Global Engagement and Returns Volatility*

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Abstract

This paper finds that a greater reliance on foreign market sales increases the volatility of firms' stock returns using high-frequency data for publicly-listed Japanese manufacturing firms over the period 2000 to 2010. The two margins of global engagement we consider, namely, exports and sales via foreign affiliates (horizontal FDI), have both a positive and economically significant effect on firm-level volatility. We find, however, that increasing the intensity of sales through foreign affiliates has a stronger effect on volatility than a similar change in export intensity. We also uncover evidence consistent with the notion that firms' need to use external finance to cover the substantial costs involved in reaching foreign consumers can be an important channel through which firms' participation in international markets increases their exposure to economic uncertainty.

Keywords: Volatility, Stock Returns, Exports, FDI, External Finance Dependence, Japan.

JEL classification: F36, F14, F23, G10.

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1. Introduction

It is hard to overstate the impact of economic uncertainty on individual firm decisions. In response to greater volatility, firms behave more cautiously in their investment and employment decisions and in turn become less responsive to policy stimuli (Leahy and Whited 1996; Bloom et al. 2007; Bloom 2009; Bloom et al. 2014). Higher volatility also weakens firms' ability to raise external finance (Froot et al. 1993; Rountree et al. 2008), and increases both risk premia and the probability of default (Adrian and Rosenberg 2008; Arellano et al. 2011), to give but a few examples.

Given the important role that volatility plays on firm-level outcomes, and in light of the strong perception among the general public that globalization increases economic uncertainty (Scheve and Slaughter 2004), in this paper we attempt to answer the following question: does a firm's greater reliance on sales in foreign markets — what we refer to as 'global engagement' — affect its volatility? Economic theory does not provide an unequivocal answer to this question. On the one hand, servicing foreign markets could allow firms to lower their volatility by diversifying away country-specific demand shocks. On the other hand, the volatility-reducing effect due to geographic diversification can be counteracted when there are substantial barriers entailed in reaching foreign customers, such as sunk costs of opening a foreign production facility or higher working capital requirements involved in exporting and Foreign Direct Investment (FDI). Since the costs associated with different margins of global engagement differ substantially — both in their nature and magnitude — a key objective of this paper is to investigate whether firm-level volatility is affected differently by changes in the intensive margin of exports and sales conducted through foreign affiliates (horizontal FDI).

We utilize data for publicly-listed Japanese manufacturing firms for the period 2000 to 2010 to conduct our analysis, and use excess stock returns as the underlying performance variable to estimate firm-level volatility, following an extensive literature in finance and macroeconomics (see e.g. Schwert 1989; Campbell et al. 2001; Comin and Philippon 2006; Bloom et al. 2007, among many others). Stock

returns are of first-order interest to investors because they reflect markets' expectations of a firm's future cash flows, but are also highly correlated with establishment-level measures of total factor productivity (Bloom et al. 2014) and are a strong leading indicator for industrial production and GDP growth at the aggregate level (Fama 1990; Beaudry and Portier 2006).

To preview our results, we find a robust and positive relationship between a firm's extent of global engagement, measured in terms of its export and foreign affiliate sales intensity, and the volatility of its excess stock returns. Crucially, we find that the quantitative effect of the horizontal FDI intensity margin on volatility is stronger than that of export intensity. To be more precise, a one standard deviation increase in the share of total sales accounted for by exports increases the annualized volatility of stock returns by 3.36%; a change of similar magnitude in the intensity of sales carried out by foreign affiliates raises the volatility of stock returns between 3.6% and 7.4%. This result suggests a ranking of firms' volatility based on the margin used to reach foreign customers similar to that established by Helpman et al. (2004) for the first moment of firm-level productivity. This is also consistent with Fillat and Garetto (2015), who find that US multinational firms are riskier than exporters and that these in turn are riskier than domestic firms.

Our findings indicate that the effect that the intensive margin of exports and horizontal FDI exert on volatility is crucially mediated by business cycle conditions and the level of external finance dependence characterizing the industry in which a firm operates. For instance, the effect of export intensity on volatility is more sensitive to business-cycle conditions than that of horizontal FDI. Conversely, the effect of horizontal FDI on volatility is manifested primarily for firms operating in industries characterized by high external finance dependence. The latter result is consistent with the recent literature that documents the high finance intensity that characterizes international transactions; for instance due to the longer lag between production and the receipt of sales revenue in export transactions (Amiti and Weinstein, 2011; Manova, 2013), or because of the largely irreversible costs

associated with setting up and operating multinational subsidiaries (Desai et al. 2004; Bilir et al. 2015). Notably, our results are robust to the use of a GARCH-based conditional variance as our measure of returns volatility.

Our paper makes three novel contributions to the literature studying the relationship between globalization and volatility. This is, to the best of our knowledge, the first paper to investigate empirically how exports and sales via foreign affiliates affect firm-level volatility; previous work by Buch et al. (2009), Riaño (2011) and Vannoorenberghe (2012) has only considered the role of exports, while Nguyen and Schaur (2012) and Kurz and Senses (2016) have studied export and import margins jointly.[1] Exploring whether a greater reliance on affiliate sales affects firm-level volatility and whether its effect differs from those of exporting is crucial given the quantitative importance of horizontal FDI as a margin of global engagement — Antràs and Yeaple (2014) report that sales by multinational subsidiaries are on average three times as large as export sales for large US firms; while we find a corresponding 42% premium for Japanese manufacturing firms. Moreover, as Ramondo et al. (2014) show, sales to unaffiliated parties — the specific type of multinational activity that we investigate — constitute by far the most important margin of operation for affiliates located abroad.

We also depart from the existing literature in international trade in making use of high-frequency data on excess stock returns rather than yearly data on sales or employment to estimate firm-level volatility. The low-frequency data typically available in surveys conducted at the firm/establishment-level has forced researchers to estimate volatility using rolling standard deviations. This approach is problematic for several reasons: (i) it assumes that volatility is constant within the estimation window, a feature which is inconsistent with the extensive literature documenting the salient variation of volatility across time (see e.g. Schwert 1989; Campbell et al. 2001; Bloom 2014); (ii) measured volatility is also highly sensitive to the breadth of the rolling window used in the estimation

[1] Similarly, di Giovanni and Levchenko (2009) and Caselli et al. (2014) have focused on the link between exports and volatility at the industry and aggregate-levels respectively. Neither of them considers the role of sales conducted by foreign affiliates in shaping sectoral or aggregate volatility.

