/higher risk (newer) mode of operation. The willingness to take on idiosyncratic risk by the firm will depend on the overall risk of the investors portfolio. For a (purely) domestic investor, the country-level risk component is "background risk" that increases the aversion to take on further risk. A foreign investor is often able to diversify away domestic country-level shocks and foreign investors may, therefore, choose production with higher risk and returns.

Some firms may not be able to change their risk expectations. However, such firms may be relatively more attractive to foreign investors. The management of firms with risky/high return operations/mode of production may raise capital in foreign capital markets.[15] This line of thought gives us our main testable implication that international financial integration will be associated with relatively high firm level volatility. Firm level volatility, may carry over to regional volatility if firm size distribution is fat-tailed as discussed above, or if firms are subject to common shocks or might be affected differentially from such shocks. Based on the models reviewed in the introduction, the effect of foreign ownership at the firm level may also carry to the regional level if firms specialize in risky sectors as a result of increased foreign ownership, or if there are more entry by small volatile firms as a result of increased integration.

[14] Idiosyncratic risk of a firm cannot be fully diversified in the sense that the owner/operator often is required to hold a significant stake given moral hazard, as modeled by Holmstrom and Tirole (1994).

[15] One may think of a model where foreign investment is subject to higher costs. In the case of fixed costs, smaller investors will invest locally while large investor (maybe mutual funds) will invest internationally as well as locally.

3 Data and Construction of Variables

We construct a unique data set combining on and off-balance sheet items for firms including measures of foreign ownership from the AMADEUS database with macroeconomic variables at the level of regions corresponding to the Nomenclature of Territorial Units for Statistics of Europe (NUTS-2), from Eurostat. To correctly assign firm-level data from AMADEUS to Eurostat's NUTS-2 level regions we utilize firms geographic information.

3.1 Firm-Level Data

The AMADEUS Database

The AMADEUS database (Analyze Major Databases from European Sources) is provided by Bureau van Dijk Electronic Publishing (BvD). AMADEUS contains information between 1996–2007 for both on balance-sheet and off-balance sheet items, such as income statements and profit and loss accounts, for over 14 million public and private companies of large, medium, and small size (according to revenue, total assets, and number of employees) from 41 countries, including all the EU countries and Eastern Europe. Listed companies comprise a small number compared to the total number of all firms. For the 41 countries covered, there are about 10 thousand listed companies in the AMADEUS database. The data coverage varies in terms of the number of companies by country and time period for a given company.[16]

Sample Selection Criterias

We focus on 12 long-EU countries with 7 million firms to have a homogenous sample. Depending on the companies' organizational structure, the AMADEUS database contains unconsolidated financial accounts, consolidated accounts, or both types of accounts. A company which has subsidiaries is required to prepare consolidated accounts which include information on the parent as well as its subsidiaries. We use only *unconsolidated* accounts to avoid double counting since we have subsidiaries in the sample. This reduces the sample of firms to 6.8 million for the whole period

[16]While collecting firm-level data, BvD takes advantage of the legal requirement for the European companies to file their accounts at official government registries in their own country. Not all the companies required to do so though and rules change from country to country. Thus, BvD also collects firm information from reputable information providers, such as Verband der Vereine Creditreform (Germany), Annual Return and Jordans (UK), and Novcredit (Italy). These providers collect data either directly from the companies or via official bodies using the audited accounts. Bvd also has private communications and questionnaires sent to the companies. The data is then organized in a standardized format resembling the most common formats used for firm accounts in Europe.

of 1996–2007.

It is extremely important just to use the unconsolidated accounts. AMADEUS categorizes everything as subsidiary regardless of the percentage of ownership. Although in standard accounting a company A will only be classified as a subsidiary of a company B iff company B owns more than 50 percent of company A, in AMADEUS company A will be called a subsidiary even company B owns a 1 percent stake. There can be direct subsidiaries and also indirect ones owned by the direct subsidiaries for a parent company. For example, BMW has 186 recorded subsidiaries, 54 of which are outside Europe (like BMW, U.S.) and hence not in our data set. 77 out of the remaining 132 are direct subsidiaries owned more than 50 percent by the parent company.[17] The remaining 55 companies are subsidiaries of these 77 companies. By using unconsolidated accounts we only account for the outcomes of the actual company and not that of the parent's that owns it. Another example is Lego that have 38 total subsidiaries where only 3 of these are direct and the rest are under these 3 subsidiaries. By looking at the consolidated accounts of these 3 direct subsidiaries, we manage to verify that sum of sales and employment of the indirect subsidiaries is less than the numbers reported in the consolidated accounts of the 3 direct subsidiaries. It will not be an exact match since some of the subsidiaries are outside Europe and hence we do not have their data.

The AMADEUS Ownership database is the main source for the foreign ownership variables. The database is issued by BvD in the form of yearly DVDs containing the ownership information at the end of a given year. The earliest DVD with the systematic ownership information is for 2000, though the firm coverage is very sparse. We need to match this ownership information to the firms' financial data. Thus, we utilize balance sheet information from the AMADEUS Financials database. While the Financial database reports financial information between 1996–2007, the best firm coverage is for the 2001–2005. Delays with financial reporting make the dataset incomplete for the later years and for the earlier years less firms were included in the database. Ownership and balance sheet information are matched by a unique firm identifier.

Out of 6.8 million unconsolidated accounts, we were able to identify a sample of 2.8 million firms with ownership and geographic information in the 2002 vintage of the AMADEUS, close to 4 million firms in the 2004 vintage, and 2.7 million firms in 2006 vintage. We also require assets to be non-missing. We match these firms from each vintage to firms' financial data from WDRS for the years 2001–2005. We have decided to focus on a single cross-section first in the analysis given the limited time series variation in the foreign ownership variable (as will be discussed later).

[17]Note that it is not necessarily the case that more than 50 percent of the direct subsidiaries is owned by the parent company.

Given the maximum number of firms is obtained from the 2004 vintage, we start with that sample.

Next we eliminate the outlier firms. We keep the firms non-negative assets. We also force the assets to be larger than 1,000 Euro. We drop the firms with the number of employees larger than 2 million (the employment of Walmart) and also firms with zero employment. We also drop firms below the 0.1th percentile and above the 99.99th percentile in the distribution of sales to assets, operating revenue to assets, and employment to assets. In the case of sales to revenue, we drop firms below the 5th percentile and above the 99th percentile in the distribution to get rid of firms with high financial income. Overall, these filters allow us to get rid of phantom firms and tax-fronts. We also drop firms where the outcome growth is more than 100 percent in the absolute value. These adjustments left us with 3.2 million firms.

We work with two different samples. In the *permanent* firm sample we keep all firms with the firm outcomes non-missing in every year in the 2001–2005 period. We obtain 826,109 firms with non-missing sales, 952,666 firms with non-missing operating revenue, and much smaller sample of 508,003 firms with non-missing employment out of 3.2 million firm-level observations.

In the larger firm sample of the *permanent and non-permanent* firms we allow firms to have missing outcomes at the beginning or at the end of the 2001–2005 period but drop the firms that have "holes" in the data in the middle. This means we allow firms to die and born but not born die and then reborn. We have 1,304,245 firms with at least three years of sales data; 1,547,292 firms with at least three years of revenue data; and 595,144 firms with at least three years of employment data out of 3.2 million firms.

We also trace our 3.2 million of 2004 vintage firms over 10 years between 1996–2006 in AMADEUS Financials, to get time series observations on total assets, sales, operating revenue, and employment. Table 1 presents the number of firms by country with non-missing data for the indicated outcome variables. Figure 2 presents the distribution of the firm-level total assets and outcomes. The majority of the firms are relatively small.

3.1.1 Foreign Ownership

The shareholders file of the AMADEUS Ownership database contains detailed information on the owners of firms including the name of the owner, the owner type (e.g., bank, financial company, state, public), owner country, and other information. For each owner of every firm there is one observation, where we refer to such record as an "ownership link." BvD traces the link between two entities even when the percentage is very small (less than 1 percent). An ownership link indicating

that an entity A owns a certain percentage of Firm B is referred to in AMADEUS as a "direct" ownership stake.

At the firm-level, *Foreign Ownership* (FO), is given as follows. For a firm i the FO_i is the sum of all percentages of direct ownership by foreigners as reported. For example, if a Company A has three foreign owners with the stakes 10%, 15%, and 35%, FO for this company would be 60%. Figure 3 shows the distribution of this variable.

Figures 4 and 5 display the distribution of direct foreign ownership FO_i for two random regions, Scotland and Oberbayern, respectively. Each bar corresponds to the number of companies with a foreign ownership stake of the given percentage. The scale of the graph is logarithmic. The majority of companies within each size group have no foreign owners. However, there are noticeable differences between firms in different size tiers and in different regions. In particular, larger firms tend to have higher foreign ownership stakes.

3.1.2 Domestic Ownership

We measure the extent of each firm's level of domestic cross-ownership by counting the number of ownership links where the owner resides in the same country as the firm (the variable *Number of Domestic Ownership Links*). Note that this variable is *not* 100 percent minus foreign ownership percent. For example, if a Company A is located in Germany and has two owners in Germany and one owner in UK, the domestic links for this company will be two.

3.1.3 Assets, Sales, Employment, and Additional Controls

We measure firm size using total assets of firms from AMADEUS Financial. We consider the following outcome variables for firms to calculate firm-level volatility: firm sales, the number of employees, and the operating revenue. Operating revenue is sales plus other revenues such as interest and capital gains on financial asset holdings.

3.2 Regional Level Data

We use regional NUTS-2 level data for over 180 regions from the following 12 longstanding EU countries: Austria, Belgium, Finland, France, Germany, Ireland, Italy, Netherlands, Portugal, Spain, Sweden, and the United Kingdom. Countries with only one NUTS-2 region, such as Denmark, are left out.

3.2.1 Financial Integration

Our measure of deep financial integration (FI) is calculated using firm-level data from AMADEUS aggregated to the regional level. In symbols, for companies indexed by i in a NUTS-2 region j:

$$\mathrm{FI}_j = \sum_i w_{j,i} \mathrm{FO}_{j,i} \tag{4}$$

Here $\mathrm{FO}_{j,i}$ represents the percentage of foreign ownership at the firm-level for the firm located in region j, and $w_{j,i}$ represents the weight for the firm i in region j. To obtain the weights $w_{j,i}$, we calculate the sum of total assets for all companies *in the region* as $\mathrm{TOAST}_j = \sum_i \mathrm{TOAS}_{j,i}$, where $\mathrm{TOAS}_{j,i}$ is the total assets of company i. We then calculate firm-specific weights as $w_{j,i} = \mathrm{TOAS}_i/\mathrm{TOAST}_j$.

In Figure 6, we display the weighted average level of foreign ownership of each region relative to the average of the country. Darker color represents a higher value of foreign ownership and hence a higher level of financial integration. This is equivalent to our empirical work, where we include dummy variables for each country.

3.2.2 Domestic Financial Development

We measure financial development as the weighted average of the number of domestic links in each region. This variable is computed by the formula similar to the Eq. (4) with the number of domestic ownership links in each firm i instead of $FO_{i,j}$. So it is a weighted average of individual companies number of links using company assets as weights.

