Deep Financial Integration and Volatility

PRELIMINARY

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Abstract

We investigate the relationship between financial integration, firm-level volatility, and aggregate output fluctuations. We ask whether capital market integration is associated with increased or decreased volatility of firms and whether firm-level volatility carries over to aggregate data. 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 cross-ownership within a region. First, we examine the effect of direct foreign ownership on firm-level volatility. Then we aggregate up to regions within countries to examine the effect of financial integration on aggregated volatility. Next, we study the effect of integration on the volatility of regional level GDP from Eurostat. We find a significant positive effect of deep financial integration on the volatility of firms' sales and employment. This effect survives aggregation (both by us and by Eurostat) and carries over to regional output. Interestingly, a higher level of domestic financial development has no effect on regional output volatility, nor do firms with more diversified domestic ownership structure display different levels of fluctuations.

JEL Classification: E32, F15, F36, O16

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1 Introduction

What is the effect of financial integration on volatility of output growth? We employ a novel approach to study this question in an empirical framework. 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 allows us to investigate whether aggregation "averages away" firm-level volatility, controlling for country-wide aggregate shocks.

Theory predicts an ambiguous effect of financial integration on output volatility. There are (at least) four different channels at work:[1] 1) 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 in turn is likely to lead to higher firm-level volatility. If certain regions (or countries) have comparative advantage in certain high risk/high return sectors, this will carry over to the aggregate level through increased specialization in these sectors resulting in higher macroeconomic volatility.[2] However, a higher level of sectoral specialization resulting from risk diversification may also lower the correlation between sectors leading to lower aggregate volatility.[3] 2) Financial integration may lower barriers to entry and hence increase the number of smaller firms, who may be more volatile.[4] Aggregate output, on the other hand, may become less volatile through averaging across a larger number of firms. 3) Under financial integration, when countries are hit by positive (negative) permanent productivity shocks, firms receive more (less) foreign investment. As a result, the effect of productivity shocks gets amplified, leading to higher aggregate volatility.[5] 4) Finally, corporate finance models with moral hazard can predict several outcomes: 4i) If negative

[1] Regardless of the effects on output volatility, theory suggests that financial integration should reduce consumption 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).

[2] See Obstfeld (1994). See Kalemli-Ozcan, Sorensen, and Yosha (2003) for empirical evidence. Domestic financial frictions might also lead to a complementarity between trade in assets and industrial specialization as recently emphasized by Antras and Caballero (2008).

[3] See Koren and Tenreyro (2007), who decompose sources of aggregate volatility into 3 parts: sectoral volatility, co-movement between sectors, and aggregate shocks.

[4] See Arrow (1971), Acemoglu and Zilibotti (1997), Black and Strahan (2002), and Kerr and Nanda (2007). Cetorelli and Strahan (2006), show an increase number of firms and a decrease in the average size of firm (decrease in monopoly power) as a result of innovation (banking reform). 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. Recently authors such as Caballero, Fahri, and Gourinchas (2008), and Mendoza, Quadrini, and Rios-Rull (2007), emphasize the role of domestic financial development on determining the patterns of external borrowing and lending and hence global volatility.

[5] See Baxter and Crucini (1995), who also allows for endogenous supply of labor.

shocks are associated with loss of collateral, foreign lenders may contract capital provision in bad times, exacerbating downturns and vice versa in good times; 4ii) 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, this will carry over to regions and countries.[6]

Overall, it is hard to test the predictions of these models. Firm level patterns may or may not hold in the aggregate data, when firms are heterogenous and complete insurance markets are absent. The empirical literature that uses country-level data have failed to deliver robust regularities.[7] The investigation of the effect of financial integration on aggregate volatility must wrestle with the following issues. First, as highlighted by the above discussion, one cannot assume that firm-level volatility and aggregate fluctuations will 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.[8] Others have shown that there has been a large increase of U.S. firm-level volatility during the same time period.[9] This difference can be explained by aggregate monetary policy shocks, but this appears not to be the full explanation. For example, some other studies find declining firm level volatility within the U.S.[10] 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. Averaging may not smooth away firm-level shocks, however, if the firm-size distribution is fat-tailed, such that a few large firms can drive aggregate volatility.[11] Therefore, an understanding of the effect of financial integration on the firm-level volatility is necessary in order to fully understand the effect of integration on the aggregate volatility.

[6]See Holmstrom and Tirole (1997) and Morgan, Rime, and Strahan (2004).

[7]Kose, Prasad, and Terrones (2004) find that increasing financial openness is associated with rising relative volatility of consumption and output. Bekaert, Harvey, and Lundblad (2006) find increased volatility of both output and consumption growth as a result of trade and financial openness. They also find 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.

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

[9]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.

[10]See Davis and Kahn (2008) and Davis et al. (2006).

[11]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 which is consistent with the fat-tailed size distributions.

Second, the effect of financial integration on aggregate volatility is hard to pin down using cross-country data. Figure 1 shows a positive relation between volatility, measured as the standard deviation of real GDP per capita growth between 1995 and 2005, and a measure of financial integration; namely, assets and liabilities divided by GDP and averaged over 1995–2005.[12] The figure suggests a strong relation, but countries differ in numerous aspect with respect to industrial structure, financial markets, policy, etc. It is therefore hard to know if the pattern seen in Figure 1 is simply capturing the impact of such country level features.

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.[13] In this case, analysis done at the country level, based on a representative agent framework, will be misleading. Hence, it is important to separate the effects of domestic financial development/integration from international financial integration.

We use firm-level data from AMADEUS and regional-level data from Eurostat. Both databases are for Europe. Europe provide an ideal "laboratory" for our study, because financial integration has increased cross-country ownership in Europe dramatically over the last 15 years. We can also investigate the role of financial integration and domestic financial development simultaneously by comparing within-country (across regions and firms) and between-country integration. 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 information to the regional level in order to examine if financial integration measured as average levels of foreign ownership are correlated with regional output volatility.[14] We 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 data give information for each firm of direct ownership by domestic as well as by foreign residents. We find a significant positive effect of international financial integration on the volatility of firms' sales and employment and we find that this carries over to regional output. Interestingly, a higher level of domestic financial development has no effect on regional output volatility, nor are firms with more diversified domestic ownership structure relative more volatile.

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

[12] These data are from Lane and Milesi-Ferretti (2004).
[13] See Ekinci, Kalemli-Ozcan, and Sorensen (2007), and Banerjee and Duflo (2005), respectively.
[14] We take asset-weighted averages of firm-level measures to construct regional measures.

specification and presents results. Section 5 concludes.

2 Conceptual Framework

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

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

where u_t^s is a **sector-specific** i.i.d shock, ν_t^a is a **country-specific** GDP shock and ϵ_i is a shock that is idiosyncratic for firm i.[15]

We can write aggregate volatility as:

$$Var(x_t^a) = \sum_i^n \alpha_i^2 Var(x_i) + 2\sum_{j>i}^n \alpha_i \alpha_j Cov(x_i, x_j) \tag{2}$$

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.[16] It is clear that a decline in aggregate volatility can be due to a decline in firm-level volatility, a decline in co-movement between firms or an increase in the number of firms.[17] As shown in equation (1), the co-movement between firms can come from the common component of the sector and country specific shocks.

The growth rate of output in country (or region) a and b will be:[18]

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

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

[15] Note that the assumption of sectoral shocks being i.i.d implies sectors being equally risky. This assumption may not hold in the data.

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

[17] Note that the previous empirical literature typically interprets i as indexing sectors due to unavailability of relevant firm-level data.

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

the average of the idiosyncratic firm shocks with mean zero. Note that these shocks will not average away 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.

If region has a comparative advantage in sector s then firms in region i 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 firm 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 or certain sectors growing large (higher γ_s).[19] These consideration deliver two testable implications: domestic cross-ownership will increase sectoral specialization and sectoral specialization will increase aggregate volatility.[20] The same effect can also be obtained via foreign ownership. Hence it is essential to investigate the effect of both.