(Comin and Philippon 2006); and critically, (iii) this method underestimates volatility when, as is often the case, episodes of high volatility are short-lived (Bachmann et al. 2013). We overcome these limitations by constructing the volatility of returns using daily data and estimating a dynamic panel fixed effects model of the determinants of volatility at a monthly frequency.

Over the last two decades, research in international trade has identified a host of robust relationships between a firm's participation in foreign markets and the first moment of a wide range of performance indicators. Namely, firms that export or engage in foreign direct investment have been found to be on average, larger, more productive, and more capital, skill and R&D-intensive than firms serving exclusively domestic markets (see Bernard et al. 2007; Antràs and Yeaple 2014, and references therein). Much less is known, however, about the extent to which global engagement affects the second moments of firm-level outcomes. Similarly, the finance literature studying the determinants of stock returns volatility (e.g. Schwert 1989; Pástor and Veronesi 2003; Wei and Zhang 2006; Fink et al. 2010) has not considered the role played by firms' internationalization strategies. Thus, this paper helps to bridge the gap between these two broad research fields by providing empirical evidence on the robust link that exists between globalization and volatility at the firm level.

Besides the availability of high-quality data, Japan constitutes an excellent laboratory to study the relationship between global engagement and the volatility of firms' stock returns. The sample period that we consider is characterized by a high level of economic turbulence, including two domestic recessions in 2001-02 and 2004, as well as the 2008-09 global financial crisis. De Veirman and Levin (2012) document a sharp increase in firm-level earnings, employment and sales volatility during the deep recession that hit Japan between 1998 and 2002 and a subsequent decline in volatility following the export-led recovery that took place in the middle of the decade. At the time of the 2008-09 global financial crisis, an event which affected Japanese exports particularly hard (Eaton et al. 2011), both aggregate and firm-level volatility rose sharply again, but this spike quickly subsided in less than

one year. Quite importantly, deeper trade integration with China and the US has significantly increased the importance of external markets for Japanese producers (OECD 2011), although a substantial number of large, publicly-listed manufacturing firms are still primarily dependent on domestic sales.

The rest of the paper is organized as follows: Section 2 summarizes the theoretical framework guiding our empirical analysis. Sections 3 and 4 describe our data and empirical identification strategy respectively. Our main results and robustness checks are presented in Section 5, and Section 6 concludes.

2. Global Engagement and Firm-level Volatility

The aim of this section is to discuss the potential mechanisms through which a firm's extent of global engagement can influence its volatility, in order to direct our empirical analysis.

For a firm, selling its output abroad is a highly risky endeavor. During the time it takes to complete an international transaction, an exporter is exposed to, among other things, adverse movements in exchange rates and demand, payment default and customs-related disruptions. Relying on sales through foreign affiliates, alternatively, can make firms vulnerable to unexpected changes in regulations and political instability. Nevertheless, even if foreign demand is more volatile than domestic sales, firms can reduce their volatility by selling abroad as a result of a portfolio diversification effect, provided that demand shocks are not too highly correlated across markets. Hirsch and Lev (1971) find early support for the hypothesis that diversification of export sales helps to stabilize firms' sales. More recently, Buch et al. (2009) also find that German exporters have less volatile sales than their domestic counterparts.

Participating in international markets, however, is a costly activity; firms need to incur substantial investments in logistics, market research and distribution arrangements before being able to reach foreign customers. The exact nature of these costs has important implications for the

relationship between operating in foreign markets and firm-level volatility, and can even overturn the volatility-reducing effect generated by the international diversification of sales. Riaño (2011) shows that if the costs required to start exporting are sunk, exporters are more volatile than domestic firms — even when producers are risk-averse. This follows because exporters are reluctant to stop selling abroad in response to negative shocks in order to avoid incurring the entry costs again in the future. Vannoorenberghe (2012) finds that when firms have increasing marginal costs of production, a U-shaped relationship arises between a firm's export intensity and the volatility of its sales. In this case, the cost advantage that a firm achieves by rebalancing its domestic and export sales in response to demand shocks outweighs the diversification effect for high-intensity exporters.

The models discussed above treat exporting as the only margin of global engagement available to firms. Setting up a foreign subsidiary (engaging in horizontal FDI), however, allows a producer to sell its output abroad while avoiding the international shipment of final goods. Because sales by multinational firms' foreign affiliates are substantially larger than export sales — particularly for large firms in developed countries — it is of great interest to explore if the means through which firms serve foreign buyers affect firm-level volatility differently.

The proximity-concentration theory, the workhorse model analyzing a firm's choice between exports and foreign direct investment, shows that the tradeoff between these two margins of global engagement is determined by a comparison between the higher variable costs associated with exporting (e.g. transport costs and import tariffs) and the larger fixed cost of setting up and operating a foreign affiliate facility (Helpman et al. 2004).

On the one hand, if the costs of establishing a subsidiary abroad are to a large extent irreversible, then the resulting hysteresis implies that firms serving foreign markets using horizontal FDI will be more volatile than those choosing to rely on exports, following an argument analogous to

that of Riaño (2011) discussed above. Fillat and Garetto (2015) provide evidence in support of this mechanism. They establish that US multinational firms are riskier in the sense that the *level* of their stock returns exhibits a higher covariance with aggregate consumption growth than that of exporters, which are in turn, riskier than domestic firms.