3.2.3 Regional Output and Population

For population, we use the annual average population series from Eurostat at NUTS-2 level. Regional output data are also from Eurostat, that is regional GDP. We use nominal data in national currency divided by the national CPI.[18] We calculate growth rates as log-differences and the volatility of output as the standard deviation of the annual growth rate.

[18] For EMU countries, we divide by the Harmonized Average Consumer Price Index

3.2.4 Regional Specialization

We calculate regional specialization indices following Kalemli-Ozcan, Sorensen, and Yosha (2003). We calculate sectoral and total employment for each region using data from Eurostat. Then, we calculate shares of each sector. Next we calculate the specialization index both for 1-digit and 2-digit industries for each NUTS-2 region. The formula for this index is as follows. Let e_j^s denote the employment of sector s in region j, and e_j^{Tot} the total employment in this region. The index measures the distance between the vector of sector shares in region j, $e_j^s \,/\, e_j^{Tot}$, and the vector of average sector shares in the regions other than j:

$$SPEC_j = \sum_{s=1}^{S} \left(\frac{e_j^s}{e_j^{Tot}} - \frac{1}{K-1} \sum_{k \neq j} \frac{e_k^s}{e_k^{Tot}} \right)^2 , \tag{5}$$

where S is the number of sectors and K is the number of regions. The index measures how the sectoral composition in region j differs from the composition in the other regions.

3.2.5 Confidence Indicators

In the instrumental variables analysis we instrument the Foreign Ownership by the confidence indicators from the from World Values Survey as in Ekinci, Kalemli-Ozcan, and Sorensen (2007). World Values Surveys were designed to enable a cross-national, cross-cultural comparison of values and norms on a wide variety of topics and to monitor changes in values and attitudes across the globe. Broad topics covered including perception of life, family, work, traditional values, personal finances, religion and morale, the economy, politics and society, the environment, allocation of resources, contemporary social issues, national identity, and technology and its impact on society. Confidence scales from 1 to 4, higher values indicate less confidence in the institution named in the question. The institution is armed forces in question 1; education system in question 2; press in question 3; labor unions in question 4; police in question 5; parliament in question 6; the civil services in question 7; the social security system in question 8; major companies in question 9; justice system in question 10 and the European Union in question 11. We take the average of individual responses over the regions, and divide by the maximum value of the regional averages in our sample. Confidence index is constructed as multiplying the sum of these rescaled values of regional averages by (-1). We reverse the sign in order to make the interpretation easier. For the final value of confidence index, higher values of confidence index indicates higher confidence in certain institutions.

3.3 Country Level Data

3.3.1 Regulation

We measure the country-level regulatory environment by the regulatory and administrative opacity index from the OECD Indicators of Product Market Regulation (PMR). The index measures general regulatory environment and barriers and includes features such as licenses and permits system and the communication and simplification of rules and procedures. We normalize the index to vary from zero to one, where a higher value indicates a high level of regulation, but the rules and procedures are transparent.

4 Empirical Analysis

We start by examining the effect of direct foreign ownership at the firm-level on firm-level volatility. This, important, relation appears not to have been studied before. As argued in the introduction, the key to the investigation of the effect of financial integration on volatility is to start at the firm level. We also include a measure of within-country cross-ownership. For firm-level outcomes, we use sales and operating revenue. Sales are typically used to study volatility but we include operating revenue because the sales variable is not available for UK regions.[19] We use two measures of firm-level volatility. The literature on firm-level volatility, which mostly focuses on large publicly traded firms, use the standard deviation of growth.[20] For small firms, this measure tend to have bad properties because, say, a firm growing from 1 to 2 employees will have a growth rate of 100 percent. Since we have many small private firms, we prefer to use coefficient of variation for the level of outcomes to measure volatility. On the other hand, economic debate often focus on standard deviation of growth, which the coefficient of variation measures only indirectly. We therefore show both measures.

As we have mentioned, even if foreign ownership is associated with high volatility at the firm level this pattern may not carry over to aggregated macroeconomic data (or vice versa). To examine this, first we measure average foreign ownership in a region as a weighted average of firm-level direct foreign ownership.[21] We consider this a measure of international financial integration at the regional

[19] We believe the other firm outcome available, employment, is not appropriate for our purposes since many Southern European countries have labor regulations aimed at limiting employment volatility.

[20] See Comin and Philippon (2005).

[21] See the data section for the exact formula.

level. We first ask if (average) foreign ownership affect median volatility, which we interpret as the typical level of volatility for a firm in a given region.[22] We expect to find results similar to those at the firm level, or no association if averaging of the ownership results in little variation between regions due to law of large numbers. It could also be the case that there would be no relation because average volatility in some regions might be high due to, say, 40 percent of firms being fully owned by foreigners with the remaining, including the median, having no foreign ownership. This will be the case of the distribution of the volatility is skewed to the right.

We also examine the effect of average foreign ownership on (asset weighted) average volatility, which is affected more by large (since weighted) and/or highly volatile firms.[23] It may be that foreign ownership affects the typical firm but not the average or vice versa, since law of large numbers can kill the variation in average volatility (and not in average foreign ownership) even if there is a relation between average foreign ownership and the median firm.

The volatility of the *aggregated* data may or may not show the same patterns as average or median volatility. For example, if the majority of variation at the firm-level is distributed i.i.d. across firms and regions, then aggregate volatility will be very low and unlikely to co-vary with foreign ownership. Thus even if the foreign ownership is important for the firm level volatility, if firms that make up the regions and regions themselves on average are similar in their level of foreign ownership, there will not be any between regional variation. However, if the size distribution of firms is very heavy-tailed, as Gabaix (2008) shows is the case for the United States, volatility may survive aggregation even firm outcomes are independent, although in this case the aggregate volatility will solely be due to very large firms. In our final set of regressions, we use the volatility of regional level GDP per capita growth from the Eurostat Database and regress this on our measure of foreign ownership. The coefficient in such a regression is likely to be attenuated because our calculated foreign ownership is based on firm headquarters while GDP is based on the output of establishments which are not always located in the same region as the headquarters. This deficiency is, however, extremely unlikely to make any variable spuriously significant.[24]

[22] It is very common to investigate the behavior of median volatility as in Comin and Philippon (2005).

[23] Davis, Haltiwanger, Jarmin, and Miranda (2006) study patterns in average volatility for several samples of U.S. firms.

[24] Note, we could also sum all the firms a region and calculate volatility based on this sum and regress this measure on foreign ownership. This would allow us to examine directly the effect of aggregating, keeping foreign ownership and output calculated from the same set of firms. In preliminary work, we found that outlier noise made such regression very fragile.

4.1 Specification: Firm-Level

We regress the volatility of firm output on indicators of foreign and domestic ownership, country- and sector-dummies, and firm size to control for large firms potentially being able to smooth shocks through averaging of volatility of different products, etc. Our specification is in log-log form since firm-size distribution has long-tails as shown in figure 2.

$$\log(VOL_{ij}) = \mu_c + \mu_s + \alpha \log(FO_{ij}) + \beta \log(DO_{ij}) + \mathbf{X}'_{ij}\delta + \epsilon_j \,, \tag{6}$$

where VOL_{ij} is measured either as the coefficient of variation of sales or operating revenue, or standard deviation of growth of sales or operating revenue over the period 2001–2005 for firm i in region j. μ_c is a country-specific constant, and μ_s is a set of sectoral dummies that are based on the firm's primary industry code at the 2-digit level. We control all the country- and industry-level factors and exploit solely the firm-level variation. FO_{ij} is the percent foreign ownership for firm i located in region j and DO_{ij} is the number of domestic ownership links. $\mathbf{X}'_{ij}$ is a matrix of controls for firm size. All right hand side variables are measured in 2004 for consistency with the sample for FO_{ij}.

One can argue that large firms are more important for macroeconomic volatility, and hence we perform not only OLS regressions, but also WLS regressions which are more informative about large firms. Furthermore we also show WLS results of large firms alone, which will capture the very large firms. We show result for "permanent" firms, with data in all years, as well as firms that enter or exit the AMADEUS data. Considering permanent firms obviously misses news firms and dying firms but these non-permanent firms may be atypical due to differences in AMADEUS coverage of, say, small versus large firms from one country to the other. The firm-level regressions are winsorized at the 99 percent level to remove large outliers in addition to all the other data filters that are described in the data section.[25]

[25] Winsorizing refers to replacing all observations beyond the 99 percentile with the value of the 99th percentile, limiting the influence of outliers.

4.2 Specification: Regional Level

4.2.1 Median Volatility

We estimate the relation between cross-ownership and median volatility at the regional level as follows:

$$VOL_j^{MED} = \mu_c + \alpha \log(FI)_j + \beta \log(FD)_j + \mathbf{X}_j'\delta + \epsilon_j \,, \tag{7}$$

where VOL_j^{MED} is the median value in region j of the firm-level standard deviations or coefficients of variation used in the firm-level regressions—we do not take logarithms of the regional measures whose distributions do not have long tails. μ_c is a country-specific constant, and FI_j (a measure of financial integration) is the asset-weighted average percent foreign ownership across the firms in a region. FD_j (domestic financial development) is the asset-weighted average of domestic ownership links across the firms in a region. $\mathbf{X}_j'$ is a matrix of controls for region j including number of firms in the region.[26]

Volatility may depend on the general regulatory environment and can be lower in regions in countries with high regulation of economic activity due to constraints on the production decisions, such as inability to fire workers. The impact of foreign ownership on volatility may also be different in such countries. Domestic firms who have a higher percentage of foreign ownership might take more risk relative to domestic firms who are not foreign owned and do not take risk due to high regulatory environment. It is also possible that foreign investors invest is riskier firms more in a high regulatory environment given their hedge position. It can also be the case that foreign ownership itself is affected by regulation if it comes in the form of entry barriers, biasing our specification towards finding a smaller effect.

To explore this issue we estimate the following relation:

$$VOL_j^{MED} = \mu + \gamma\, regul_c + \alpha \log(FI)_j + \delta \log(FI)_j * regul_c + \beta \log(FD)_j + \mathbf{X}_j'\delta + \epsilon_j \,, \tag{8}$$

where we have dropped country dummies and included an index, $regul_c$, of regulation in the country c where region j is situated. This index is scaled to take values between 0 and 1. We expect the

[26] See the data section for the exact formulas.

coefficient γ to be negative, and the coefficient to the interaction term, δ to be positive, as argued above. The partial effect of foreign ownership, α, is also expected to be positive. We also expect the total effect, given by, $\alpha + \delta regul_c$ to be positive. As in the firm-level regressions, we also show results with WLS to explore the possibility of results being driven by small versus large firms.

4.2.2 Mean Volatility

The region-level relation between cross-ownership and average volatility is estimated as:

$$VOL_j^{AVG} = \mu_c + \alpha \log(FI)_j + \beta \log(FD)_j + \mathbf{X}_j'\delta + \epsilon_j \,, \tag{9}$$

where VOL_j^{AVG} is the asset-weighted mean value in region j of the firm-level standard deviations or coefficients of variation used in the firm-level regressions. μ_c is a country-specific constant, and FI_j (a measure of financial integration) is the asset-weighted average percent foreign ownership across the firms in a region. FD_j (domestic financial development) is the asset-weighted average of domestic ownership links across the firms in a region. $\mathbf{X}_j'$ is a matrix of controls for region j including number of firms in the region.