There can be an additional role of foreign ownership as far as firms' production decisions are concerned. For a given level of sectoral specialization, a firm may often choose between a well-known safe mode of operation and a higher return/higher risk newer mode of operation. This is after firm decides to specialize in a certain sector and involves another risk/return trade-off. A domestic owner will be subject to sector, country, and idiosyncratic shocks as highlighted in equation (1). Country-level shocks cannot be diversified by domestic owners with no foreign diversification. If the domestic owner holds a diversified portfolio within his own country, sectoral shocks may be well diversified. For many companies, the idiosyncratic shocks may be much larger than sector-level shocks. Idiosyncratic shocks could be fully diversified if a company is owned by hundreds of thousands of diversified owners but diversification usually stops well short of this.[21] 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

[19] Koren and Tenreyo (2007) show that in the early stages of development countries specialize in less risky sectors. Volatility of these developing countries is still higher than the developed ones due to the decreased co-movement between sectors due to specialization. Their results are at odds with the results of Imbs and Wacziarg (2003) who show that sectoral level specialization first decreases and then increases with the stages of development a la predictions of Acemoglu and Zilibotti (1997).

[20] 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).

[21] Due to moral hazard all idiosyncratic risk of a firm cannot be diversified in the sense that the owner/operator often is required to hold a significant stake as modeled by Holmstrom and Tirole (1994).

the aversion to take on further risk. A foreign investor is able to diversify away country-level shocks and foreign investors may, therefore, choose production with higher risk and returns-. The management of firms with risky/high return operations may actively seek to raise capital in foreign capital markets.[22] This line of thought gives us our third testable implication that international financial integration will be associated with relatively high firm level volatility. Firm level volatility, will then carry over to regional volatility if the size distribution of firms is fat-tailed as discussed above.

3 Data and Construction of Variables

We construct a unique data set combining measures of firm-level foreign ownership and other firm characteristics 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 from the AMADEUS firm profile. Very often the name of a region in AMADEUS does not correspond to the name of the region according to the NUTS-2 classification in Eurostat. In those cases we match the firm to its NUTS-2 region by the geographical location of the city where the firm is located.

3.1 Firm-Level Data

The AMADEUS database is provided by Bureau van Dijk Electronic Publishing (BvD). AMADEUS is a financial database containing information on over 14 million public and private companies of large, medium, and small size (according to revenue, total assets, and number of employees) from 38 countries, including all EU countries and Eastern Europe. We construct a representative sample of between 2.8 and 4.1 million companies for different years by extracting all large, medium and small firms in the AMADEUS universe registered in the countries in our sample. The 2002 vintage of AMADEUS has a sample of 2,837,718 firms. The 2004 vintage has 4,077,986 firms, and the 2006 vintage has data for 2,661,630 firms. The AMADEUS Ownership database is the main source for the foreign ownership variables. We also utilize balance sheet information from the separate

[22] 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.

AMADEUS Financials database. A Technical Appendix (available upon request) describes these datasets and the construction of our variables in detail. In this section, we briefly summarize the main variables.

While collecting firm-level data, BvD takes advantage of the legal requirement for *all* European companies to file their accounts at official government registries in their own country. However, BvD collects firm information not only from official bodies, but also from reputable information providers,[23] directly from the companies (using the annual reports, private communications and questionnaires sent to the companies), or from any other available sources (company web-sites, telephone calls, news articles, press releases, and so on). The data is then organized in a standardized format resembling the most common formats used for firm accounts in Europe.

The majority of stock exchanges require publicly quoted ("listed") companies to disclose financial and ownership information. The AMADEUS database includes not only publicly quoted companies but also "unlisted" companies (not listed on a stock exchange or not traded over-the-counter). To have a more representative sample we would like to use all firms. Listed companies comprise a small number compared to the total number of all firms. There are about 10 thousand listed companies in the AMADEUS database, whereas the total number of companies in the database is 14 million!

Depending on the companies' organizational structure, the AMADEUS database may 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 the consolidated statements to avoid double counting since we have subsidiaries in the sample.

Matching of ownership and financial information at the firm-level

Ownership and balance sheet information are packaged by BvD as separate datasets and we match them by a unique firm identifier. While AMADEUS reports financial information from as early as 1996 and as late as 2007, the best firm coverage, especially regarding financial information, is for the 2002-2004 reporting years. Delays with financial reporting make the dataset incomplete for the later years and for the earlier years less firms were included in the database.

[23] Examples of information providers are 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 official filed and audited accounts.

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." In 2002, there are a total of 3,524,873 ownership links, for 2004 there are 6,459,095 links; and in 2006 sample there are 4,783,546 links. 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 (the variable ODIRECT in AMADEUS Ownership database). When the information source indicates that an entity A has a stake in Company B but the path through which the ownership is held is unknown, BvD calls the link a "total" ownership stake. In this paper, we focus on "direct" ownership links.

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

We illustrate the distribution of direct foreign ownership FO_i for two EU-regions. Figures 2 and 3 display the distribution of direct foreign ownership FO_i for 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 Financials (the AMADEUS Financials variable TOAS). 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 the regional NUTS-2 level data from the following twelve 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 and $w_{j,i}$ represents the weight of the company 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. TOAST_j is thus *region-specific*. We then calculate firm-specific weights as $w_{j,i} = \mathrm{TOAS}_i / \mathrm{TOAST}_j$.

Figure 4 display our measure of financial integration where we subtract the country average from the value for each region and paint each region accordingly. In our empirical work we include dummy variables for each country which implies that the results for the variables of interest are driven by within country differences and in Figure 4 we therefore display the level of foreign ownership of each region relative to the average of the country. The darker color represents a higher value of the foreign ownership and hence a higher level of financial integration.

3.2.2 Domestic Financial Development

We measure financial development as the weighted average 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. We use nominal data in national currency divided by the national CPI (for EMU countries, we divide by the Harmonized Average Consumer Price Index). We calculate growth rates as log-differences and the volatility of output as the standard deviation of the annual growth rate.

3.2.4 Regional Specialization

We calculate regional specialization indices following Kalemli-Ozcan, Sorensen, and Yosha (2003). We calculate the indices both by using data from AMADEUS and data from Eurostat. When we use the data from Eurostat we do not need to aggregate firm outcome to arrive at the regional outcome since Eurostat provides the regional data. When we use data from AMADEUS, we start by assigning firms to the 1-digit NACE sectors using the AMADEUS NACE codes for firms. Then we calculate total employment for these sectors using firm level employment for the given region.[24] Then, we calculate shares of each sector in total. Next we calculate the specialization index for sixteen 1-digit level sectors (see Appendix A for the list of sectors) for each NUTS-2 region, for a given year. 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:

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

[24] We use two firm outcomes to calculate the specialization index: employment and total assets.

where S is the number of sectors and K is the number of regions in the group. The index measures how the sectoral composition of in region j differs from the composition of in the other regions.[25]

The Manufacturing Specialization Index is calculated similarly using the shares of fourteen manufacturing sectors at the 2-digit NACE level in total employment in the Manufacturing (code D) sector in each region (see Appendix A for the list of sub-sectors).

3.3 Data Issues

The coverage of the firm-level data differs a lot from country to country and year to year. As mentioned before, the early issues of AMADEUS have relatively few firms. According to the BvD, major efforts to increase the coverage of ownership data were undertaken in 2002–2003. Hence, we use 2004 for our deep financial integration measure.

AMADEUS reports the geographic location of firms' headquarters while many firms have establishments which contribute to employment and output in different regions. If a region is the headquarter of many firms with production plants in other regions, then the total employment of firms the AMADEUS assigns to the region may be larger than total employment according to Eurostat. We can get an indicator of whether a region is dominated by headquarters or by establishments with headquarters in other regions by calculating a *Headquarterness Index* defined as the ratio of total employment of all the firms from our AMADEUS sample to the corresponding Eurostat employment series. Since the Eurostat collects data by the geographic location of production establishments and not by the legal location of the firm (which is its headquarter's location), the measure would show whether a given NUTS-2 region has relatively many headquarters compared to the number of establishments.