On the other hand, the higher variable costs that characterize export transactions could result in exporters being more volatile than firms engaged in horizontal FDI. This would be the case if the longer lag between production and receipt of revenues combined with higher project risk — the probability that the importing party will default on an order's payment — increases the cost of working capital for exporters, hampering their ability to access external finance and tightening credit constraints. Amiti and Weinstein (2011) find that Japanese exporters, and particularly those shipping their goods by sea, are more sensitive to financial shocks such as the deterioration of the balance sheet of the main bank providing export credit to an exporter, than firms using foreign subsidiaries. Thus, relying more intensively on foreign affiliates than on exports to serve foreign markets might, by shortening delivery and payment lags, improve a firm's ability to hedge its exposure to foreign shocks and lower its volatility. Conversely, if firms rely extensively on external borrowing to finance the costs of setting-up and operating foreign affiliates (Desai et al. 2004; Feinberg and Phillips 2004; Bilir et al. 2015), one could also witness a strong and positive relationship arising between volatility and the intensity of sales accounted for foreign affiliates for firms with high external finance requirements.

So far we have reviewed mechanisms through which a firm's choice of whether to sell its output abroad and the means to reach foreign customers can affect the volatility of its performance indicators. It is also possible, however, that the underlying sectoral or country-level volatility faced by a producer in a given destination shapes its decision of what margin of global engagement to use to sell there. Conconi et al. (2013) find that when facing riskier markets, Belgian firms rely primarily on exports as a more cost-effective way to learn about their profitability abroad before establishing

foreign affiliates. Similarly, Ramondo et al. (2013) find that both output volatility and cross-country output correlations are significant predictors of the ratio of exports to affiliate sales across countries for US multinational firms.[2] Thus, it is crucial that in our empirical analysis we control for the second moments of broad stock indices in the destination markets that firms sell to.

Lastly, it is important to emphasize that producers are not only exposed to external shocks on their demand side by selling their output abroad, as we focus on in this paper, but also through their costs, e.g. by importing intermediate inputs and capital goods or by splitting their production process across countries (offshoring). As firms increasingly engage in global production sharing, input-output linkages can facilitate the international transmission of shocks, thereby influencing firm-level volatility. Nguyen and Schaur (2012) find that both exporting and importing increase the volatility of sales for Danish firms in a similar magnitude, while Kurz and Senses (2016) find that the intensive margin of imports has a stronger impact on the volatility of firms' employment for US firms.

We have highlighted several channels through which the extent of global engagement can affect firm-level volatility: substantial irreversible costs to establish a presence in foreign markets, higher working capital requirements, and longer cash conversion cycles can increase the volatility of firms that rely intensively on foreign sales; the potential diversification of country-specific demand and supply shocks can, on the other hand, produce the opposite result. We have also shown that the importance of these mechanisms differs markedly depending on the mode of operation that a firm chooses to serve foreign markets, although existing theories of the trade-off between exporting and horizontal FDI provide ambiguous predictions regarding how differences between these two margins

[2] The theory does not necessarily predict that higher volatility in destination markets always induces firms to favour exporting over horizontal FDI. Using a version of the proximity-concentration model incorporating uncertainty about a firm's productivity growth, Sala and Yalcin (2014) show theoretically that greater uncertainty induces firms to favor foreign market entry via horizontal FDI rather than through exporting.

affect firm-level volatility. We now proceed to explore the relationship between global engagement and the volatility of stock returns from an empirical perspective.

3. Data

The dataset we use consists of 1,474 manufacturing firms listed in the Tokyo Stock Exchange observed over the 132 months spanning the period between January 2000 and December 2010. The firms in our sample are large and important for the Japanese economy as a whole; they account for more than 60% of manufacturing employment and a substantial share of the firms engaged in exporting or multinational activities across the period of analysis.[3] Table 1 provides the precise definition and sources of the variables used in our analysis.

[Table 1 goes about here]

As far as the microeconomic literature on globalization and volatility is concerned, the use of high-frequency data to construct our volatility measure is an important contribution of our paper. Previous work studying the relationship between exporting and the volatility of firm-level sales or employment which relied on low-frequency yearly data, used rolling standard deviations to measure volatility (Buch et al. 2009; Riaño 2011; Vannoorenberghe 2012; Kurz and Senses 2016). This estimator is problematic in that it imposes volatility to be constant within the estimation windows, over-smooths volatility because it does not capture volatility changes taking place within a year, and produces very little time-series variation.[4]

Daily stock returns are constructed as the first-difference of the logarithm of a firm's stock price. Following Campbell et al. (2001), we define excess stock returns — the performance measure

[3] According to Basic Survey of Japanese Business Structure and Activities there were approximately 6,000 exporting firms (out of which 4,000 were manufacturing firms) and 2,500 firms that owned foreign affiliates (Survey on Overseas Business Activities) on average during our period of study. Table 2 below shows that 875 firms in our sample exported or sold their output through foreign subsidiaries at least once over the same period.

[4] Notice that the estimated volatilities for two consecutive time periods would differ only by the two data points in each limit of the estimating window.

which we use to compute volatility — as the difference between an individual firm's return and the market-value-weighted mean return of firms in the corresponding SIC2 industry. Firm-level volatility is simply calculated as the standard deviation of a firm's daily excess stock returns in a given month.

Annual export sales figures are obtained from Datastream and Bloomberg. The latter also provides information on firms' export intensity (exports sales/total sales) with further breakdown into four aggregate export destinations: Asia, Europe, North America and Other destinations. Sales generated from operations in foreign countries excluding export sales, our measure of horizontal FDI, are obtained from Datastream. Bureau van Dijk's Orbis database is used to obtain information on the geographic distribution of sales by foreign subsidiaries. Other firm-level control variables including monthly market value, quarterly measures of financial performance (returns on assets), as well as age and leverage (measured at a yearly frequency), are also sourced from Bloomberg and Datastream.

Figure 1 presents the value-weighted mean conditional volatility of returns for the firms included in our sample and contrasts it with the conditional volatility of the TOPIX-100 index, which includes all the firms listed in the Tokyo Stock Exchange's First Section (i.e. the largest 100 firms listed in the exchange), over the sample period.[5] The volatility of returns in our sample of manufacturing firms follows a time-series pattern similar to that of the TOPIX-100. Conditional volatility displays substantial variation over time (Schwert 1989; Campbell et al. 2001), but unlike the case of the US, no secular trends are apparent (Comin and Philippon 2006; Davis et al. 2007). Volatility falls steadily from the end of the 2001-02 domestic recession through the export-led recovery of the middle of the decade, until it starts to rise again in 2007 — exhibiting substantial spikes during the global financial crisis in 2008-09. Following a similarly quick reduction after 2009, and a short-lived burst in the middle

[5] Note that both series have been rescaled with their value on January 2000 = 100, in order to make their dynamics comparable.

of 2010, mean volatility for manufacturing firms at the end of our sample period is significantly lower than at the beginning of the decade.