The mean volatility puts significantly more weight on large firms within a region. We still show results with WLS to explore the possibility of results being driven by very large firms. We also allow the impact of foreign ownership on average volatility to to vary with the level of regulation, as in the case of median volatility:

$$VOL_j^{AVG} = \mu + \gamma\, regul_c + \alpha \log(FI)_j + \delta \log(FI)_j * regul_c + \beta \log(FD)_j + \mathbf{X}_j'\delta + \epsilon_j \,. \tag{10}$$

4.2.3 Aggregate GDP Volatility

The region-level relation between cross-ownership and the volatility of regional GDP (from Eurostat) volatility is estimated as:

$$VOL_j^{AGG} = \mu_c + \alpha \log(FI)_j + \beta \log(FD)_j + \mathbf{X}_j'\delta + \epsilon_j \,, \tag{11}$$

where VOL_j^{AGG} is the volatility of real (CPI-adjusted) per capita GDP-growth in region j. In these "Eurostat" regressions the $\mathbf{X}_j'$ matrix of controls including population of the regions. For the Eurostat data we calculate volatility over the longer period 1996–2005, we found that volatility

measures calculate from sample as short of those used for the AMADEUS data were too noisy.[27] We also add an interaction term with regulation for these regressions using aggregate volatility.

4.3 Regression Results

4.3.1 Firm-level regressions

Table 2 shows the results of Ordinary Least Squares (OLS) regressions of equation (6).[28] We show 4 set of results with different left-hand side measures of firm-level volatility. Log-coefficient of variation of sales and operating revenue in the top panel A and log-standard deviation of growth rates in panel B. The OLS results will be dominated by small firms because there are many more relatively small firms than relatively large firms. We find that firms with high foreign ownership are significantly more volatile whether volatility is measured via sales or operating revenue independently of which volatility measure we use. The estimated coefficients are elasticities in the order of 0.03-0.04 and statistically significant at extremely high levels. These coefficients implies that a 100 percent increase in firm-level foreign ownership (measured in percentage points) increases the firm-level volatility (standard deviation of growth or coefficient of variation) by 3 percent.

Clearly, foreign owners are relatively more willing to take risk in a given country i, likely due to their ability to diversity their income across several countries. This can be driven both by foreign owners buying firm that are more volatile a priori or by foreign owners increasing the volatility of firms after they have acquired them. On the contrary, domestic owners appear to shun volatile firms, the coefficient is of the same order of magnitude as that for foreign ownership with a negative sign. This can also be due to domestic firms not investing in a priori volatile firms or due to firms with many domestic owners avoiding risky investments. This coefficient is also highly significant with with a t-statistic near 10 (in absolute value) in all specifications. It is less straightforward to interpret the magnitude of this coefficient since domestic ownership is measured in the more cumbersome fashion of the number of other domestic owners independently of their ownership share. However, if we interpret the coefficient literally, it implies that a doubling of the number of domestic owners are associated with a decrease in volatility of 3 percent.

Finally, larger firms are less volatile as shown by the large coefficient to log assets (with "off-the-chart" t-values of about 100). A doubling of firm's assets leads to a 5 percent reduction in

[27] We also run our AMADEUS regressions, both at the firm level and at the regional level on a permanent sample of firms over 10 years. The results stay qualitatively the same.

[28] The descriptive statistics are given in the appendix table.

volatility. Firm-level volatilities are calculated over a short samples and likely to be noisy but the regressions deliver precise results due to the large sample of nearly a million observations.

In Table 3, which follows the lay-out of the previous table, the regressions are estimated by Weighted Least Squares (WLS) where the data are weighted by the square root of firm's total assets. In this table, the results are more affected by larger firms. The results are similar to those found using OLS. Again foreign ownership is highly significant albeit with a slightly smaller coefficient while the coefficients to domestic cross-ownership are very similar for the coefficient of variation measure and somewhat larger for the growth-rate measure to those found using OLS. Larger firms, as measured by assets, still are predicted to be less volatile.

Table 4 reports weighted least squares regressions performed only for large firms.[29] This sample closer to those often used in the literature that uses publicly traded firms. In this regression, where the results are dominated by very large firms, the relation between foreign ownership of volatility is less strong, but the statistical significance of the foreign ownership variable still is very high. One might speculate that the slightly lower coefficient found for very large firms is due to large firms being less volatile in general or due to large firms more easily being able to attract foreign investors, independently of volatility.

The results of the previous three tables used permanent firms only and it is important to verify that the patterns found holds more generally. Table 5 displays the results of regressions using our full sample of permanent and non-permanent firms. We show results for OLS, WLS, and WLS for large firms for this larger sample, which has up to 1.7 million observation in the case of operating revenue. The results are very close to those previously reported for permanent firms.

4.3.2 Region-level regressions using AMADEUS data

We now shift attention to region-level regressions with much lower degrees of freedom. We use regions that have 50 or more firms in the analysis.[30] Table 6 considers whether the volatility of a typical firm with median volatility correlates with the average level of foreign ownership in the region of the firm using regional data constructed from the sample of permanent firms. The left-hand side variable is now median volatility and the regressions are performed using regions as the unit of observation. We display OLS and WLS results for sales only using the alternative measures of volatility—in these regressions the weights are the square root of the number of AMADEUS firms

[29] Large firms are the firms who have assets more than 10 million euros and employees more than 100.
[30] We also used regions with 100 or more firms, obtaining similar results.

in the region.[31] The results are similar for operating revenue. In regional-level regressions, noise may have a larger impact of the results, due to the much smaller sample and indeed we do not find a significant coefficient to foreign ownership using the specifications used for the firm-level data. This holds whether country dummies are included or not. Domestic ownership is significant at the 10 percent level in OLS with country dummies (and less precisely estimated without dummies), still with a negative sign, and insignificant in WLS. The median volatility in a region is increasing in the number of firms in the region. This likely captures that small firms are more volatile as found at the firm level (in regions where AMADEUS have larger samples of firms, this is typically due to more small firms being included). The estimated coefficient to foreign ownership is so far from statistical significance that it appears not just to be due to noise. We therefore in the right-most columns examine if the coefficient to foreign ownership varies across countries in a way that correlated with the country level of regulation. Thus, in these columns, country dummies are dropped and a variable for regulation (which only varies by country) is included. The results are pretty similar to those of the first column without dummies. Regarding regulation: first observe that, as expected, the median firm in a region in a country with a high amount of regulation displays significantly less volatility. Second, for the interaction between regulation and foreign ownership we find a positive coefficient, significant at levels of 5–10 percent. We normalized the regulation variable to be between 0 and 1, and the total effect of foreign ownership is positive at the minimum level of regulation, which is around 0.3.

Table 7 repeats the regressions of the previous table on data constructed from the sample of both permanent and non-permanent firms and displaying the OLS and WLS results for both sales and operating revenue. In this table, only the specification with the interaction term is included while there are no country dummies. Again, we find a negative relation between foreign ownership and volatility for the countries with the lowest values of regulation while there is a positive relation in the countries with the highest amount of regulation. If the typical firm in a high regulation country increases its foreign ownership by 100 percent then the median volatility increases by 0.03, a very similar effect to that of the one found in the firm level regressions.

Next, we consider average volatility. In Table 8, we repeat the specification of the previous table. The results are quite similar with the interaction term typically significant at the 5 percent level, although the WLS-regressions for sales have a totally insignificant interaction term. For the larger sample (including the UK) using operating revenue the estimated coefficient to the interaction term

[31] We have experimented with different weights such as the sum of employment of the firms in the same region. The results qualitatively stays the same.

is large and significant at the 5 percent level. In the sample used for sales, we do not have the regions of the U.K., a low regulation country so the results for operating revenue are more reliable. If average ownership increases by 100 percent then average volatility increases 0.04

Averaging of volatility "kills" the (partial) correlation with the average number of domestic ownership links. We conjecture that this is the case since the variable for domestic ownership is imprecisely measured. It might also be the case that domestic owners cannot hedge in the same way as the foreign ones, which affects the average effect.

4.3.3 Regressions using GDP growth volatility from Eurostat

Finally, we examine if macroeconomic volatility, measured as the standard deviation of real per capita regional GDP is higher in regions with high foreign ownership. As argued in the introduction one channel through which firm-level volatility may carry over to aggregate volatility is through industrial specialization. To examine this issue, we include sectoral specialization within manufacturing. Diversified foreign investors may be more tolerant to volatility and therefore tolerant of specialization. At the firm level, this may manifest itself in highly specialized production of a few items but we cannot observe this. However, specialization at the sectoral level is detectable from Eurostat regional data and we examine if there is a tendency for sectoral specialization to be associated with higher volatility.

Table 9 displays results from the estimation of previous equation in the top panel A. The estimated coefficients are of a smaller order of magnitude for the aggregated AMADEUS data but the qualitative patterns are remarkably similar to those found using volatility extracted from the AMADEUS data. The coefficient to foreign ownership is negative, but statistically insignificant for both OLS and WLS. For OLS and WLS the interaction with regulation statistically significant at the 10 percent level. We cannot detect any direct effect of regulation on volatility which may be due to the public sector, or other sectors with low AMADEUS coverage, being more volatile in high regulation countries. In these regressions, we again do not find any effect of domestic ownership. We also observe that more populous regions are less volatile with a second order term, indicating a U-shape, being significant in OLS although this pattern disappears in the weighted regressions.

For the role of specialization, we find—at a 5 percent level of significance—that there is a positive association between specialization and volatility. There does not seem to be a strong tendency for the effect of foreign ownership to be lower when specialization is included in the regression. This would be the case if sectoral specialization is the main channel through which

foreign ownership correlated with volatility. In the bottom panel B of Table 9, we examine whether sectoral specialization within manufacturing is indeed higher in regions with more foreign ownership. This would need to hold in order for sectoral specialization to be one channel through which firm take more risk. Regions with more foreign ownership indeed are more specialized—we find this result with a 5 percent level of significance using WLS and with a 10 percent level of significance using OLS. The estimated impact of domestic cross-ownership is also positive but not significant at conventional levels. More populated regions are, not surprisingly, less specialized.

4.4 Instrumental Variables Regressions

If foreign investors in a region better diversify risk of investing in the region we should find a correlation between foreign ownership and volatility as documented in the tables discussed so far. This could solely be due to foreigners investing in firms a priori high levels of volatility or firms which receive foreign investments starting to take more risk as implied by a majority of the models discussed in the introduction. We here briefly explore the direction of causality showing the results of instrumental regressions with foreign ownership instrumented by the level of trust within a region—a variable that is likely to be determined by political history and is likely to correlate with foreign investment. Table 10 shows the results of two regressions: the left-most column have average AMADEUS volatility on the left-hand side while the right-most column utilize volatility from Eurostat GDP data. The results of qualitatively quite similar for the two columns. The interaction of regulation and foreign ownership is positive and significant at the 10 percent level, making the total effect of foreign ownership positive. Our samples are somewhat small for us to push the result of either regression too hard, but the similarity of the findings, in spite of left-hand side variables from very different sources, lends credence to the conclusion there is a direct causal effect from foreign ownership to volatility. We will try alternative identification strategies in the future.

5 Conclusion

Theoretical predictions regarding the effect of financial integration on output fluctuations are ambiguous and empirical studies, whether at the country- or firm-level, find mixed results. Although the most important factor for the relationship between finance and volatility is the effect of foreign ownership on the risk taking behavior of firms, most empirical studies focus on region or country

level measures of financial integration due to the unavailability of direct observations of foreign ownership at the firm level. We argue that the key to understand the relationship between international financial integration and volatility is to study the effect of foreign ownership on firm-level volatility and then examine if the firm-level patterns carry over to aggregate data.