4 Empirical Analysis

We start by examining the effect of direct foreign ownership at the firm level on firm-level volatility. For firm-level outcomes we use sales and employment. Our second set of regression use average firm-level volatility across firms in a given region and regress this on an average measure of foreign ownership in the same region. We measure average foreign ownership in a region by a weighted average of direct ownership as described in the data section. This is our measure of deep financial

[25] We also calculated 1-digit specialization omitting sectors such as mining, agriculture, fisheries, and government, whose size is likely to depend on natural resource endowments.

integration. If the direct foreign ownership at the firm-level is distributed i.i.d., then this measure will display no variation and will have no effect on average volatility.[26] In our final set of regressions, we use the volatility of regional level GDP per capita growth from Eurostat and regress this on our measure of deep financial integration.[27]

4.1 Descriptive Statistics

Tables 1–9 presents descriptive statistics and correlations for both firm-level and regional data.

4.2 Specification: Firm-Level

We regress the volatility of firm output on indicators of 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, establishments, etc. Our specification is:

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

where VOL_{ij} is the standard deviation of sales and/or employment growth over the period 2002–2006 for firm i in region j. μ_c is a country-specific constant, and μ_s is a set of sectoral dummies (2 digit). FO_i is the percent foreign ownership for firm i located in region j and DO_{ij} is percent domestic ownership for firm i located in region j. Both these variable are measured at the beginning of the sample in 2002. $\mathbf{X}'_{ij}$ is a matrix of controls for firm size. Sectoral dummies are based on the firm's primary industry code at the 2-digit level.

4.3 Specification: Regional Level

We estimate the relation between integration and volatility at the regional level as follows:

$$VOL_j = \mu_c + \alpha\, FI_j + \beta\, FD_j + \mathbf{X}'_j\delta + \epsilon_j\,, \tag{7}$$

[26] If the size distribution of firms is very heavy-tailed, this is not necessarily true for the weighted data.

[27] Note, that we can sum all the firms in a region and calculate volatility based on this sum and regress this measure on our measure of deep financial integration. Here if firm-outcomes are distributed i.i.d., the dependent variable will display no variation and we would find no relationship between financial integration and regional volatility. However given the previously mentioned headquarters problem and the fact that many of our regions are small regions we may not be able to distinguish between a "true" no variation and noise caused by these problems. This is why we prefer to use Eurostat data.

where VOL_j is the standard deviation of (real, per capita) GDP growth of region j over the period 1996–2005. μ_c is a country-specific constant, and FI_j is our measure of financial integration based on foreign ownership at the firm-level and averaged to regional level. FD_j is our measure of domestic financial development based on diversified domestic ownership. We use 2004 values for FI and FD given the fact that we have the best coverage in that year, an important issue in aggregating to regions. $\mathbf{X}'_j$ is a matrix of controls for regional size, number of firms and sectoral specialization.

4.4 Regression Results

Table 10 shows the results of OLS regressions of equation (6). We show results for sales, Operating revenue, and employees—we include operating revenue because this variable is available for the larger number of firms (more than 1.5 million). 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, operating revenue, or employment. The impact of domestic ownership is not robustly estimated, the coefficient is positive for operating revenue, otherwise negative. (The positive coefficient is significant at the 5 percent level, but with 1.5 million observations this could well be a coincidence.) In particular, it appears that domestic ownership is associated with lower volatility of employment. Larger firms are less volatile as shown by the large coefficient to log assets (with an "off-the-chart" t-value).

In Table 11, the data are weighed by the square root of assets implying a much larger weight to large firms. Again foreign ownership is highly significant while the coefficient to domestic cross-ownership changes sign across the columns. Larger firms, as measured by assets, still are predicted to be less volatile. The coefficient to log-assets is smaller now that small companies have been given smaller weights.

Table 12 performs the weighted least squares regression only for large firms.[28] In this regression, where the results are dominated by very large firms there is no traceable impact on domestic cross ownership on volatility. We abstain from speculating why, but there is lower volatility of employment for small firms with diversified domestic ownership.

Table 13 considers whether averaging of ownership across firms in a regions "kills" the variation.

[28] Large firms are the firms who have assets more than 10 million euros and employees more than 100.

The left-hand side variable is now average volatility and the regressions are performs using regions as observations. We find that average foreign ownership clearly is associated with higher volatility with the coefficient being statistically significant at the one percent level. Domestic cross-ownership is not significant. The results are very robust to whether volatility is calculated from employment or from operating revenue.

Table 14 displays results from the estimation of equation (7). As discussed before, we use 184 regions from EU countries. The coefficient to foreign ownership is statistically significant at the 5 percent level for all the specifications, while domestic financial development has no effect. We also observe that more populous regions are less volatile with a second order term, indicating a U-shape, being significant in most columns.[29] Specialization is significant whether it is measured at the 1-digit and at the 2-digit level although the 2-digit specialization index is clearly more significant in statistical terms. Specialization is positively correlated with volatility as predicted by theories outlined in the introduction. The inclusion of specialization does not reduce the impact of foreign ownership markedly, so while the results are consistent with a channel from foreign ownership to sectoral specialization to volatility this appears not to the main channel. This, of course, doesn't rule out that effect of foreign ownership is due to specialization at the firm-level instead of sectoral level (which is what was measured in the table), meaning firms are investing in more risky projects. In fact this type of behavior will manifest itself in higher level firm volatility as discussed before, which is what we found.

We find the expected negative effect of number of firms on volatility. This variable is significant at only the 10 percent level and it doesn't change the estimated effect of the cross-ownership variables. Overall, there is strong evidence that higher foreign ownership is associated with higher volatility and this effect is robust to various controls.

Table 15 presents preliminary evidence on the determinants of specialization. We consider whether specialization, in either 1-digit sectors or manufacturing sub-sectors, is higher where there is a higher level of foreign ownership or domestic cross-ownership. We do not find evidence of an impact of foreign ownership on sectoral specialization, which is consistent with finding of a direct effect of foreign ownership on volatility. However, we find a strong positive significant effect of domestic cross-ownership on 1-digit industrial specialization. Larger regions are, as expected, less

[29]This non-linear relationship is consistent with the model of Acemoglu and Zilibotti (1997) and the evidence provided in Imbs and Wacziarg (2003) and Kalemli-Ozcan, Sorensen, and Yosha (2003). The non-linear effect disappears though once we control for specialization, again consistent with the evidence in Kalemli-Ozcan, Sorensen, and Yosha (2003).

specialized while regions that include countries' capital city tend to be more specialized.

5 Conclusions

TO BE WRITTEN...

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Table 1: Descriptive statistics for firm level data: Sample 1

Raw data

variable	N	mean	sd	min	max
CVSALE	1,183,342	24.8	27.3	0	223.6
CODIRECTF	1,183,342	0.1	2.7	0	100.0
CLINKSDOM	1,183,342	1.2	1.0	1	242.0
TOAS	1,183,342	1.3e+07	1.1e+09	2	8.1e+11

	CVSALE	CODIRECTF	CLINKSDOM
CODIRECTF	-0.0018*		
CLINKSDOM	-0.0240*	0.0290*	
TOAS	-0.0005	0.0093*	0.0168*

Regression variables

variable	N	mean	sd	min	max
LCVSALE	1,183,342	2.7	1.0	-10.1	5.4
LCODIRECTF	1,183,342	0.0	0.2	0.0	4.6
LCLINKSDOM	1,183,342	0.1	0.3	0.0	5.5
LTOAS	1,183,342	13.3	1.8	0.7	27.4

	LCVSALE	LCODIRECTF	LCLINKSDOM
LCODIRECTF	-0.0047*		
LCLINKSDOM	-0.0413*	0.0621*	
LTOAS	-0.0324*	0.0932*	0.2048*

Notes: Unit of observation is a firm. Sample 1 is the sample of firms for the outcome variable "Sales." CVSALE—the Coefficient of Variation (in %) of Sales, 2002–2006; CODIRECTF—Foreign Ownership Percentage, 2002; CLINKSDOM—Number of Domestic Ownership Links, 2002; TOAS—Total Assets, 2002. The letter "L" represents Ln transformation. Sales and Total Assets are in local currency at 2005 prices.