[Figure 1 goes about here]

The distribution of firms in our sample across different margins of global engagement is presented in Table 2. Approximately 60% of firms export or use foreign affiliates, and among these, the majority (64%) utilizes both margins of global engagement at some point during this period.[6] Although a non-negligible share of firms only reach foreign markets through exports, very few firms rely exclusively on foreign affiliates. The extent of global engagement among our sample of publicly-listed firms is substantially higher than what is observed in more representative firm-level surveys for Japan. Kimura and Kiyota (2006) using data from the Basic Survey of Japanese Business Structure and Activities, which includes all firms with more than 50 employees or with capital in excess of 30 million Yen, find that only 24% of firms export or own foreign subsidiaries.

Table 3 reports a range of summary statistics of the key variables used in our empirical analysis. Several points are noteworthy; to start with, globally-engaged firms are not only more volatile than their domestic counterparts, but also exhibit higher stock returns. Firms conducting horizontal FDI exhibit annualized excess stock returns that are 3.1 percentage points higher than their domestically-oriented counterparts, while exporters' returns are one percentage point higher than those of domestic firms, the same ranking found by Fillat and Garetto (2015) among publicly-listed US firms. The same pattern arises when we consider returns on assets. Globally-engaged firms are also larger in terms of size and market value, but are not significantly different from domestically-oriented firms in terms of leverage.

[6] Global engagement status is also highly persistent. Among the 562 firms that engage at least once in exporting or horizontal FDI, 272 utilize both margins in every year of the sample period.

Our empirical strategy to identify the impact of exports and horizontal FDI on returns volatility crucially relies on within-firm variation in the intensity of global engagement. Column (3) of Table 3 shows that a substantial fraction of the variance of volatility as well as that of exporting and horizontal FDI intensities is due to within-firm time-series variability. Moreover, column (4) shows that time-invariant firm effects and macro shocks captured via time effects are not sufficient to adequately explain volatility differences in our data.

[Table 3 goes about here]

4. Empirical Identification Strategy

In this section, we describe the empirical approach used to identify the effect of global engagement on stock returns volatility. We specify the following dynamic panel data model of the determinants of volatility with firm-specific heterogeneity, and year and month effects:

$$\log \sigma_{it} = \beta_0 \log \sigma_{it-1} + GLOB'_{it-12}\alpha + X'_{it-12}\beta + DV'_{it-12}\gamma + f_i + f_t + \varepsilon_{it.} \qquad (1)$$

In the above equation i and $t \in \{2000:1, \ldots, 2010:12\}$ index firms and month-year periods respectively, and $t-12$ is used to indicate that the relevant variable is lagged by one year. The dependent variable $\log \sigma_{it}$ is the log of monthly standard deviation of a firm's stock returns relative to the value-weighted SIC2 industry average calculated from the underlying daily returns. The importance of incorporating dynamics into the model stems from the fact that volatility is a persistent series.[7]

We now move to discuss the determinants of returns volatility included in our model. The vector $GLOB$ consists of two variables measuring the extent of firm-level global engagement, namely, exports and horizontal FDI sales intensities; therefore, the vector α is the main set of coefficients of interest. X is a vector of control variables that are commonly used to explain cross-sectional

[7] Since T=132 the standard fixed effects estimator would not suffer from the so-called Nickell bias.

differences in the volatility of stock returns; these include firm's age, size (total assets), leverage and returns on assets (ROA) (see e.g. Pástor and Veronesi 2003; Wei and Zhang 2006; Fink et al. 2010). All these variables are lagged one year to mitigate endogeneity concerns not accounted for by firm and time fixed effects in the model. DV_{it} is a vector that includes the contemporaneous conditional volatility of the nominal Japanese Yen/US dollar exchange rate, as well as the volatility of stock market indices in the broadly-defined foreign destination markets served by the firm.[8]

Unobserved, time-invariant firm-specific heterogeneity which is correlated with the regressors is captured by f_i, while f_t is a vector of year and month effects that is intended to capture aggregate shocks and seasonal patterns. ε_{it} is a random error term which is allowed to exhibit arbitrary cross-sectional and temporal dependence. It is important to account for these two sources of potential correlation of the error term when estimating volatility models based on firm-level panel data, because stock returns have been show to display substantial cross-sectional and time-dependence, both in their first and second moments (Andersen et al. 2001; Vuolteenaho 2002). We use the covariance matrix estimator proposed by Driscoll and Kraay (1988) to compute standard errors in order to deal with this issue. This estimator is appropriate in the present context, because unlike typical micro panels, our dataset has a large time dimension.

In summary, we employ a dynamic panel fixed effects framework with a host of control variables and cross-sectional dependence, and exploit within-firm variation in the intensity of global engagement and stock returns volatility to identify the parameters of interest.

5. Main findings and discussion

Baseline specification

[8] We use the following indices as proxies for foreign destinations' stock markets: S&P 500 index for North America, DAX index for Europe, KOSPI index for Asia and ASX index, the benchmark stock index for Australian markets, for other destinations, since Australia is the largest export destination market for Japan outside Asia, Europe and North America; see http://www.jetro.go.jp/en/reports/statistics/.

The estimates from the baseline model are reported in Table 4. In all our regressions we have winsorized the top and bottom 1% of our dependent variable to ensure that our findings are not unduly driven by outliers.

Regarding the effect of our control variables, we establish a robust and negative relationship between firm size and financial performance (return on assets) and the volatility of returns. These results are consistent with the findings of Pástor and Veronesi (2003) and Wei and Zhang (2006) for US firms. Leverage, in contrast, exerts a positive effect on the volatility of returns, indicating that firms with higher debt stocks relative to their market value are perceived by the market to be riskier — perhaps due to the view that they face a higher likelihood of default. Firm's age is negatively correlated with volatility — in line with the existing literature showing that as firms learn about their profitability, the uncertainty about their performance falls — although this effect is not statistically significant.