We investigate the relationship between financial integration, firm-level volatility, and aggregate output fluctuations. We find a significant positive effect of deep financial integration on the volatility of firms' outcomes. This effect survives aggregation and carries over to regional output, conditional on the extent of regulation. Although a high level of domestic cross-ownership is associated negatively with firm-level volatility, there is no robust effect of domestic financial development on regional output volatility. We also show that the level of volatility is lower in the countries that are highly regulated.

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Table 1: Number of Firms by Country

Country	Firm-level Variable	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
AT	Total Assets	458	572	557	584	541	357	846	2079	2410	605	17
	Sales	449	565	547	573	529	318	627	1425	1607	382	17
	Operating Revenue	452	568	550	577	533	319	635	1535	1777	453	17
	Number of Employees	145	173	162	154	133	97	141	777	1279	397	13
BE	Total Assets	81943	171991	182194	201412	217624	233309	250997	267461	271992	257831	144397
	Sales	4000	9517	9916	10463	11067	11607	12285	12767	13252	12791	7954
	Operating Revenue	37331	73742	76209	83413	85730	88318	90640	90835	87898	73736	35370
	Number of Employees	36824	74787	77085	82953	87342	91741	95877	99527	101000	96862	61461
DE	Total Assets	2868	3479	4009	4593	4772	6796	13660	36273	64364	44384	4157
	Sales	2432	3027	3448	3955	4075	5678	11083	22819	34319	23272	3027
	Operating Revenue	2500	3106	3550	4086	4227	5860	11449	23625	35582	24174	3122
	Number of Employees	1000	1180	1284	1254	1397	1337	2686	4011	6472	6566	1272
ES	Total Assets	160965	177333	218691	260688	300267	387590	429890	440139	457763	391349	729
	Sales	151209	167636	204077	241122	275862	354028	390914	399588	413291	361365	709
	Operating Revenue	154468	170817	208476	247318	283843	365358	404138	414153	429396	372849	716
	Number of Employees	92607	100270	132967	171830	209150	279517	318207	334232	352840	317292	574
FI	Total Assets	4555	17960	27218	31795	35018	39000	43348	44823	46625	45170	26634
	Sales	4387	17423	26367	30878	34019	37740	41705	42948	44379	42803	25276
	Operating Revenue	4473	17657	26703	31168	34308	38033	42008	43233	44747	43167	25468
	Number of Employees	1752	6947	14724	19911	22126	23608	27950	31860	35118	34487	20945
FR	Total Assets	–	280233	404353	445363	484580	533169	588386	628647	654246	591077	253969
	Sales	–	267174	386604	425049	461382	506149	557612	595119	619631	560390	243608
	Operating Revenue	–	269664	390167	429126	466058	511470	563423	601423	625709	565876	245329
	Number of Employees	–	96531	152896	176442	190930	210416	234749	256787	351852	407154	210581
GB	Total Assets	75500	222320	296304	478297	556792	628878	714184	847164	928977	839447	–
	Sales	0	0	0	0	0	0	0	0	0	0	–
	Operating Revenue	31369	85139	108005	164079	183442	198215	215744	240575	245961	206266	–
	Number of Employees	20529	51324	56168	66092	69384	72945	76419	80481	74673	66434	–
IE	Total Assets	8491	12426	13261	28848	46572	55696	61518	66013	69934	60585	26334
	Sales	0	0	0	0	0	0	0	0	0	0	0
	Operating Revenue	482	582	675	1692	3444	4813	5298	5714	6553	6543	2218
	Number of Employees	582	839	1579	7207	9243	775	12	0	1186	8757	6501
IT	Total Assets	37185	62012	73407	86828	101277	116307	185341	170320	195674	180252	71928
	Sales	36895	61563	72778	85708	99241	112973	180377	167140	189274	174777	70349
	Operating Revenue	37021	61795	73028	86228	100169	114598	183363	169126	192851	177786	71422
	Number of Employees	36622	60782	71858	84335	99871	116172	185233	142584	61036	58542	41933
NL	Total Assets	72928	84649	90437	97870	105902	122886	184366	194984	205013	175155	29609
	Sales	1179	1470	1671	1913	2149	2961	4247	4366	4596	3743	915
	Operating Revenue	1693	2027	2273	2498	2693	3677	5364	5466	5677	4580	1156
	Number of Employees	55901	30541	4726	5062	7187	8952	8899	7966	26289	108743	22194
PT	Total Assets	5620	6741	10894	17120	19514	19451	21339	25497	28955	21305	2377
	Sales	5430	6496	10303	16008	18172	18291	20309	24305	27389	20335	2304
	Operating Revenue	5477	6552	10451	16308	18602	18641	20602	24664	27813	20604	2338
	Number of Employees	2213	2523	3233	877	966	888	1020	1185	1305	1136	398
SE	Total Assets	268	126733	131393	139283	148785	160465	171814	182944	185799	182050	–
	Sales	0	56089	123111	130518	138596	148482	157624	167021	168257	165117	–
	Operating Revenue	0	57633	124679	132149	140580	150591	160032	169520	171076	167835	–
	Number of Employees	60	101589	105207	111311	118265	126549	133895	141341	142586	139985	–
TOTAL	Total Assets	450781	1166449	1452718	1792681	2021644	2303904	266568	2906344	3111752	2789210	560151
	Sales	205981	590960	838822	946187	1045092	1198227	137678	1437498	1515995	1364975	354159
	Operating Revenue	275266	749282	1024766	1198642	1323629	1499893	170269	1789869	1875040	1663869	387156
	Number of Employees	248235	527486	621889	727428	815994	932997	108508	1100751	1155636	1246355	365872

Notes: The table presents the number of firms by country with non-missing data for the shown variables and years after we apply our sample selection criteria as discussed in detail in the data section. The country name abbreviations denote Austria (AT), Belgium (BE), Finland (FI), France (FR), Germany (DE), Ireland (IE), Italy (IT), Netherlands (NL), Portugal (PT), Spain (ES), Sweden (SE), and the United Kingdom (GB).

Table 2: Firm-Level Volatility: OLS

Sample: Permanent firms over the period 2001–2005

	(1)	(2)	(3)	(4)
	Panel A: Dependent variable is the Logarithm of the coefficient of variation of the firm outcome			
Firm Outcome	Sales		Operating Revenue	
Log Foreign Ownership Percentage	3.29*** (0.17)	2.81*** (0.18)	3.58*** (0.14)	3.03*** (0.15)
Log Number of Domestic Ownership Links		–3.17*** (0.41)		–3.46*** (0.36)
Log Total Assets	–5.16*** (0.06)	–5.05*** (0.06)	–4.56*** (0.05)	–4.46*** (0.05)
Country Dummies	yes	yes	yes	yes
2-digit Sector Dummies	yes	yes	yes	yes
R^2	0.069	0.069	0.063	0.063
Obs	826,109	826,109	952,666	952,666
	Panel B: Dependent variable is the Logarithm of the standard deviation of the firm outcome growth in percent			
Firm Outcome	Sales		Operating Revenue	
Log Foreign Ownership Percentage	3.93*** (0.17)	3.40*** (0.18)	4.00*** (0.14)	3.36*** (0.15)
Log Number of Domestic Ownership Links		–3.47*** (0.41)		–4.01*** (0.36)
Log Total Assets	–7.73*** (0.06)	–7.60*** (0.06)	–6.87*** (0.05)	–6.76*** (0.05)
Country Dummies	yes	yes	yes	yes
2-digit Sector Dummies	yes	yes	yes	yes
R^2	0.093	0.093	0.086	0.086
Obs	826,109	826,109	952,666	952,666

Notes: Standard errors are in parentheses. *** , **, and * denote significance at 1%, 5%, and 10%. Permanent firm sample over the period 2001–2005 includes firms with the *given* outcome variables non-missing in every year of this time period. The construction of the variables is described in Section 3 in detail. In Panel A, the dependent variable is calculated as the logarithm of the standard deviation of sales or operating revenue over the period for individual firms, divided by the corresponding average over the period (the coefficient of variation). In Panel B, the dependent variable is calculated as the logarithm of the standard deviation of sales or operating revenue growth over the period for individual firms. Both dependent variables are in percent. Foreign Ownership Percentage is the sum of all percentages of direct ownership by foreigners in a firm in 2004; Number of Domestic Ownership Links is the number of ownership links where the owner resides in the same country as the firm in 2004; Total Assets is total firm assets in 2004. Sales, operating revenue, and total assets are in Euros at 2005 prices.

Table 3: Firm-Level Volatility: WLS

Sample: Permanent firms over the period 2001–2005

	(1)	(2)	(3)	(4)
	Panel A: Dependent variable is the Logarithm of the coefficient of variation of the firm outcome			
Firm Outcome	Sales		Operating Revenue	
Log Foreign Ownership Percentage	2.30*** (0.10)	1.46*** (0.11)	2.49*** (0.09)	1.57*** (0.10)
Log Number of Domestic Ownership Links		–5.35*** (0.33)		–5.89*** (0.30)
Log Total Assets	–5.47*** (0.05)	–5.25*** (0.06)	–4.75*** (0.05)	–4.56*** (0.05)
Country Dummies	yes	yes	yes	yes
2-digit Sector Dummies	yes	yes	yes	yes
R^2	0.065	0.065	0.061	0.061
Obs	826,109	826,109	952,666	952,666
	Panel B: Dependent variable is the Logarithm of the standard deviation of the firm outcome growth in percent			
Firm Outcome	Sales		Operating Revenue	
Log Foreign Ownership Percentage	2.60*** (0.10)	1.58*** (0.11)	2.64*** (0.09)	1.47*** (0.10)
Log Number of Domestic Ownership Links		–6.44*** (0.33)		–7.45*** (0.30)
Log Total Assets	–8.42*** (0.05)	–8.15*** (0.06)	–7.35*** (0.05)	–7.11*** (0.05)
Country Dummies	yes	yes	yes	yes
2-digit Sector Dummies	yes	yes	yes	yes
R^2	0.092	0.093	0.085	0.085
Obs	826,109	826,109	952,666	952,666

Notes: WLS estimation uses square root of firm's total assets as weights. Standard errors are in parentheses. *** , **, and * denote significance at 1%, 5%, and 10%. Permanent firm sample over the period 2001–2005 includes firms with the *given* outcome variables non-missing in every year of this time period. The construction of the variables is described in Section 3 in detail. In Panel A, the dependent variable is calculated as the logarithm of the coefficient of variation over the period of sales or operating revenue for individual firms. In Panel B, the dependent variable is calculated as the logarithm of the standard deviation of sales or operating revenue growth over the period for individual firms. Both dependent variables are in percent. Foreign Ownership Percentage is the percent of each firm directly owned by foreigners in 2004; Number of Domestic Ownership Links is the number of ownership links where the owner resides in the same country as the firm in 2004; Total Assets is total firm assets in 2004. Sales, operating revenue, and total assets are in Euros at 2005 prices.