Table 2: Descriptive statistics for firm level data: Sample 2

Raw data

variable	N	mean	sd	min	max
CVOPRE	1,506,502	26.6	29.2	0	223.6
CODIRECTF	1,506,502	0.1	2.7	0	100.0
CLINKSDOM	1,506,502	1.2	0.9	1	242.0
TOAS	1,506,502	1.3e+07	1.0e+09	1	8.1e+11

	CVOPRE	CODIRECTF	CLINKSDOM
CODIRECTF	-0.0012		
CLINKSDOM	-0.0266*	0.0345*	
TOAS	0.0039*	0.0125*	0.0208*

Regression variables

variable	N	mean	sd	min	max
LCVOPRE	1,506,502	2.8	1.0	-8.1	5.4
LCODIRECTF	1,506,502	0.0	0.2	0.0	4.6
LCLINKSDOM	1,506,502	0.1	0.3	0.0	5.5
LTOAS	1,506,502	13.0	2.2	0.0	27.4

	LCVSALE	LCODIRECTF	LCLINKSDOM
LCODIRECTF	-0.0026*		
LCLINKSDOM	-0.0420*	0.0782*	
LTOAS	-0.0799*	0.0878*	0.2191*

Notes: Unit of observation is a firm. Sample 2 is the sample of firms for the outcome variable "Operating Revenue." CVSALE—the Coefficient of Variation (in %) of Sales, 2002–2006; CODIRECTF—Foreign Ownership Percentage, 2002; CLINKSDOM—Number of Domestic Ownership Links, 2002; TOAS—Total Assets, 2002. The letter "L" represents Ln transformation. Operating revenue includes sales, stock variations, and other operating revenues. Operating Revenue and Total Assets are in local currency at 2005 prices.

Table 3: Descriptive statistics for firm level data: Sample 3

Raw data

variable	N	mean	sd	min	max
CVEMPL	771,961	24.1	21.0	0	223.4
CODIRECTF	771,961	0.1	3.3	0	100.0
CLINKSDOM	771,961	1.2	1.1	1	242.0
TOAS	771,961	2.0e+07	1.1e+09	1	8.1e+11

Correlation Matrix

	CVEMPL	CODIRECTF	CLINKSDOM
CODIRECTF	-0.0052*		
CLINKSDOM	-0.0472*	0.0384*	
TOAS	-0.0052*	0.0173*	0.0294*

Regression variables

LCVEMPL	771,961	2.8	0.9	-3.6	5.4
L1CODIRECTF	771,961	0.0	0.2	0.0	4.6
LCLINKSDOM	771,961	0.1	0.4	0.0	5.5
LTOAS	771,961	13.8	1.8	0.0	27.4

Correlation Matrix

	LCVEMPL	LCODIRECTF	LCLINKSDOM
LCODIRECTF	-0.0217*		
LCLINKSDOM	-0.1098*	0.0915*	
LTOAS	-0.2926*	0.1125*	0.2043*

Notes: Unit of observation is a firm. Sample 3 is the sample of firms for the outcome variable "Employment." LCVEMPL—the Coefficient of Variation (in %) of Employment, 2002–2006; CODIRECTF—Foreign Ownership Percentage, 2002; CLINKSDOM—Number of Domestic Ownership Links, 2002; TOAS—Total Assets, 2002. The letter "L" represents Ln transformation. Total Assets are in local currency at 2005 prices.

Table 4: Descriptive statistics for regional level raw data: AMADEUS (Sample 1)

Variable	Mean	Std. dev.	Min	Max
CVemA0206	12.49	9.81	0.34	107.49
FDOA	1.00	0.89	0.00	5.03
WDomLnks	2.15	1.40	0.68	16.19
Frm	0.15	0.21	0.00	1.87
Frm2	0.07	0.30	0.00	3.49
CapitReg	0.06	0.24	0.00	1.00
SPECama1a	0.07	0.07	0.00	0.61
SPECama2ma	0.15	0.15	0.01	0.71

Correlation Matrix

Variable	1	2	3	4	5	6	7
CVemA0206	1.00	0.13	-0.08	-0.08	-0.05	-0.00	0.07
FDOA	0.13	1.00	0.20	0.24	0.20	0.23	-0.08
WDomLnks	-0.08	0.20	1.00	0.02	0.01	0.09	0.14
Frm	-0.08	0.24	0.02	1.00	0.88	0.17	-0.15
Frm2	-0.05	0.20	0.01	0.88	1.00	0.14	-0.04
CapitReg	-0.00	0.23	0.09	0.17	0.14	1.00	0.08
SPECama1a	0.07	-0.08	0.14	-0.15	-0.04	0.08	1.00
SPECama2ma	0.06	-0.20	0.14	-0.20	-0.09	0.08	1.00

Notes: Unit of observation is a NUTS2 region. Sample 1 is the sample of regions for the outcome variable the Coefficient of Variation (%) of Employment, 2002-06. CVrevA0206: Coefficient of Variation (%) of Employment, 2002-06; FDOA: Foreign Ownership of Firm Assets, 2002; WDomLnks: Number of Domestic Ownership Links, 2002; Frm and Frm2: Number of firms and Number of firms^2 (hundred thousands), 2002; CapitReg: capital region dummy; SPECama1a: Regional Specialization (1-digit Sectors) based on total assets, 2002; SPECama2ma: Regional Specialization (2-digit Manuf. Sectors)based on Employment, 2002.

Table 5: Descriptive statistics for regional level raw data: AMADEUS (Sample 2)

Variable	Mean	Std. dev.	Min	Max
CVrevA0206	20.87	16.45	3.82	152.31
FDOA	1.00	0.90	0.00	5.03
WDomLnks	2.14	1.41	-0.04	16.19
Frm	0.15	0.21	0.00	1.87
Frm2	0.07	0.30	0.00	3.49
CapitReg	0.06	0.24	0.00	1.00
SPECama1a	0.08	0.19	0.00	2.40
SPECama2ma	0.17	0.24	0.01	2.75

Correlation Matrix

Variable	1	2	3	4	5	6	7
CVrevA0206	1.00	0.17	-0.02	0.01	-0.01	0.08	0.58
FDOA	0.17	1.00	0.19	0.25	0.20	0.23	0.07
WDomLnks	-0.02	0.19	1.00	0.01	0.01	0.10	-0.05
Frm	0.01	0.25	0.01	1.00	0.88	0.17	-0.00
Frm2	-0.01	0.20	0.01	0.88	1.00	0.14	-0.01
CapitReg	0.08	0.23	0.10	0.17	0.14	1.00	0.02
SPECama1a	0.58	0.07	-0.05	-0.00	-0.01	0.02	1.00
SPECama2ma	0.46	-0.03	-0.01	-0.07	-0.05	0.04	1.00

Notes: Unit of observation is a NUTS2 region. Sample 2 is the sample of regions for the outcome variable the Coefficient of Variation (%) of Operating Revenue (2005 prices), 2002-06. CVrevA0206: Coefficient of Variation (%) of Operating Revenue (2005 prices), 2002-06; FDOA: Foreign Ownership of Firm Assets, 2002; WDomLnks: Number of Domestic Ownership Links, 2002; Frm and Frm2: Number of firms and Number of firms^2 (hundred thousands), 2002; CapitReg: capital region dummy; SPECama1a: Regional Specialization (1-digit Sectors) based on total assets, 2002; SPECama2ma: Regional Specialization (2-digit Manuf. Sectors)based on Employment, 2002.