In line with the literature that documents the significant effect of exchange rate movements on firm equity (Dominguez and Tesar 2006) — we find that a 10% increase in the conditional volatility of the Yen/USD nominal exchange rate is associated with a 0.7% increase in returns volatility, everything else constant. Destination-specific stock market volatilities, on the other hand, have a small and for the most part, insignificant effect on volatility. The positive and significant coefficients on lagged volatility which are generally in the region of 0.3 suggest that monthly volatility is moderately persistent for our sample of Japanese firms.

[Table 4 goes about here]

In what follows we focus our discussion on the global engagement variables, which are the main focus of this study. Our baseline estimates are reported in column (1) of Table 4. They indicate that a higher intensity of global engagement has a positive and significant impact on the volatility of firms' stock returns. The intensive margins of exporting and horizontal FDI exert a large effect on firm-level volatility: a one standard deviation (0.215) increase in exporting intensity is associated with a

0.1% increase in monthly volatility, which in turn translates into a 3.36% rise in annualized volatility.[9] A similar increase in the intensity of sales through foreign affiliates of the same magnitude is associated with a 3.58% higher annualized volatility.

Columns (2) and (3) of Table 4 present a first-pass robustness analysis of our main result. Since Gabaix (2011) has shown that shocks to large firms can play an important role on aggregate volatility due to the granularity of economic activity, in column (2) we weight our panel fixed effects regression by a firm's total market value so as to give greater weight to larger firms in the identification of average effects. The results from this specification are quite similar to those presented in column (1). The positive relationship between the intensive margin of sales in foreign markets and volatility also survives the inclusion of export and foreign affiliate dummy variables in the regression (column (3)), which controls for differences between globally-engaged firms and those operating in the domestic market alone.

Factors mediating the relationship between global engagement and firm-level volatility

We now proceed to investigate whether the positive relationship we have identified between the intensity of global engagement and the volatility of stock returns is mediated by aggregate characteristics such as the business cycle and the covariance between domestic and foreign markets as well as industry characteristics such as external finance dependence. We also show that our results hold when we estimate our benchmark regression using yearly data. Lastly, we present results regarding the relationship between the volatility of sales — the performance measure most frequently used in the existing literature on globalization and volatility at the micro level — and the intensive margin of exports and horizontal FDI. These results are presented in Table 5.

[Table 5 goes about here]

[9] $\sqrt{12} \times 0.0097 = 0.036$.

Does global engagement affect firm-level volatility primarily during recessions?

Firstly, we want to explore whether the positive relationship between global engagement and returns volatility is a phenomenon that manifests itself primarily during economic downturns, which is when volatility tends to rise (see Bloom 2014 and Figure 1). The results presented in column (1) of Table 5, show that although the effect of both margins of global engagement intensity on volatility remains positive, the effect of the intensive margin of exports turns insignificant when recession periods are excluded. The magnitude and significance of the horizontal FDI margin, on the other hand, remains largely unchanged compared to our benchmark specification. This asymmetry might be a reflection of the fact that exports tend to be concentrated on highly procyclical durable and capital goods (Eaton et al. 2011; Engel and Wang 2011). Thus, our findings suggest that a greater reliance on exports might increase firm-level volatility by intensifying the sensitivity of firms' demand to business-cycle conditions.

Are our results affected by the degree of covariance across international stock markets?

The scope for a volatility-reducing effect resulting from the international diversification of firm-level sales depends crucially on the degree of covariance among domestic and foreign markets. The potential for diversification will be higher if stock markets across the world tend to not commove strongly. Additionally, Bollerslev et al. (1988) show that the conditional covariance of stock returns and the market portfolio is also a quantitatively important determinant of asset risk premium. Thus, we augment our benchmark specification with the conditional covariance between Japan's TOPIX index and a firm-specific weighted average of stock market indices in the four broadly-defined foreign destinations available in our data, where the weights are given by each individual firm's export and foreign affiliate sales shares to each destination. The results presented in column (2) of Table 5 show that a higher export and horizontal FDI-weighted covariance between the Japanese and foreign stock

markets increases the volatility of returns, while the positive volatility premium of global engagement intensity remains unchanged.

The role of external finance dependence

The discussion in Section 2 suggests that the cost of working capital might be higher for firms that rely more intensively on exports than on sales by foreign subsidiaries due to the longer lag between production and receipt of revenues that characterizes international trade transactions. By potentially increasing the likelihood of experiencing a binding borrowing constraint, this channel suggests that a greater reliance on exports would have a stronger effect on the volatility of firms characterized by higher demand for external finance. It is possible, however, that if the costs associated with setting-up and operating a foreign affiliate are primarily financed through external borrowing (see e.g. Desai et al. 2004, Feinberg and Phillips 2004, and Bilir et al. 2015), that we would observe a stronger relationship between a firm's horizontal FDI intensity and volatility when firms operate in sectors with high external finance requirements.

We re-estimate our benchmark specification by splitting our sample according to whether the industry in which a firm operates is characterized by a high degree of dependence on external finance. Our indicator of high external finance dependence is drawn from Hosono et al. (2013), who replicate the measure developed by Rajan and Zingales (1998) using Japanese data. Firms operating in industries for which only a small fraction of investment is financed directly from retained earnings, are classified as being highly dependent on external finance; more precisely, firms that belong to industries for which the external finance index is above the median (see Table 1 for further details).

The results reported in columns (3) and (4) of Table 5 show that positive relationship between global engagement in the form of horizontal FDI and volatility is primarily driven by firms characterized by high requirements for external financing. This result is consistent with the recent literature that documents the high external finance intensity of multinational activity, due to the largely

irreversible costs associated with setting up and operating foreign subsidiaries. The effect of export intensity on volatility, however, does not appear to be affected differentially by firms' external finance dependence.

Does the level of aggregation of our data matter?