Table 4: Firm-Level Volatility: WLS for Large Firms

Sample: Permanent firms over the period 2001–2005

	(1)	(2)	(3)	(4)
	Panel A: Dependent variable is the Logarithm of the coefficient of variation of the firm outcome			
Firm Outcome	Sales		Operating Revenue	
Log Foreign Ownership Percentage	1.78*** (0.27)	0.93*** (0.32)	1.88*** (0.24)	1.09*** (0.28)
Log Number of Domestic Ownership Links		–5.30*** (1.07)		–5.05*** (0.95)
Log Total Assets	–5.92*** (0.31)	–5.83*** (0.31)	–4.96*** (0.25)	–4.89*** (0.25)
Country Dummies	yes	yes	yes	yes
2-digit Sector Dummies	yes	yes	yes	yes
R^2	0.070	0.070	0.075	0.076
Obs	42,975	42,975	55,409	55,409
	Panel B: Dependent variable is the Logarithm of the standard deviation of the firm outcome growth in percent			
Firm Outcome	Sales		Operating Revenue	
Log Foreign Ownership Percentage	2.15*** (0.27)	0.92*** (0.32)	2.14*** (0.24)	0.94*** (0.28)
Log Number of Domestic Ownership Links		–7.69*** (1.09)		–7.62*** (0.95)
Log Total Assets	–7.07*** (0.31)	–6.93*** (0.31)	–5.74*** (0.25)	–5.64*** (0.25)
Country Dummies	yes	yes	yes	yes
2-digit Sector Dummies	yes	yes	yes	yes
R^2	0.071	0.072	0.080	0.081
Obs	42,975	42,975	55,409	55,409

Notes: WLS estimation uses square root of firm total assets as weights. Standard errors are in parentheses. *** , **, and * denote significance at 1%, 5%, and 10%. Permanent firm sample over the period 2001–2005 includes firms with the *given* outcome variables non-missing in every year of this time period. The variables are calculated using the large firms in terms of sales, total assets, and number of employees according to the AMADEUS classification. The construction of the variables is described in Section 3 in detail. The construction of the variables is described in Section 3 in detail. In Panel A, the dependent variable is calculated as the logarithm of the coefficient of variation over the period of sales or operating revenue for individual firms. In Panel B, the dependent variable is calculated as the logarithm of the standard deviation of sales or operating revenue growth over the period for individual firms. Both dependent variables are in percent. Foreign Ownership Percentage is the percent of each firm directly owned by foreigners in 2004; Number of Domestic Ownership Links is the number of ownership links where the owner resides in the same country as the firm in 2004; Total Assets is total firm assets in 2004. Sales, operating revenue, and total assets are in Euros at 2005 prices.

Table 5: Firm-Level Volatility: OLS, WLS, WLS for Large Firms

Sample: Permanent and non-permanent firms over the period 2001–2005

	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Dependent variable is the Logarithm of the coefficient of variation of the firm outcome					
Firm Outcome	Sales			Operating Revenue		
Estimated By	OLS	WLS	WLS Large firms	OLS	WLS	WLS Large firms
Log Foreign Ownership Percentage	2.96*** (0.16)	1.50*** (0.10)	0.96*** (0.30)	3.20*** (0.14)	1.43*** (0.09)	0.93*** (0.26)
Log Number of Domestic Ownership Links	–4.85*** (0.37)	–6.28*** (0.30)	–5.28*** (1.00)	–5.86*** (0.32)	–8.15*** (0.26)	–6.65*** (0.89)
Log Total Assets	–6.33*** (0.05)	–5.91*** (0.05)	–4.93*** (0.28)	–5.36*** (0.04)	–4.84*** (0.04)	–4.23*** (0.23)
Country Dummies	yes	yes	yes	yes	yes	yes
2-digit Sector Dummies	yes	yes	yes	yes	yes	yes
R^2	0.060	0.062	0.062	0.054	0.057	0.069
Obs	1,387,976	1,387,976	64,813	1,666,018	1,666,018	82,964
	Panel B: Dependent variable is the Logarithm of the standard deviation of the firm outcome growth in percent					
Firm Outcome	Sales			Operating Revenue		
Estimated By	OLS	WLS	WLS Large firms	OLS	WLS	WLS Large firms
Log Foreign Ownership Percentage	2.96*** (0.17)	1.53*** (0.10)	1.24*** (0.30)	3.07*** (0.14)	1.24*** (0.09)	0.95*** (0.26)
Log Number of Domestic Ownership Links	–4.59*** (0.39)	–6.58*** (0.30)	–6.51*** (1.02)	–5.11*** (0.33)	–8.90*** (0.27)	–8.58*** (0.89)
Log Total Assets	–7.42*** (0.05)	–7.87*** (0.05)	–6.08*** (0.29)	–6.42*** (0.05)	–6.60*** (0.04)	–5.04*** (0.23)
Country Dummies	yes	yes	yes	yes	yes	yes
2-digit Sector Dummies	yes	yes	yes	yes	yes	yes
R^2	0.069	0.080	0.067	0.061	0.070	0.072
Obs	1,387,976	1,387,976	64,813	1,666,018	1,666,018	82,964

Notes: WLS estimation uses square root of firm total assets as weights. Standard errors are in parentheses. *** , **, and * denote significance at 1%, 5%, and 10%. The sample includes firms with outcome variables possibly missing in some years in the beginning or the end, but not in the middle of the time period. The construction of the variables is described in Section 3 in detail. In Panel A, the dependent variable is calculated as the logarithm of the coefficient of variation over the period of sales or operating revenue for individual firms. In Panel B, the dependent variable is calculated as the logarithm of the standard deviation of sales or operating revenue growth over the period for individual firms. Both dependent variables are in percent. Foreign Ownership Percentage is the percent of each firm directly owned by foreigners in 2004; Number of Domestic Ownership Links is the number of ownership links where the owner resides in the same country as the firm in 2004; Total Assets is total firm assets in 2004. Sales, operating revenue, and total assets are in Euros at 2005 prices.

Table 6: Regional Median Volatility: OLS, WLS

Sample: Permanent firms over the period 2001–2005

	(1)	(2)	(3)	(4)	(5)
	Panel A: Dependent variable is the Median of the coefficient of variation of the firm outcome				
Firm Outcome	Sales				
Estimated By	OLS	OLS	WLS	OLS	WLS
Log Foreign Ownership Percentage	–0.27 (0.22)	–0.15 (0.13)	–0.17 (0.16)	–0.48 (0.35)	–0.99* (0.50)
Log Foreign Ownership × Regulation				1.40* (0.81)	2.63** (1.12)
Regulation				–6.02*** (1.86)	–7.53 (2.75)
Log Number of Domestic Ownership Links	–0.52 (0.41)	–0.52* (0.33)	–0.46 (0.36)	–0.51 (0.37)	–0.01 (0.41)
Number of Firms (in '0,000s)	1.69*** (0.38)	0.60** (0.24)	0.47 (0.28)	1.62*** (0.44)	1.67*** (0.44)
Number of Firms^2 (in '0,000s)	–0.16*** (0.04)	–0.03 (0.03)	–0.02 (0.03)	–0.16*** (0.04)	–0.16*** (0.05)
Country Dummies	no	yes	yes	no	no
R^2	0.24	0.81	0.82	0.32	0.33
Obs	109	109	109	109	109
	Panel B: Dependent variable is the Median of the standard deviation of the firm outcome growth in percent				
Firm Outcome	Sales				
Estimated By	OLS	OLS	WLS	OLS	WLS
Log Foreign Ownership Percentage	–0.41 (0.27)	–0.25 (0.17)	–0.20 (0.19)	–0.74 (0.45)	–1.18* (0.60)
Log Foreign Ownership × Regulation				1.66* (1.05)	2.69** (1.37)
Regulation				–6.22*** (2.42)	–6.74*** (3.40)
Log Number of Domestic Ownership Links	–0.71 (0.50)	–0.82* (0.46)	–0.70 (0.50)	–0.66 (0.47)	–0.08 (0.55)
Number of Firms (in '0,000s)	2.29*** (0.50)	0.69** (0.30)	00.56 ((0.36)	2.30*** (0.50)	2.26*** (0.57)
Number of Firms^2 (in '0,000s)	–0.22*** (0.05)	–0.03 (0.03)	—0.03 ((0.03)	–0.22*** (0.05)	–0.21*** (0.05)
Country Dummies	no	yes	yes	no	no
R^2	0.29	0.81	0.82	0.32	0.33
Obs	109	109	109	109	109

Notes: WLS uses square root of the number of firms in a given region as weights. Standard errors are in parentheses. *** , **, *, denote significance at 1%, 5%, 10%. The samples are restricted to regions with at least 50 firms with available firm-level data. Data for sales is not available for firms registered in the UK and Ireland. The construction of the variables is described in Section 3 in detail. In Panel A, the dependent variable is the median of the coefficient of variation for firm sales (in 2005 prices) over the period in a given region. In Panel B, the dependent variable is the median in a given region of the standard deviations of firm sales (in 2005 prices) growth over the period. Both dependent variables are in percent. Foreign Ownership is a weighted average across firms in a region of the percent of each firm directly owned by foreigners, in 2004. Number of Domestic Ownership Links is a weighted average of the number of ownership links in the firms where the owner resides in the same country as the firm, in 2004. For regional averages, the weights are firm assets relative to the sum of total assets for all companies in the region. Regulation is the Regulatory and administrative opacity index from OECD.

Table 7: Regional Median Volatility: OLS, WLS

Sample: Permanent and non-permanent firms over the period 2001–2005

	(1)	(2)	(3)	(4)
	Panel A: Dependent variable is the Median of the coefficient of variation of the firm outcome			
Firm Outcome	Sales		Operating Revenue	
Estimated By	OLS	WLS	OLS	WLS
Log Foreign Ownership Percentage	–1.85***	–1.35***	–1.25***	–0.61
	(0.31)	(4.54)	(0.49)	(0.46)
Log Foreign Ownership × Regulation	3.82***	3.30**	2.40**	2.00*
	(0.82)	(1.44)	(1.09)	(1.35)
Regulation	–8.99***	–8.63***	–7.61***	6.44**
	(1.97)	(3.09)	(2.27)	(2.99)
Log Number of Domestic Ownership Links	–0.76***	–0.23	–1.89**	–0.88
	(0.24)	(0.35)	(0.72)	(1.09)
Number of Firms (in '0,000s)	1.33***	0.82***	1.02***	0.41*
	(0.23)	(0.27)	(0.25)	(0.26)
Number of Firms^2 (in '0,000s)	–0.09***	–0.05***	–0.07***	–0.02
	(0.01)	(0.02)	(0.02)	(0.18)
Country Dummies	no	no	no	no
R^2	0.47	0.25	0.22	0.10
Obs	135	135	173	173
	Panel B: Dependent variable is the Median of the standard deviation of the firm outcome growth in percent			
Firm Outcome	Sales		Operating Revenue	
Estimated By	OLS	WLS	OLS	WLS
Log Foreign Ownership Percentage	–2.09***	–1.37**	–1.42**	–0.52
	(0.41)	(0.56)	(0.64)	(0.58)
Log Foreign Ownership × Regulation	3.40***	2.78*	2.15*	1.62*
	(1.03)	(1.70)	(1.40)	(0.90)
Regulation	–7.54***	–6.64*	–6.49**	–4.66*
	(2.20)	(3.60)	(2.78)	(3.12)
Log Number of Domestic Ownership Links	–0.89***	–0.29	–2.74	–0.99
	(0.31)	(0.43)	(0.87)	(1.33)
Number of Firms (in '0,000s)	1.76***	1.05***	1.29***	0.46
	(0.27)	(0.30)	(0.30)	(0.30)
Number of Firms^2 (in '0,000s)	–0.10***	–0.06***	–0.09***	–0.02
	(0.02)	(0.02)	(0.02)	(0.03)
Country Dummies	no	no	no	no
R^2	0.50	0.24	0.20	0.10
Obs	135	135	173	173

Notes: WLS uses square root of the number of firms in a given region as weights. Standard errors are in parentheses. *** , **, *, denote significance at 1%, 5%, 10%. The samples are restricted to regions with at least 50 firms with available firm-level data. Data for sales is not available for firms registered in the UK and Ireland. The construction of the variables is described in Section 3 in detail. In Panel A, the dependent variable is the median of the coefficient of variation for firm sales (in 2005 prices) over the period in a given region. In Panel B, the dependent variable is the median in a given region of the standard deviations of firm sales (in 2005 prices) growth over the period. Both dependent variables are in percent. Foreign Ownership is a weighted average across firms in a region of the percent of each firm directly owned by foreigners, in 2004. Number of Domestic Ownership Links is a weighted average of the number of ownership links in the firms where the owner resides in the same country as the firm, in 2004. For regional averages, the weights are firm assets relative to the sum of total assets for all companies in the region. Regulation is the Regulatory and administrative opacity index from OECD.