Table 6: Descriptive statistics for regional level transformed data: AMADEUS (Sample 1)

Variable	Mean	Std. dev.	Min	Max
lnCVemA0206	2.32	0.70	-1.08	4.68
lnFDOA	0.61	0.40	0.00	1.80
lnWDomLnks	1.09	0.30	0.52	2.84
Frm	0.15	0.21	0.00	1.87
Frm2	0.07	0.30	0.00	3.49
CapitReg	0.06	0.24	0.00	1.00
lnSPECama1a	-3.17	1.03	-6.04	-0.49
lnSPECama2ma	-2.28	0.88	-4.30	-0.34

Correlation Matrix

Variable	1	2	3	4	5	6	7
lnCVemA0206	1.00	0.14	-0.12	0.04	-0.01	0.02	-0.11
lnFDOA	0.14	1.00	0.10	0.23	0.17	0.20	-0.10
lnWDomLnks	-0.12	0.10	1.00	0.04	0.04	0.10	0.16
Frm	0.04	0.23	0.04	1.00	0.88	0.17	-0.15
Frm2	-0.01	0.17	0.04	0.88	1.00	0.14	-0.04
CapitReg	0.02	0.20	0.10	0.17	0.14	1.00	0.08
lnSPECama1a	0.01	-0.06	0.13	-0.21	-0.02	0.13	1.00
lnSPECama2ma	0.04	-0.17	0.13	-0.20	-0.07	0.04	1.00

Notes: Unit of observation is a NUTS2 region. Sample 1 is the sample of regions for the outcome variable the Coefficient of Variation (%) of Employment, 2002-06. CVrevA0206: Coefficient of Variation (%) of Employment, 2002-06; FDOA: Foreign Ownership of Firm Assets, 2002; WDomLnks: Number of Domestic Ownership Links, 2002; Frm and Frm2: Number of firms and Number of firms^2 (hundred thousands), 2002; CapitReg: capital region dummy; SPECama1a: Regional Specialization (1-digit Sectors) based on total assets, 2002; SPECama2ma: Regional Specialization (2-digit Manuf. Sectors)based on Employment, 2002. "ln" represents logarithmic transformation.

Table 7: Descriptive statistics for regional level transformed data: AMADEUS (Sample 2)

Variable	Mean	Std. dev.	Min	Max
lnCVrevA0206	2.88	0.52	1.34	5.03
lnFDOA	0.61	0.40	0.00	1.80
lnWDomLnks	1.09	0.31	-0.04	2.84
Frm	0.15	0.21	0.00	1.87
Frm2	0.07	0.30	0.00	3.49
CapitReg	0.06	0.24	0.00	1.00
lnSPECama1a	-3.15	1.07	-6.04	0.88
lnSPECama2ma	-2.26	0.91	-4.30	1.01

Correlation Matrix

Variable	1	2	3	4	5	6	7
lnCVrevA0206	1.00	0.20	0.06	0.04	-0.00	0.16	0.27
lnFDOA	0.20	1.00	0.07	0.24	0.17	0.20	0.06
lnWDomLnks	0.06	0.07	1.00	0.02	0.03	0.10	-0.19
Frm	0.04	0.24	0.02	1.00	0.88	0.17	-0.00
Frm2	-0.00	0.17	0.03	0.88	1.00	0.14	-0.01
CapitReg	0.16	0.20	0.10	0.17	0.14	1.00	0.02
lnSPECama1a	0.22	-0.02	0.09	-0.18	-0.02	0.12	1.00
lnSPECama2ma	0.15	-0.13	0.09	-0.17	-0.07	0.04	1.00

Notes: Unit of observation is a NUTS2 region. Sample 2 is the sample of regions for the outcome variable the Coefficient of Variation (%) of Operating Revenue (2005 prices), 2002-06. CVrevA0206: Coefficient of Variation (%) of Operating Revenue (2005 prices), 2002-06; FDOA: Foreign Ownership of Firm Assets, 2002; WDomLnks: Number of Domestic Ownership Links, 2002; Frm and Frm2: Number of firms and Number of firms^2 (hundred thousands), 2002; CapitReg: capital region dummy; SPECama1a: Regional Specialization (1-digit Sectors) based on total assets, 2002; SPECama2ma: Regional Specialization (2-digit Manuf. Sectors)based on Employment, 2002. "ln" represents logarithmic transformation.

Table 8: Descriptive statistics for regional level raw data: Eurostat

Variable	Mean	Std. dev.	Min	Max
SDgdpgr	1.92	0.90	0.52	6.42
lnSPECama1e	0.05	0.08	0.00	0.52
SPECama2me	0.10	0.14	0.01	0.90
FDOA	1.02	0.91	0.01	7.20
Frmpc	12.26	13.59	1.08	145.11
Popul	1.93	1.59	0.06	11.10
Popul2	6.21	13.02	0.00	123.13
CapitReg	0.06	0.24	0.00	1.00
HQness	1.00	1.58	0.06	16.02
WLnks	2.54	2.04	0.55	19.82

Correlation Matrix

Variable no.	1	2	3	4	5	6	7	8	9	10
SDgdpgr	1.00	0.43	0.34	0.11	0.01	-0.17	-0.12	0.10	-0.07	-0.08
lnSPECama1e	0.43	1.00	1.00	0.03	-0.06	-0.00	0.07	0.23	0.03	-0.02
lnSPECama2me	0.34	1.00	1.00	0.03	-0.10	-0.16	-0.09	0.07	-0.04	-0.06
FDOA	0.11	0.03	0.03	1.00	0.08	0.03	0.02	0.07	0.12	-0.03
Frmpc	0.01	-0.06	-0.10	0.08	1.00	-0.07	-0.06	0.07	0.52	0.05
Popul	-0.17	-0.00	-0.16	0.03	-0.07	1.00	0.91	0.29	0.35	0.25
Popul2	-0.12	0.07	-0.09	0.02	-0.06	0.91	1.00	0.29	0.42	0.21
CapitReg	0.10	0.23	0.07	0.07	0.07	0.29	0.29	1.00	0.16	0.29
HQness	-0.07	0.03	-0.04	0.12	0.52	0.35	0.42	0.16	1.00	0.16
WLnks	-0.08	-0.02	-0.06	-0.03	0.05	0.25	0.21	0.29	0.16	1.00

Notes: SDgdpgr: Standard deviation of GDP per capita growth, 1996–2005; FDOA: Foreign Ownership of Firm Assets, 2004; Wlnks: Number of Domestic Ownership Links, 2004; Popul: Average Population (millions); CapitReg: Capital Region; HQness: Headquarterness Index; SPECama1e: Regional Specialization (1-digit Sectors) based on Employment, 2004; SPECama2me: Regional Specialization (2-digit Manuf. Sectors)based on Employment, 2004; Frmpc: Firms per '000 of Population, 2004

Table 9: Descriptive statistics for regional level transformed data: Eurostat

Variable	Mean	Std. dev.	Min	Max
SDgdpgr	1.92	0.90	0.52	6.42
lnSPECama1e	0.05	0.08	0.00	0.52
lnSPECama2me	0.10	0.14	0.01	0.90
lnFDOA	0.63	0.35	0.01	2.10
lnFrmpc	2.33	0.68	0.73	4.98
Popul	1.93	1.59	0.06	11.10
Popul2	6.21	13.02	0.00	123.13
CapitReg	0.06	0.24	0.00	1.00
lnHQness	-0.41	0.85	-2.80	2.77
lnWLnks	0.79	0.47	-0.59	2.99