As can be seen from Table 1, the variables used in our baseline regression have different frequencies (i.e. monthly, yearly and quarterly). While this is not problematic in itself — as long as there is sufficient variability in all dimensions — we wanted to check the sensitivity of our findings by aggregating the data up to yearly frequency. Column (5) of Table 5 reports the results from this experiment where the dependent variable is the log of annualized volatility.[10] Our findings are very much in line with our benchmark specification— both margins of global engagement have a positive effect on firm-level volatility, with the intensity of sales through foreign affiliates once again being quantitatively larger.

How does global engagement affect the volatility of sales?

Working at a yearly frequency allows us to contrast our results with the existing literature linking exports with the volatility of total sales. We use the volatility of sales growth, calculated using a 5-year rolling-window estimator, as our dependent variable in column (6) of Table 5. We find that the two intensive margins of global engagement are also associated with a higher volatility of sales, and that the intensity of foreign subsidiary sales has a larger effect than that of exports. From a quantitative standpoint, the effect of an increase in export intensity on the volatility of sales is lower than that found by Vannoorenberghe (2012) for French firms.[11]

[10] Yearly volatility is estimated as the yearly standard deviation based on daily returns data. Thus our volatility measure is still estimated using high frequency data.

[11] Vannoorenberghe (2012) reports that an increase in a firm's export intensity from 0 to 50% leads to an increase of one-third of a standard deviation in the volatility of its total sales among French firms. In our case, the same change in export intensity is associated with 0.09 standard deviations increase in the volatility of total sales. Buch et al. (2009), on the other hand using data for the German state of Baden-Württemberg, find a smaller negative effect of export intensity on sales volatility. Namely, a one standard deviation increase in export intensity is associated with a 0.52% fall in the unconditional volatility of sales.

6. Conclusions

A recurring concern among policymakers and the general public at large in regards to globalization is that tighter links with the rest of the world make producers more vulnerable to external shocks, thereby increasing their volatility. This paper contributes to current research efforts to provide microeconomic evidence on this issue. In so doing, we depart from existing work that has studied the relationship between global engagement and volatility at the firm level in several key dimensions.

Ours is the first paper in investigating if the means by which firms reach foreign customers — exports and sales through foreign affiliates — have a differential impact on firm-level volatility. Furthermore, by focusing on publicly-listed firms, we make use of high-frequency data on stock returns that can appropriately capture the frequent and often short-lived bursts that characterize volatility, a feature which is likely to be missed when employing the low-frequency, yearly data usually available in firm/establishment surveys. The use of stock returns as the underlying performance variable, for which volatility is estimated, is also an important contribution to the literature studying the link between globalization and firm-level volatility. Equity returns reflect the market's expectation of a firm's future profitability, and are therefore a vital concern for individual investors as well as a key leading indicator of economic activity at the aggregate level.

Our results show that a greater reliance of firms on foreign market sales — both through exports and sales of foreign affiliates — is associated with a statistically and economically-significant increase in the volatility of their stock returns. Moreover, we find, across a wide range of specifications, that the intensity of horizontal FDI sales has a stronger effect on volatility than the intensive margin of exports. This result is consistent with the proximity-concentration theory of foreign direct investment, which emphasizes the higher, and to a large extent irreversible, costs of setting-up and operating foreign affiliates vis-à-vis exporting.

We also find that the positive relationship between the intensity of foreign affiliate sales and volatility is crucially driven by firms operating in sectors characterized by high external finance requirements. This result is consistent with recent empirical evidence that supports the view that operating in international markets is an activity which is highly intensive in its use of external sources of finance. Our results therefore shed light on an important channel through which firms' participation in international markets increases their exposure to economic uncertainty.

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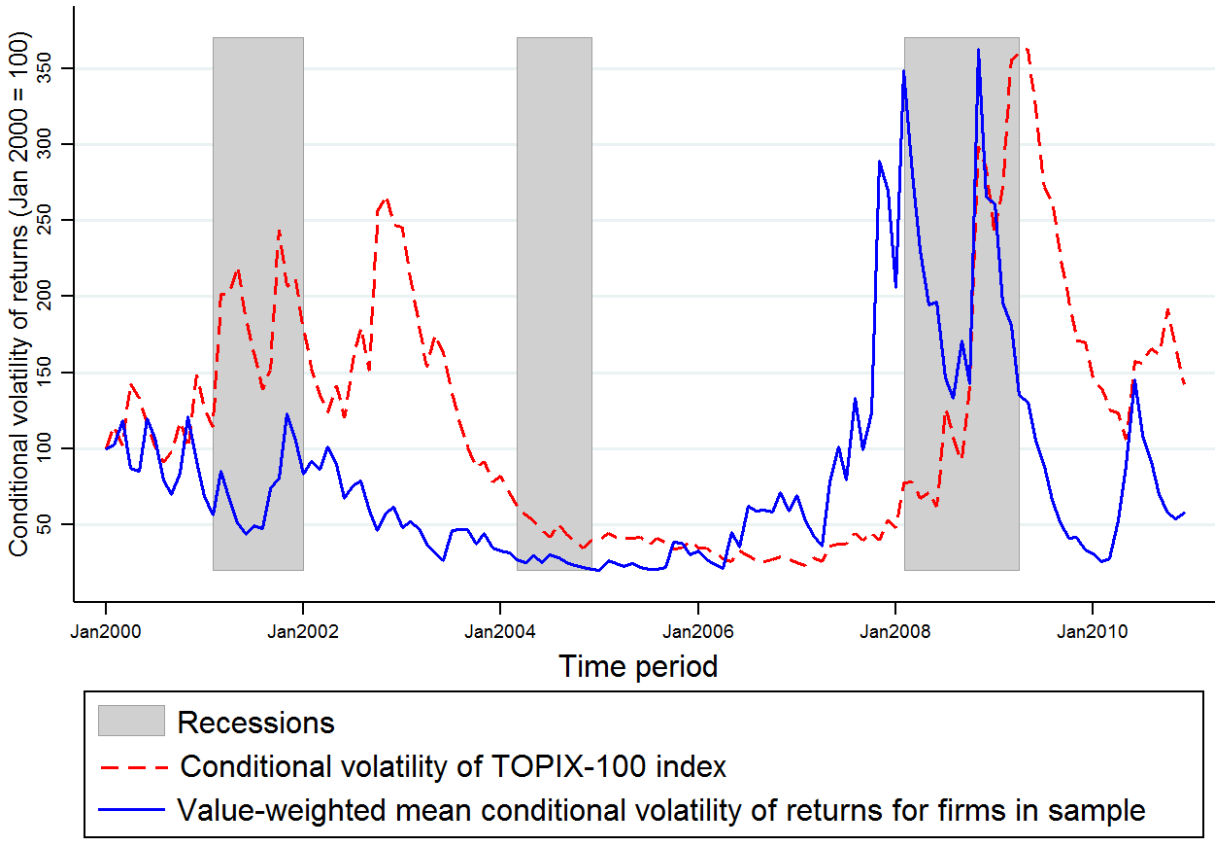
Figure 1: Value-weighted average sample volatility versus TOPIX-100 index volatility