Table 8: Regional Average Volatility: OLS, WLS

Sample: Permanent and non-permanent firms over the period 2001–2005

	(1)	(2)	(3)	(4)
	Panel A: Dependent variable is the Weighed average of the coefficient of variation of the firm outcome			
Firm Outcome	Sales		Operating Revenue	
Estimated By	OLS	WLS	OLS	WLS
Log Foreign Ownership Percentage	–1.64**	–1.16*	–1.97***	–2.35***
	(0.70)	(0.69)	(0.62)	(0.79)
Log Foreign Ownership × Regulation	2.35*	0.03	4.36***	4.10**
	(1.78)	(1.68)	(1.74)	(2.03)
Regulation	–11.56***	–7.30***	–14.56***	–13.97***
	(3.79)	(3.48)	(3.75)	(4.18)
Log Number of Domestic Ownership Links	0.03	0.98	–0.13	–1.32
	(1.36)	(1.39)	(1.36)	(1.89)
Number of Firms (in '0,000s)	2.07***	0.87***	2.24***	1.38***
	(0.30)	(0.23)	(0.35)	(0.35)
Number of Firms^2 (in '0,000s)	–0.01***	–0.007***	–0.01***	–0.01***
	(0.003)	(0.001)	(0.003)	(0.002)
Country Dummies	no	no	no	no
R^2	0.45	0.45	0.35	0.29
Obs	135	135	173	173
	Panel B: Dependent variable is the Weighed average of the standard deviation of the firm outcome growth in percent			
Firm Outcome	Sales		Operating Revenue	
Estimated By	OLS	WLS	OLS	WLS
Log Foreign Ownership Percentage	–2.13***	–1.21*	–2.22***	–2.13***
	(0.67)	(0.71)	(0.59)	(0.81)
Log Foreign Ownership × Regulation	2.75**	0.32	4.43**	3.51**
	(1.68)	(2.10)	(1.79)	(2.29)
Regulation	–12.91***	–6.62	–15.03	–11.69**
	(4.15)	(4.66)	(4.07)	(4.99)
Log Number of Domestic Ownership Links	0.42	1.01	0.10	–1.29
	(1.43)	(1.39)	(1.44)	(1.89)
Number of Firms (in '0,000s)	2.12***	0.91***	2.22***	1.40***
	(0.29)	(0.24)	(0.35)	(0.36)
Number of Firms^2 (in '0,000s)	–0.02***	–0.07***	–0.02***	–0.01***
	(0.003)	(0.01)	(0.003)	(0.002)
Country Dummies	no	no	no	no
R^2	0.51	0.48	0.37	0.29
Obs	135	135	173	173

Notes: WLS uses square root of the number of firms as weights. Standard errors are in parentheses. *** , **, *, denote significance at 1%, 5%, 10%. The samples are restricted to regions with at least 50 firms with available firm-level data. Data for sales is not available for firms registered in the UK and Ireland. The construction of the variables is described in Section 3 in detail. In Panel A, the dependent variable is the weighted average of the coefficient of variation of firm sales (in 2005 prices) over the period. In Panel B, the dependent variable is the weighted average of the standard deviations of the firm sales (in 2005 prices) growth over the period. Both dependent variables are in percent. For regional averages, the weights are firm assets relative to the sum of total assets for all companies in the region. Foreign Ownership is a weighted average across firms in a region of the percent of each firm directly owned by foreigners, in 2004. Number of Domestic Ownership Links is a weighted average of the number of ownership links in the firms where the owner resides in the same country as the firm, in 2004. Regulation is the Regulatory and administrative opacity index from OECD.

Table 9: Regional Volatility: OLS, WLS

Sample: Eurostat data over the period 1996–2005 and
Permanent and non-permanent firms over the period 2001–2005

	(1)	(2)	(3)	(4)
	Panel A: Dependent variable is the Standard deviation of regional GDP per capita growth			
Estimated By	OLS‡		WLS‡	
Log Foreign Ownership Percentage	–0.02 (0.03)	–0.03 (0.03)	–0.01 (0.03)	–0.02 (0.03)
Log Foreign Ownership × Regulation	0.02* (0.01)	0.02* (0.01)	0.03** (0.01)	0.02* (0.01)
Regulation	–0.03 (0.06)	–0.01 (0.06)	–0.05 (0.06)	0.03 (0.09)
Log Number of Domestic Ownership Links	–0.04 (0.03)	–0.04 (0.03)	–0.04 (0.03)	–0.03 (0.06)
Population	–0.25*** (0.09)	–0.17* (0.09)	–0.24*** (0.08)	–0.18** (0.08)
Population^2	0.16** (0.81)	0.10 (0.08)	0.15** (0.07)	–0.10 (0.07)
Specialization		0.02*** (0.00)		0.02*** (0.001)
Country Dummies	no	no	no	no
R^2	0.08	0.12	0.10	0.14
Obs	164	164	164	164
	Panel B: Dependent variable is Specialization Index			
Estimated By		OLS	WLS	
Log Foreign Ownership Percentage		0.18* (0.10)	0.21** (0.09)	
Log Number of Domestic Ownership Links		0.50 (0.46)	0.55 (0.48)	
Population		–3.74*** (0.89)	–3.29*** (0.87)	
Population^2		3.37*** (0.91)	2.92*** (0.89)	
Country Dummies		yes	yes	
R^2		0.48	0.51	
Obs		164	164	

Notes:‡All coefficients are multiplied by 10 in Panel A of this table. The regressions are estimated by WLS using square root of the regional average population as weights. Robust standard errors are in parentheses. *** , **, * denote significance at 1%, 5%, 10%. The samples are restricted to regions with at least 500 firms with available firm-level data. The construction of the variables is described in Section 3 in detail. The dependent variable is the standard deviation over the period of the yearly growth rate (in percent) of the regional real GDP per capita from Eurostat. Foreign Ownership is a weighted average across firms in a region of the percent of each firm directly owned by foreigners, in 2004. Number of Domestic Ownership Links is a weighted average of the number of ownership links in the firms where the owner resides in the same country as the firm, in 2004. Weights use firm assets from AMADEUS relative to the sum of total assets for all companies in the region. Average Population is the average over the period. Regional Specialization measures how the sectoral composition of in a region differs from the composition of in the other regions using employment data for 2-digit Manufacturing sectors from Eurostat. Regulation is the Regulatory and administrative opacity index from OECD.

Table 10: Regional Volatility: IV

Sample: Eurostat data over the period 1996–2005 and
Permanent and non-permanent firms over the period 2001–2005

	(1)	(2)
Firm Outcome	Average Sales Growth volatility from AMADEUS	GDP Volatility from Eurostat‡
Log Foreign Ownership Percentage	–3.50* (2.02)	–0.09 (0.07)
Log Foreign Ownership × Regulation	9.26* (5.50)	0.028* (0.018)
Regulation	–28.14** (11.17)	–0.06 (0.04)
Log Number of Domestic Ownership Links	–0.04* (0.03)	0.01 (0.05)
Number of Firms (in '0,000s)	1.39*** (0.31)	
Number of Firms^2 (in '0,000s)	–0.01*** (0.002)	
Population		–0.35*** (0.12)
Population^2		0.27*** (0.10)
Country Dummies	no	no
R^2	0.55	0.50
Obs	118	151

Notes: ‡All coefficients are multiplied by 10 column (2) of this table. Robust standard errors are in parentheses. *** , **, * denote significance at 1%, 5%, 10%. The construction of the variables is described in Section 3 in detail. In both regressions Foreign Ownership is a weighted average across firms in a region of the percent of each firm directly owned by foreigners, in 2004. Number of Domestic Ownership Links is a weighted average of the number of ownership links in the firms where the owner resides in the same country as the firm, in 2004. Weights use firm assets from AMADEUS relative to the sum of total assets for all companies in the region. The Foreign Ownership is instrumented in level and interaction terms by the composite confidence indicators defined such that the higher value implies more confidence of the population in institutions. Regulation is the Regulatory and administrative opacity index from OECD.