Correlation Matrix

Variable no.	1	2	3	4	5	6	7	8	9	10
SDgdpgr	1.00	0.43	0.34	0.11	0.01	-0.17	-0.12	0.10	-0.18	-0.15
lnSPECama1e	0.43	1.00	1.00	0.03	-0.12	-0.00	0.07	0.23	0.09	-0.06
lnSPECama2me	0.34	1.00	1.00	-0.03	-0.23	-0.16	-0.09	0.07	-0.02	-0.08
lnFDOA	0.11	0.03	-0.03	1.00	0.17	0.07	0.05	0.13	0.24	-0.05
lnFrmpc	0.01	-0.12	-0.23	0.17	1.00	-0.04	-0.04	0.09	0.48	0.09
Popul	-0.17	-0.00	-0.16	0.07	-0.04	1.00	0.91	0.29	0.31	0.30
Popul2	-0.12	0.07	-0.09	0.05	-0.04	0.91	1.00	0.29	0.29	0.26
CapitReg	0.10	0.23	0.07	0.13	0.09	0.29	0.29	1.00	0.27	0.24
lnHQness	-0.18	0.09	-0.02	0.24	0.48	0.31	0.29	0.27	1.00	0.35
lnWLnks	-0.15	-0.06	-0.08	-0.05	0.09	0.30	0.26	0.24	0.35	1.00

Notes: SDgdpgr: Standard deviation of GDP per capita growth, 1996–2005; lnFDOA: Ln Foreign Ownership of Firm Assets, 2004; lnWLnks: Ln Number of Domestic Ownership Links, 2004; Popul: Average Population (millions); CapitReg: Capital Region; lnHQness: Ln Headquarterness Index; lnSPECama1e: Ln Regional Specialization (1-digit Sectors) based on Employment, 2004; lnSPECama2me: Ln Regional Specialization (2-digit Manuf. Sectors)based on Employment, 2004; lnFrmpc: Ln Firms per '000 of Population, 2004.

Table 10: Firm-Level Volatility: OLS

Dependent variable: Logarithm of the Coefficient of Variation (%) of the Firm Outcome, 2002–2006

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	OLS	OLS	OLS	OLS	OLS
Firm Outcome	Sales	Operating Revenue	Number of Employees	Sales	Operating Revenue	Number of Employees
Ln Foreign Ownership Percentage, 2002	4.42*** (0.55)	5.95*** (0.51)	8.51*** (0.47)	4.48*** (0.55)	5.90*** (0.51)	8.93*** (0.47)
Ln Number of Domestic Ownership Links, 2002				–1.15*** (0.28)	0.54** (0.28)	–3.98*** (0.28)
Ln Total Assets, 2002	–5.77*** (0.06)	–4.95*** (0.04)	–16.20*** (0.06)	–5.72*** (0.06)	–4.97*** (0.04)	–16.01*** (0.06)
Country Dummies	yes	yes	yes	yes	yes	yes
2-digit Sector Dummies	yes	yes	yes	yes	yes	yes
R^2	0.085	0.080	0.145	0.085	0.080	0.145
Obs	1,183,342	1,506,502	771,961	1,183,342	1,506,502	771,961

Notes: The coefficients are multiplied by 100. Standard errors are in parentheses. *** , **, and * denote significance at 1%, 5%, and 10%. Operating revenue includes sales, stock variations, and other operating revenues. Sales, operating revenue, and total assets are in local currency at 2005 prices.

Table 11: Firm-Level Volatility: WLS

Dependent variable: Logarithm of the Coefficient of Variation (%)
of the Firm Outcome, 2002–2006

	(1)	(2)	(3)	(4)	(5)	(6)
	WLS	WLS	WLS	WLS	WLS	WLS
Firm Outcome	Sales	Operating Revenue	Number of Employees	Sales	Operating Revenue	Number of Employees
Ln Foreign Ownership Percentage, 2002	5.48***	5.44***	7.75***	5.59***	5.42**	8.02***
	(0.22)	(0.19)	(0.22)	(0.23)	(0.20)	(0.22)
Ln Number of Domestic Ownership Links, 2002				–0.71***	0.14	–1.43***
				(0.21)	(0.19)	(0.23)
Ln Total Assets, 2002	–3.60***	–1.88***	–8.79***	–3.55***	–1.89**	–8.69***
	(0.04)	(0.03)	(0.05)	(0.04)	(0.04)	(0.05)
Country Dummies	yes	yes	yes	yes	yes	yes
2-digit Sector Dummies	yes	yes	yes	yes	yes	yes
R^2	0.080	0.073	0.120	0.080	0.073	0.120
Obs	1,183,342	1,506,502	771,961	1,183,342	1,506,502	771,961

Notes: The coefficients are multiplied by 100. WLS estimation uses firm total assets as weights. Standard errors are in parentheses. *** , **, and * denote significance at 1%, 5%, and 10%. Operating revenue includes sales, stock variations, and other operating revenues. Sales, operating revenue, and total assets are in local currency at 2005 prices.

Table 12: Firm-Level Volatility: WLS, Large firms

Dependent variable: Logarithm of the Coefficient of Variation (%) of the Firm Outcome, 2002–2006

	(1)	(2)	(3)	(4)
	WLS	WLS	WLS	WLS
Firm Outcome:	Sales	Number of Employees	Sales	Number of Employees
Ln Foreign Ownership Percentage, 2002	4.89*** (0.55)	4.80*** (0.51)	4.81*** (0.55)	4.83*** (0.52)
Ln Number of Domestic Ownership Links, 2002			0.48 (0.62)	–0.09 (0.60)
Ln Total Assets, 2002	–1.48*** (0.20)	–2.20*** (0.19)	–1.52*** (0.21)	–2.20*** (0.19)
Country Dummies	Yes	Yes	Yes	Yes
2-digit Sector Dummies	Yes	Yes	Yes	Yes
R^2	0.09	0.11	0.09	0.11
Obs	68,503	78,046	68,503	78,046

Notes: The coefficients are multiplied by 100. WLS estimation uses firm total assets as weights. Standard errors are in parentheses. *** , **, and * denote significance at 1%, 5%, and 10%. The variables are calculated using the large firms in terms of sales, total assets, and number of employees according to AMADEUS classification.

Table 13: Volatility of Regional GDP Growth: Aggregation from AMADEUS.

Dependent variable: Logarithm of Average Coefficient of Variation (%) of the Firm Outcome, 2002–2006								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Firm Outcome	Emp.	Emp.	Emp.	Emp.	Op. Rev.	Op. Rev.	Op. Rev.	Op. Rev.
Ln Foreign Ownership of Firm Assets, 2002	0.30*** (0.09)	0.28*** (0.09)	0.29*** (0.09)	0.31*** (0.09)	0.28*** (0.07)	0.26*** (0.07)	0.26*** (0.07)	0.29*** (0.07)
Ln Number of Domestic Ownership Links, 2002	–0.02 (0.15)	–0.02 (0.14)	0.01 (0.15)	–0.03 (0.15)	–0.15 (0.11)	–0.16^{+} (0.11)	–0.06 (0.11)	–0.10 (0.11)
Number of Firms (hundred thousands), 2002	0.26 (0.44)	0.17 (0.45)	0.20 (0.44)	0.28 (0.45)	1.02*** (0.34)	0.94*** (0.34)	0.84** (0.34)	0.91*** (0.34)
Number of Firms^2 (hundred thousands), 2002	–0.24 (0.27)	–0.21 (0.27)	–0.20 (0.27)	–0.25 (0.27)	–0.55*** (0.21)	–0.53** (0.21)	–0.47** (0.21)	–0.50** (0.21)
Capital Region		0.23^{+} (0.15)				0.21* (0.12)		
Ln Regional Specialization (1-digit Sectors), 2002			–0.67 (0.49)				0.46*** (0.15)	
Ln Regional Specialization (2-digit Manuf. Sectors), 2002				0.11 (0.26)				0.29** (0.12)
Country Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.57	0.58	0.58	0.57	0.52	0.53	0.54	0.54
Observations	183	183	183	183	184	184	184	184

Notes: Standard errors are in parentheses. *** , **, *, and $^{+}$ denote significance at 1%, 5%, 10%, and 15%. The dependent variable is a weighted average of firm level coefficient of variation calculated over the stated time period for a given region. Weights are firm's total assets. Emp. represents number of employees and Op. Rev. represents operating revenue. The variables are calculated using all companies with available data.