Shaded areas denote recession periods in Japan identified by the OECD (series JPNRECM from St Louis Fed FRED database). Recession periods in our sample are: 2001:2-2002:1; 2004:3-2004:12 and 2008:2-2009:4. The TOPIX-100 index is a capitalization-based index that includes all the firms listed in the Tokyo Stock Exchange's First Section, which groups the 100 largest firms in the exchange. It includes manufacturing firms alongside companies operating in banking and finance, transportation, real estate, services and public utilities. The conditional volatility of the TOPIX-100 index is estimated using a GARCH(1,1) specification. Online Appendix A describes the procedure used to estimate individual firm's conditional volatility.

Table 1: Variable definition and data sources

Variable	Definition	Data sources	Data frequency
Excess stock returns	Change in stock price including dividends received for a firm minus SIC2 industry value-weighted average return	DATASTREAM & BLOOMBERG for raw data; and own estimation	Monthly
Conditional volatility of excess stock returns	Log volatility of a firm's monthly excess return (relative to SIC2 industry average) estimated from a firm-specific ARCH-type model (see online Appendix A for more detail).	DATASTREAM & BLOOMBERG for raw data; and own estimation	Monthly
Unconditional volatility of excess stock returns	Log of monthly standard deviation of firm excess return (relative to SIC2 industry average) calculated from underlying daily returns.	DATASTREAM & BLOOMBERG for raw data; and own estimation	Monthly
Export intensity	Export sales/total sales, with further breakdowns into four export destinations, viz. Asia, Europe, North America and Others.	DATASTREAM and BLOOMBERG	Yearly
Horizontal FDI intensity	Sales by foreign affiliates/total sales	DATASTREAM & ORBIS.	Yearly
Size	Log of a firm's total assets which is the sum of total current assets, long term receivables, , investment in unconsolidated subsidiaries, other investments, net property plant and equipment and other assets	DATASTREAM	Yearly
Leverage	[(Long Term Debt + Short Term Debt & Current Portion of Long Term Debt) / Common Equity]*100	DATASTREAM	Yearly
Returns on assets	[(Net Income before Preferred Dividends + ((Interest Expense on Debt-Interest Capitalized) * (1-Tax Rate))) / Average of Last Year's and Current Year's Total Assets]*100	DATASTREAM	Quarterly
Age	Log of years since incorporation	ORBIS	Yearly
Market value	Log of (market Price-month end*total number of shares outstanding)	DATASTREAM and BLOOMBERG	Monthly
Investment rate in foreign subsidiaries	Change in total fixed assets of foreign subsidiaries relative to total assets with further breakdowns into four main geographic areas, viz. Asia, Europe, North America and Others	ORBIS	Yearly
External finance dependence dummy	=1 if (capital expenditure-cash flow)/capital expenditure) is above median value of 0.33, 0 otherwise	DATASTREAM and own calculations	Yearly
Exchange rate conditional volatility	Log of monthly conditional volatility of USD/Yen exchange rate estimated from a GARCH (1,1) model	BLOOMBERG and own estimation	Monthly
Conditional volatility of destination stock markets	Log of monthly conditional volatility of export/Horizontal FDI destination country stock market estimated from a GARCH (1,1) model multiplied by an indicator variable that takes the value 1 if a firm sells its output in a given destination in that period. The following indices are used as proxies for foreign destinations' stock markets: S&P 500 index (North America); DAX index (Europe); KOSPI index (Asia) and ASX index (Other)	DATASTREAM & BLOOMBERG and own estimation	Monthly
Export-weighted conditional covariance between Japanese and destination stock markets	Log of destination-specific export-share-weighted monthly conditional covariance between Japanese and export destination countries stock markets obtained via multivariate GARCH (1,1) regressions. The following indices are used as proxies for foreign destinations' stock markets: S&P 500 index (North America); DAX index (Europe); KOSPI stock index (Asia) and ASX index (Other)	DATASTREAM & BLOOMBERG and own estimation	Monthly
FDI-weighted conditional covariance between Japanese and destination stock markets	Log of destination-specific foreign-sales-share-weighted monthly conditional covariance between Japanese and FDI destination countries stock markets obtained via multivariate GARCH (1,1) regressions. The following indices are used as proxies for foreign market conditions: S&P 500 index, (North America); DAX index (Europe); KOSPI index (Asia) and ASX index (Other)	BLOOMBERG for raw data; and own estimation	Monthly
Time period:	January 2000-December 2010 (132 months)		
Number of firms:	1,474		

Table 2: Distribution of firms by mode of global engagement

Firm type	Number of firms	Export intensity		Horizontal FDI intensity	
		Mean	Std. Dev.	Mean	Std. Dev
Neither Horizontal FDI nor export across all years	599	-	-	-	-
Export at least once in the sample period	287	0.110	0.091	-	-
Horizontal FDI at least once in the sample period	26	-	-	0.038	0.043
Both Horizontal FDI and export at least once in the sample period	562	0.197	0.128	0.265	0.177