Figure 1: Macroeconomic volatility and financial integration in Europe

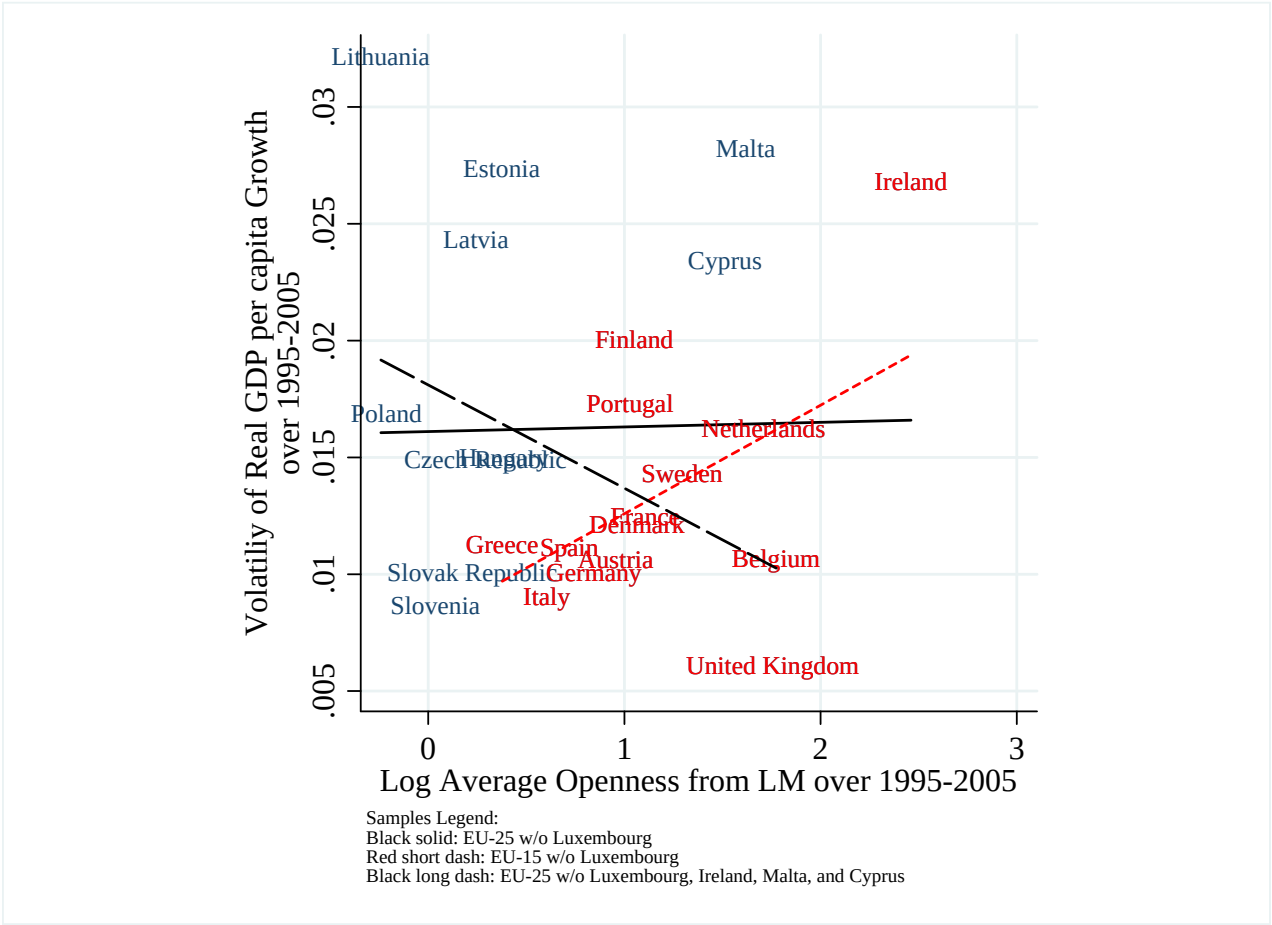
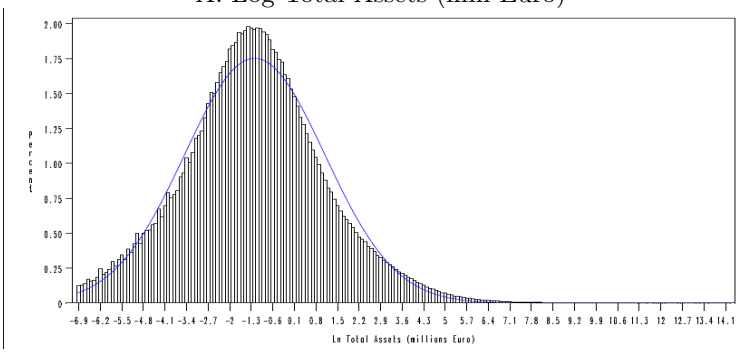
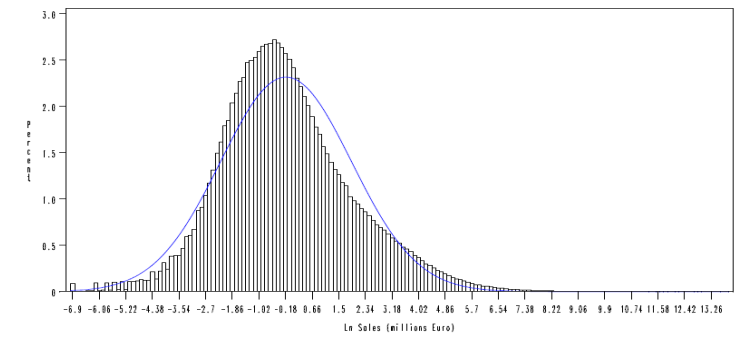


Figure 2: Distribution of the firm-level outcomes

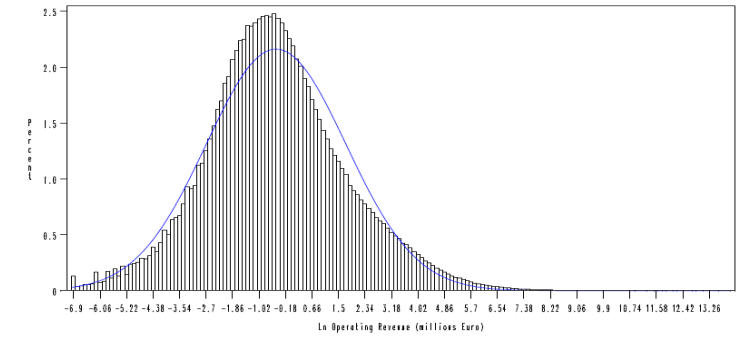
A: Log Total Assets (mill Euro)



B: Log Sales (mill Euro)



C: Log Operating Revenue (mill Euro)



D: Log Number of Employees (persons)

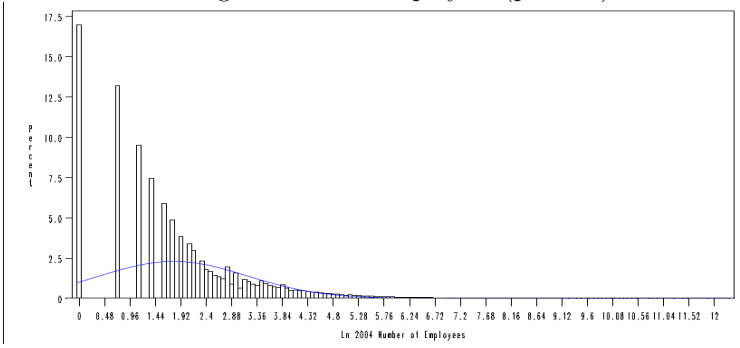
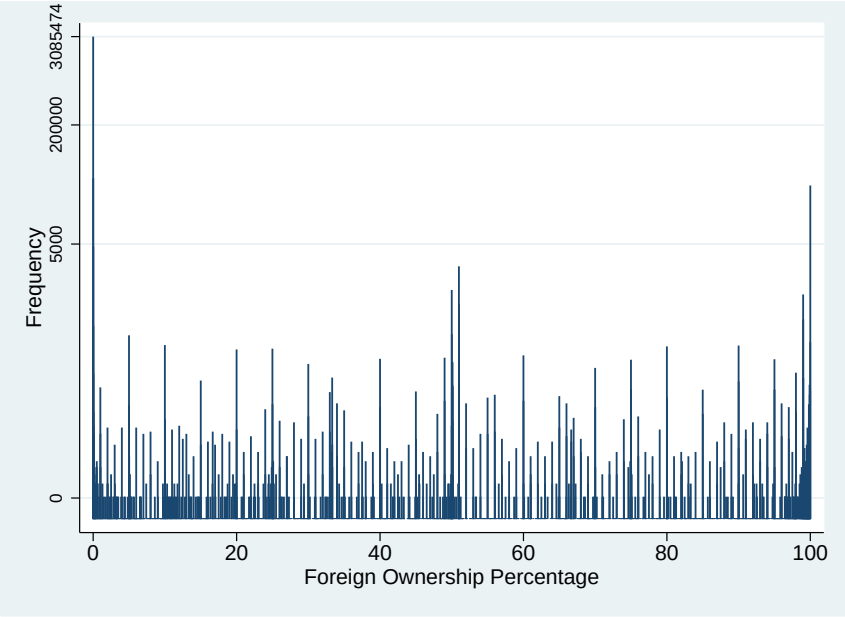


Figure 3: Distribution of the firm-level Foreign Ownership and Domestic Ownership