Table 14: Volatility of Regional GDP Growth: EUROSTAT

Dependent variable: Standard deviation of GDP per capita growth, 1996–2005

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Ln Foreign Ownership of Firm Assets, 2004	0.29** (0.13)	0.27** (0.13)	0.35** (0.14)	0.27** (0.13)		0.29** (0.13)	0.33** (0.13)
Ln Number of Domestic Ownership Links, 2004	–0.03 (0.13)	–0.07 (0.13)	0.03 (0.13)	–0.03 (0.13)	–0.07 (0.13)	–0.00 (0.12)	0.01 (0.13)
Average Population (millions)	–0.18** (0.08)	–0.19** (0.08)	–0.17** (0.08)	–0.15** (0.08)	–0.13* (0.08)	–0.13* (0.08)	–0.17** (0.08)
Average Population^2 (millions)	0.02** (0.01)	0.02* (0.01)	0.02** (0.01)	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)	0.02* (0.01)
Capital Region		0.22 (0.22)					
Ln Headquarterness Index			–0.10 (0.07)				
Ln Regional Specialization (1-digit Sectors), 2004				1.70** (0.77)	1.78** (0.78)		
Ln Regional Specialization (2-digit Manuf. Sectors), 2004						1.21*** (0.38)	
Ln Firms per '000 of Population, 2004							–0.21* (0.13)
Country Dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.52	0.53	0.53	0.53	0.52	0.55	0.53
Observations	184	184	182	184	184	184	184

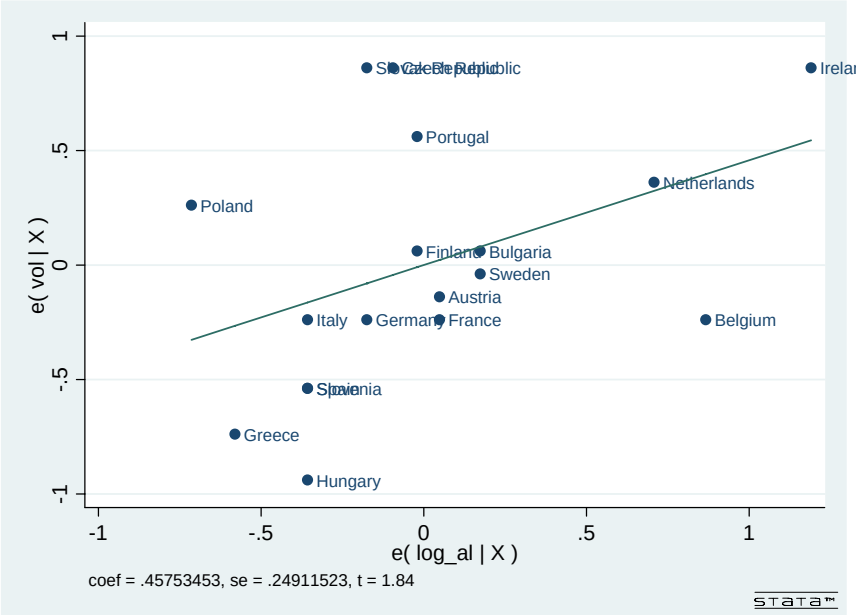
Notes: Standard errors are in parentheses. *** , **, *, and $^+$ denote significance at 1%, 5%, 10%, and 15%. Averages of macroeconomic variables are calculated over the period 1996–2005.

Table 15: Channels: Specialization

	(1)	(2)	(3)	(4)
Dependent Var. (in Ln):	1-digit Spec. 2004			Man. Spec. 2004
Ln Foreign Ownership of Firm Assets, 2004		–0.14	–0.20	–0.05
		(0.20)	(0.20)	(0.17)
Ln Number of Domestic Ownership Links, 2004	0.48**	0.46**	0.36*	–0.12
	(0.20)	(0.20)	(0.20)	(0.17)
Average Population (millions)	–0.35***	–0.34***	–0.36***	–0.37***
	(0.12)	(0.12)	(0.12)	(0.10)
Average Population^2 (millions)	0.04***	0.04***	0.04***	0.03***
	(0.01)	(0.01)	(0.01)	(0.01)
Capital Region			0.72**	0.67**
			(0.34)	(0.29)
Country Dummies	Yes	Yes	Yes	Yes
R^2	0.27	0.28	0.29	0.31
Observations	184	184	184	184

Notes: Standard errors are in parentheses. *** , **, *, and $^+$ denote significance at 1%, 5%, 10%, and 15%. Averages of macroeconomic variables are calculated over the period 1996–2005.

Figure 1: Macroeconomic volatility and financial integration in Europe.



Notes: Unconditional relationship between the standard deviation of real GDP per capita growth (volatility) between 1995–2005, sum of stocks of foreign assets and liabilities divided by GDP, averaged between 1995-2005 from Lane and Milesi-Ferretti (2004) (financial integration).