Table 3: Summary statistics

	Mean	Std. dev.	Proportion of within variance	Proportion explained by firm and time effects	Coefficient on export status	Coefficient on Horizontal FDI status
	(1)	(2)	(3)	(4)	(5)	(6)
Excess stock returns	0.000	0.103	0.993	0.000	0.001***	0.003***
Conditional volatility of excess stock returns	-0.907	1.576	0.924	0.001	0.256***	0.307***
Unconditional volatility of excess stock returns	-1.359	0.935	0.380	0.086	0.632***	0.642***
Export intensity	0.257	0.215	0.522	0.348		
Horizontal FDI intensity	0.287	0.188	0.146	0.018		
Size	17.549	1.538	0.017	0.000	1.352***	1.892***
Leverage	0.219	0.181	0.185	0.025	-0.004	-0.000
Returns on assets	1.725	7.086	0.554	0.031	0.712***	1.334***
Age	3.755	0.832	0.037	0.004	0.183	0.205***
Market value	9.779	1.770	0.072	0.022	1.592***	2.243***
External finance dependence dummy	0.498	0.500	0.753	0.000	0.033***	0.027**
Conditional volatility USD/Yen	-3.737	0.124				
Conditional volatility North American stock market	-0.110	0.255				
Conditional volatility European stock market	0.393	0.677				
Conditional volatility Asian stock market	0.089	0.255				
Conditional volatility Other destinations stock market	0.190	0.340				

Firm-year-month observations: 180,122. Column 4 reports the R squared of a regression of the respective variable with respect to firm and time fixed effects. Columns 5 and 6 report the estimated coefficient of a bivariate regression of the corresponding variable in each row of the table with respect to export and horizontal FDI dummies respectively. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 4: Volatility of stock returns and global engagement intensity

	Baseline model	Weighted regression	Including global engagement status
	(1)	(2)	(3)
Export intensity	0.045***	0.043***	0.047***
	(0.010)	(0.003)	(0.011)
Horizontal FDI intensity	0.055***	0.065***	0.114***
	(0.019)	(0.006)	(0.022)
Size	-0.019***	-0.017***	-0.022***
	(0.005)	(0.002)	(0.005)
Leverage	0.224***	0.199***	0.257***
	(0.014)	(0.004)	(0.014)
Return on assets	-0.002***	-0.002***	-0.002***
	(0.000)	(0.000)	(0.000)
Age	-0.006	-0.014***	-0.005
	(0.008)	(0.002)	(0.008)
Exchange rate volatility	0.072***	0.094***	0.183***
	(0.013)	(0.004)	(0.013)
North American stock market volatility	-0.003*	-0.002***	-0.003**
	(0.001)	(0.000)	(0.001)
European stock market volatility	0.000	-0.000	0.001
	(0.001)	(0.000)	(0.001)
Asian stock market volatility	0.001	0.001***	0.002
	(0.001)	(0.000)	(0.001)
Other stock markets volatility	-0.001	-0.001*	-0.000
	(0.001)	(0.000)	(0.001)
Lagged returns volatility	0.319***	0.322***	0.215***
	(0.002)	(0.000)	(0.002)
Export status			-0.006
			(0.005)
Horizontal FDI status			-0.042***
			(0.008)
Observations	163,820	163,820	163,820

Panel fixed effects estimates with standard errors adjusted for cross-sectional dependence and within-firm serial correlation; standard errors in parenthesis. All specifications include firm, year, and month-specific fixed effects. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 5: Volatility of stock returns and global engagement intensity — further analysis

	Excluding recession periods	Including foreign markets covariance	Low external finance industries	High external finance industries	Using yearly frequency data	Sales growth volatility (yearly)
	(1)	(2)	(3)	(4)	(5)	(6)
Export intensity	0.010	0.024**	0.043**	0.043***	0.057***	0.148**
	(0.012)	(0.011)	(0.021)	(0.012)	(0.020)	(0.067)
Horizontal FDI intensity	0.050**	0.040**	0.007	0.072***	0.088**	0.460***
	(0.023)	(0.019)	(0.039)	(0.021)	(0.040)	(0.152)
Size	-0.019***	-0.019***	-0.006	-0.022***	-0.013	0.017
	(0.006)	(0.005)	(0.010)	(0.006)	(0.013)	(0.054)
Leverage	0.276***	0.223***	0.186***	0.237***	0.220***	0.433***
	(0.017)	(0.014)	(0.026)	(0.016)	(0.050)	(0.116)
Return on assets	-0.002***	-0.002***	-0.002***	-0.002***	-0.004***	-0.003**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)
Age	-0.009	-0.006	-0.047***	0.007	-0.014	-0.171**
	(0.009)	(0.008)	(0.015)	(0.009)	(0.014)	(0.077)
Exchange rate volatility	0.305***	0.068***	0.040*	0.087***	-0.152	0.396
	(0.017)	(0.013)	(0.023)	(0.015)	(0.286)	(2.015)
North American stock market volatility	-0.005***	-0.003**	-0.005*	-0.002	0.000	-0.001
	(0.002)	(0.001)	(0.002)	(0.002)	(0.003)	(0.009)
European stock market volatility	0.000	-0.002	0.001	-0.000	-0.001	-0.001
	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.007)
Asian stock market volatility	0.007***	0.002	0.002	0.000	0.001	-0.012*
	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.007)
Other stock markets volatility	-0.003**	-0.002**	-0.001	-0.001	-0.003	0.004
	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.007)
Lagged returns volatility	0.302***	0.318***	0.323***	0.316***	0.274***	
	(0.003)	(0.002)	(0.004)	(0.003)	(0.010)	
Export-weighted covariance with foreign markets		0.001***				
		(0.000)				
Horizontal FDI-weighted covariance with foreign markets		0.000***				
		(0.000)				
Observations	163,820	163,820	50,098	113,722	13,763	10,677

Panel fixed effects estimates with standard errors adjusted for cross-sectional dependence and within-firm serial correlation; standard errors in parenthesis. Specifications (1)-(4) use monthly-frequency data and include firm, year, and month-specific fixed effects. Specifications (5) and (6) use yearly-frequency data and include firm and year fixed effects. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.