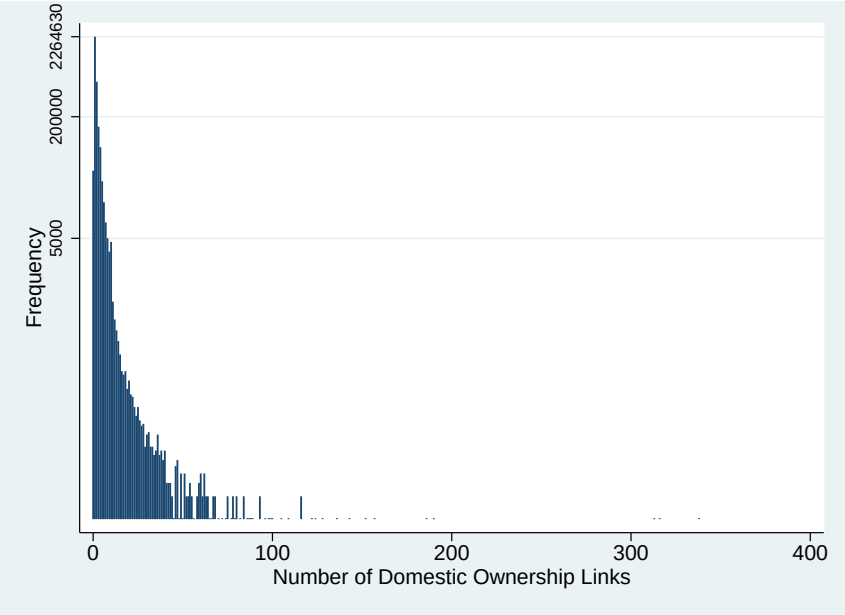


Figure 4: Foreign ownership: Scotland Region members, 2004

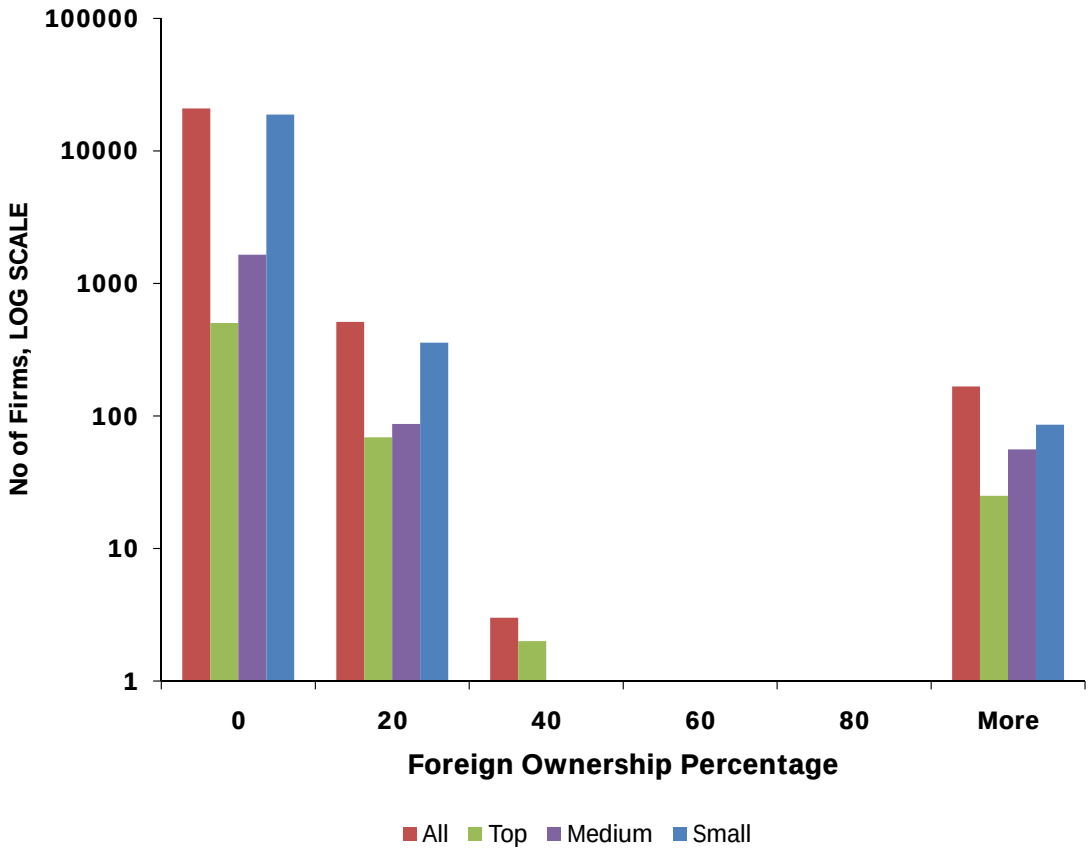


Figure 5: Foreign ownership: Oberbayern Region members, 2004

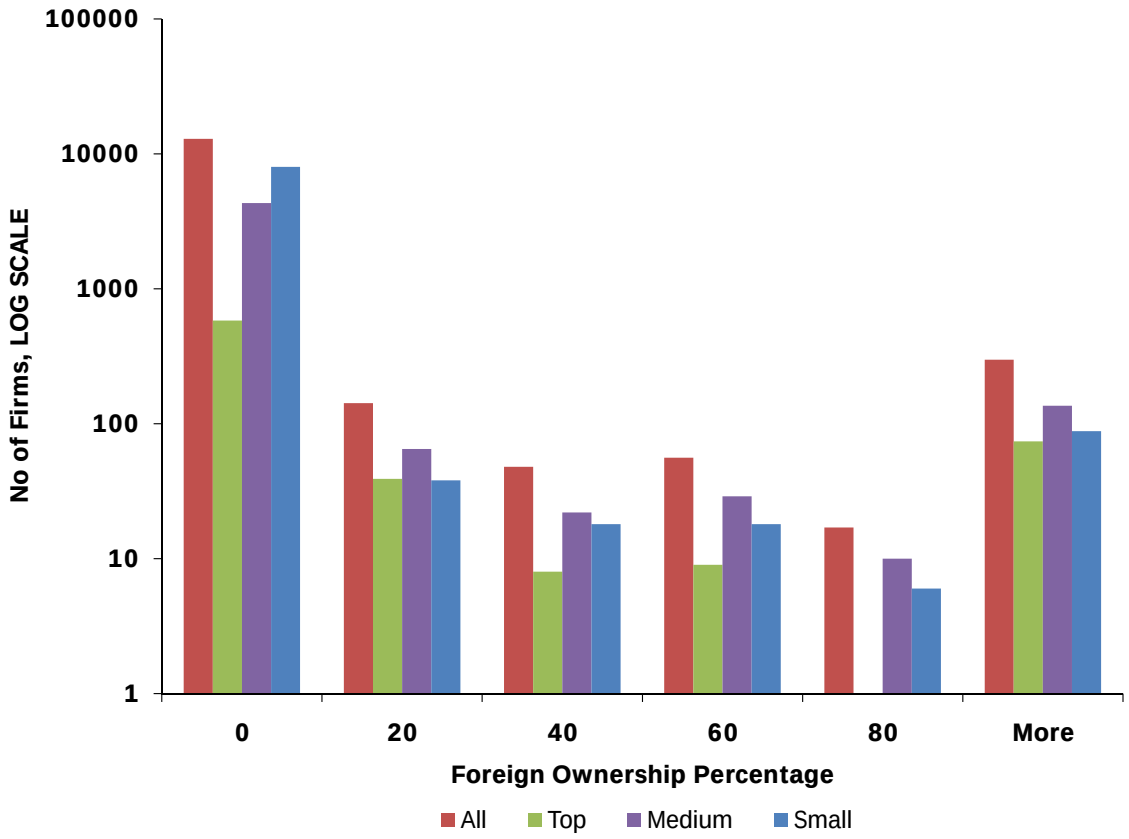
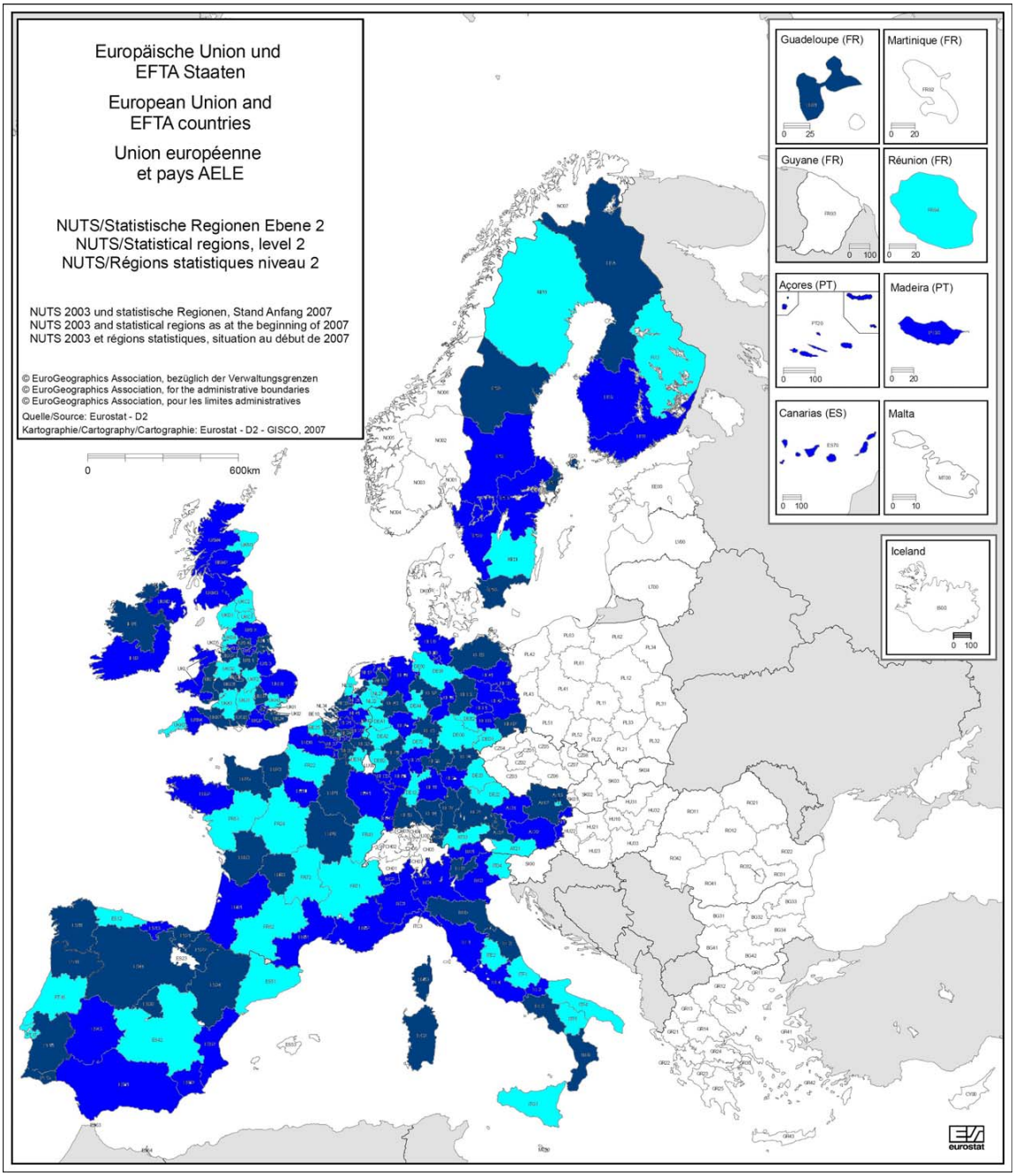


Figure 6: Deep financial integration at regional level



Notes: The darker color implies higher financial integration.

Appendix A: Classification of NACE rev. 1.1 sectors included in the calculation of the Specialization indices

Sectoral employment (number of persons employed) and total assets from Amadeus firm level data is calculated for the following 2-digit level sub-sectros of D–Manufacturing. These data is used to calculate Manufacturing Specialization Index.

Code	Name of the sub-sector
DA	Food, beverages and tobacco
DB	Textiles and textile products
DC	Leather and leather products
DD	Wood and wood products
DE	Pulp, paper and paper products
DF	Coke, refining and nuclear fuel
DG	Chemicals and man-made fibres
DH	Rubber and plastic products
DI	Other non-metallic mineral products
DJ	Basic metals and metal products
DK	Machinery and equipment, nec
DL	Electrical and optical equipment
DM	Transport equipment
DN	Nec (other)

Sectoral employment (number of persons employed) and total assets from Amadeus firm level data is calculated for the following 1-digit level sectors. These data is used to calculate 1-digit Specialization Index.

Code	Name of the sector
A	Agriculture, hunting and forestry
B	Fishing
C	Mining and quarrying
D	Manufacturing
E	Electricity, gas, and water
F	Construction
G	Wholesale and retail trade and repair services
H	Hotels and restaurants
I	Transport, storage, and communication
J	Financial intermediation
K	Real estate, renting, and business activities
L	Public administration and defence, compulsory social security
M	Education
N	Health and social work
O	Other community, social and personal service activities
P	Activities of households

Table 11: Appendix Table: Descriptive Statistics of Firm-Level Variables

Sample: Permanent firms over the period 2001–2005
Number of observations is 952,666

Raw Variables

variable	mean	sd	min	max
CVOPRE	15.5	11.6	0.0	56.5
SDGOPRE	17.9	13.5	0.1	63.9
FO	1.5	11.7	0.0	100.0
DO	1.3	0.8	0.0	5.0
TOAS (thousands)	2,927	8,836	1	68,000

Regression Variables

variable	mean	sd	min	max
Log CVOPRE	2.4	0.8	–3.5	4.0
Log SDGOPRE	2.6	0.8	–2.6	4.2
Log FO	0.1	0.6	0.0	4.6
Log DO	0.8	0.3	0.0	1.8
Log TOAS	13.2	1.8	6.9	18.0

Correlation of Regression Variables

	Log CVOPRE	Log FO	Log DO
Log FO	0.0091*	1.0000	
Log DO	0.0011	-0.2878*	1.0000
Log TOAS	-0.0639*	0.1640*	0.0784*

Correlation of Regression Variables

	Log SDGOPRE	Log FO	Log DO
Log FO	0.0022*	1.0000	
Log DO	-0.0074*	-0.2878*	1.0000
Log TOAS	-0.1062*	0.1640*	0.0784*

Notes: * denotes significance at 10%. The construction of the variables is described in Section 3 in detail. CVOPRE is the standard deviation of operating revenue over the period for individual firms, divided by the corresponding average over the period (the coefficient of variation) multiplied by 100. SDGOPRE is the standard deviation of operating revenue growth in percent over the period for individual firms. FO is Foreign Ownership Percentage defined as the sum of percentages of direct ownership by foreigners in a firm in 2004; DO is the Number of Domestic Ownership Links defined as the number of ownership links where the owner resides in the same country as the firm in 2004; TOAS is Total Assets is total firm assets in 2004. Operating revenue and total assets are in Euros at 2005 prices.