Figure 2: Foreign ownership at firm level for Scotland Region members, 2004

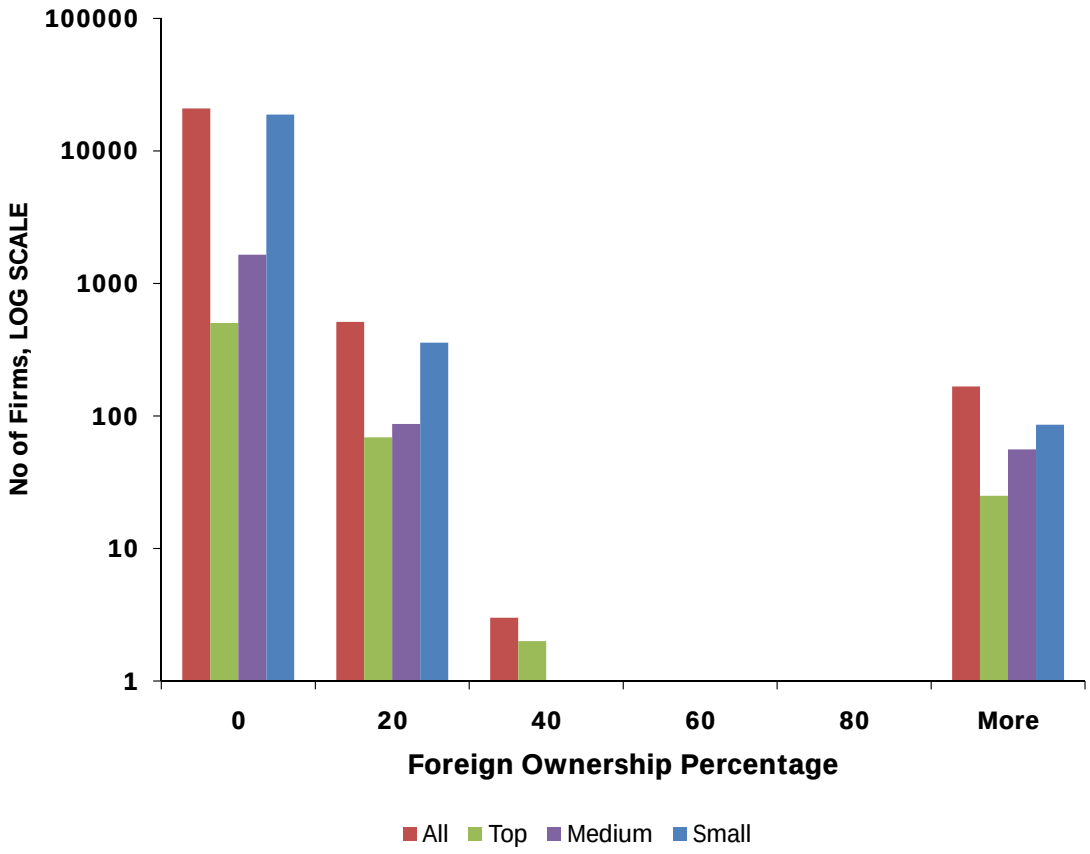


Figure 3: Foreign ownership of firm level for Oberbayern Region members, 2004

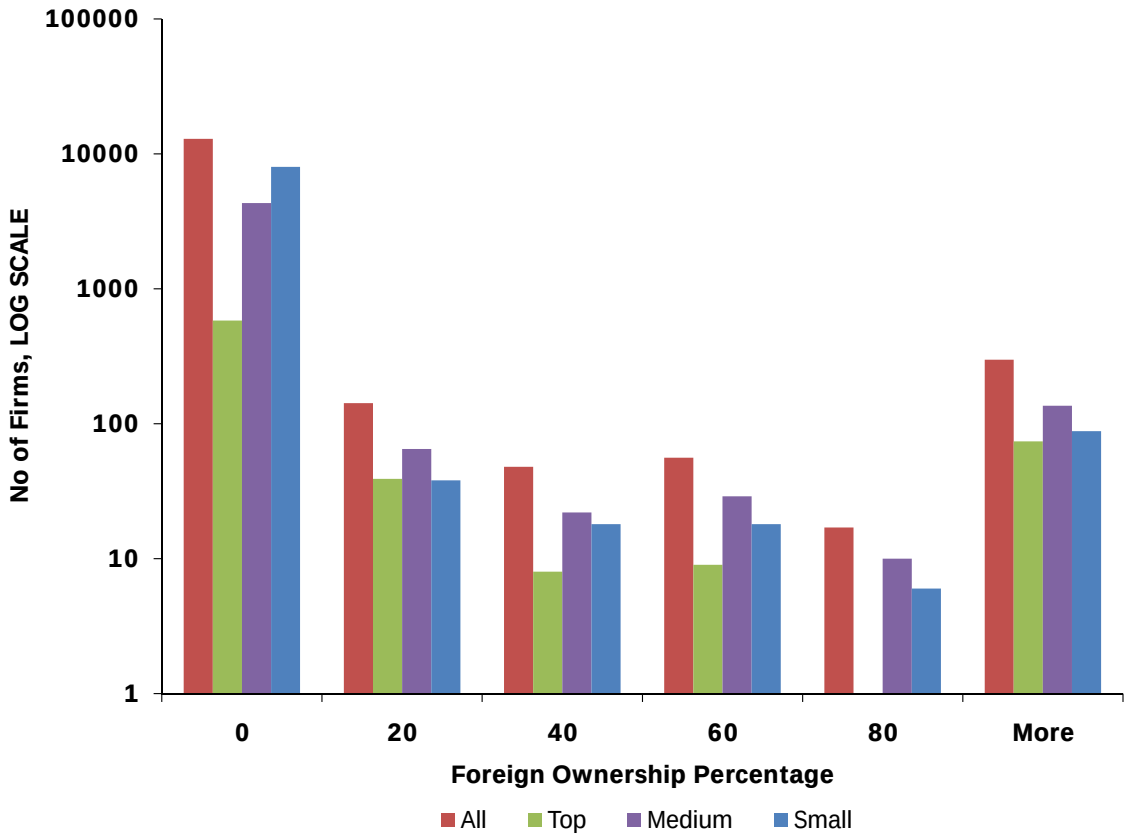
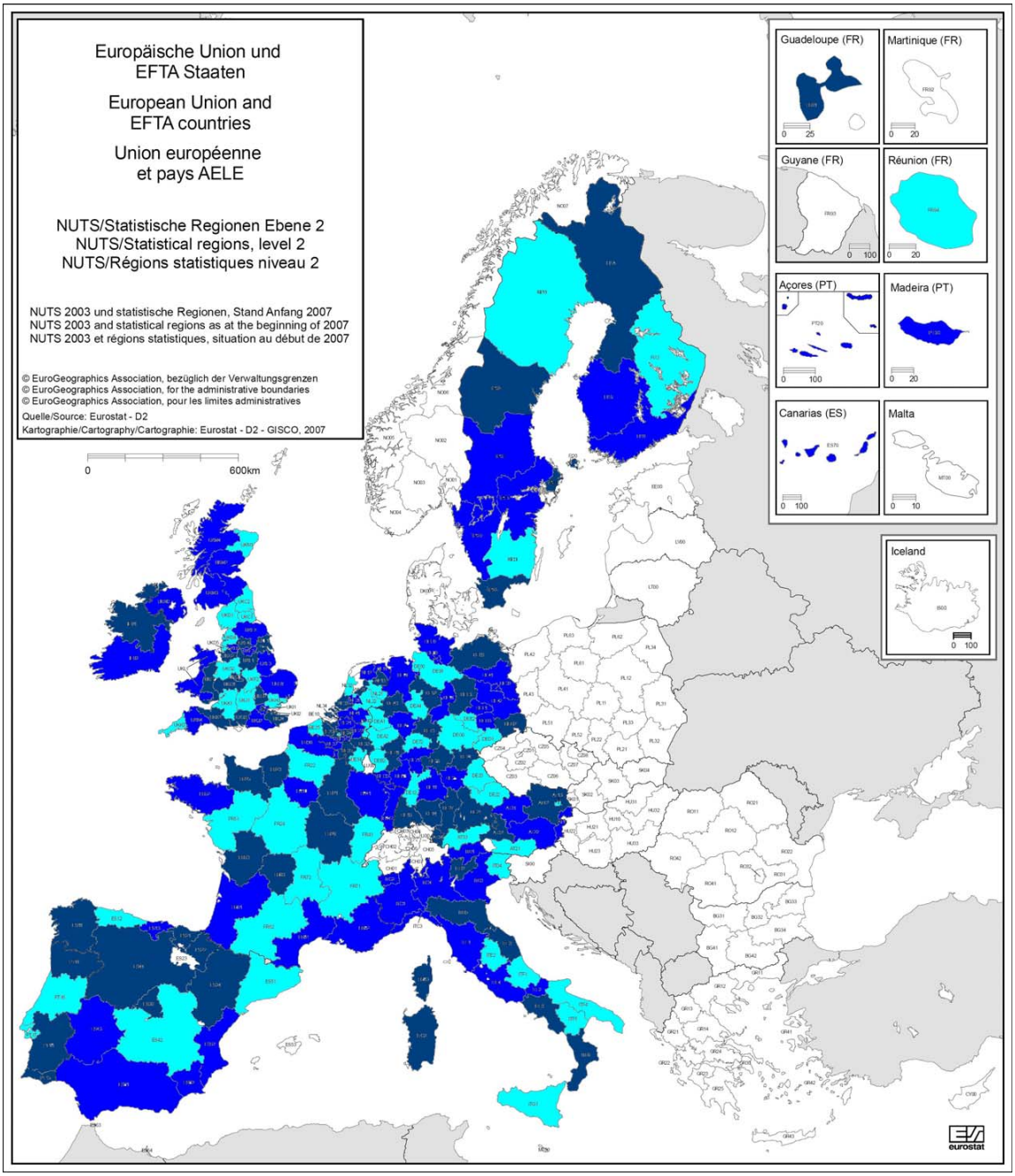


Figure 4: Deep financial integration at regional level: Foreign ownership of assets for the NUTS-2 regions of 12 longstanding EU members, 2004



Notes: Figure presents the estimates of the *Foreign Ownership of Assets* at NUTS-2 regional level for twelve longstanding EU countries used in the regional regressions. It is calculated as the sum of percentages of direct ownership that belong to the parties located in other than the firms's home country in 2004 from the Amadeus Ownership dataset by the BvD Electronic Publishing, weighed by firm total assets relative to the region's total assets in 2004. See Eq. (4) in Section 3.2 for the exact formula. The darker color implies a larger value of the Foreign Ownership of Assets.

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 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

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)