Journal of International Economics 98 (2016) 160–175

Contents lists available at ScienceDirect

Journal of International Economics

journal homepage: www.elsevier.com/locate/jie

Importing, exporting, and firm-level employment volatility☆

Christopher Kurz [a], Mine Z. Senses [b,*]

[a] Board of Governors of the Federal Reserve System, United States
[b] Johns Hopkins University, United States

ARTICLE INFO

Article history:
Received 4 March 2015
Received in revised form 14 August 2015
Accepted 26 August 2015
Available online 4 September 2015

JEL classification:
F1
F16
L25
L60

Keywords:
Trade
Firm heterogeneity
Employment volatility

ABSTRACT

In this paper, we use detailed trade and transactions data for the U.S. manufacturing sector to document a new set of stylized facts on the theoretically ambiguous relationship between the volatility of employment growth and the trade exposure of a firm. We find that, on average, firms that export are less volatile than non-traders, while importers are more volatile. The substantial variation we document across trading firms, in terms of the duration of time and the intensity with which they trade, the number and type of products they trade, and in terms of the number and characteristics of their trading partners, plays an integral role in explaining the robust association between trading and employment volatility. For trading firms, the frequency of trade is negatively associated with employment volatility. Importers with a higher share of imported inputs (especially manufactured imports) and those that source from more countries and from countries with lower per-capita income experience higher levels of volatility. A higher share of exports, fewer number of export destinations and, export destinations that are further away, and with lower average incomes are associated with higher levels of volatility for exporters.

Published by Elsevier B.V.

1. Introduction

Firms are highly heterogeneous in their degree of global engagement. The majority of firms are purely domestic; they serve only the home market and source all their inputs domestically. A number of firms do, however, engage in international trade, importing raw materials and/or intermediate inputs, exporting products, or both.[1] Such globally connected firms are likely to differ from purely domestic firms in terms of both the magnitude and volatility of shocks to which they are exposed, as well as their ability to smooth out shocks through diversification across markets. As a result, workers employed by these firms could experience different levels of volatility compared to workers employed by purely domestic firms.

In this paper, we ask whether this variation in outcomes for workers at globally engaged firms relative to domestic firms is indeed observed in the data. Specifically, we explore empirically the direction and the magnitude of the association between the exposure to trade and variation in employment volatility at the firm level.[2] This question is important, as employment volatility at the firm level has significant consequences for workers in terms of the probability and cost of displacement, as well as the associated uncertainty and income risk, each of which has been a major component of the debate on the welfare impacts of globalization.

Theoretically, there are various channels through which exposure to international trade could affect employment volatility at the micro level for firms with different levels of global engagement. Volatility will be higher for exporters relative to non-trading firms if the volatility of shocks is significantly higher in trading partners than in the United States, or if the export activity is inherently volatile (for example, due to shocks to the transport costs or to the exchange rate). Alternately,

☆ The analysis and conclusions set forth are those of the authors and do not indicate concurrence by other members of the research staff of the Board of Governors and do not necessarily represent the views of the US Census Bureau. All results have been reviewed to ensure that no confidential information is disclosed. For many helpful comments and suggestions, we are grateful to Emin Dinlersoz, Teresa Fort, Pravin Krishna, Logan Lewis, William Lincoln, Volodymyr Lugovsky and Andre Zlate. Excellent research assistance was provided by James Lin and Dominic Smith.

* Corresponding author. Tel.: 202 663 5685; fax: 202 663 7718.
E-mail addresses: christopher.j.kurz@frb.gov (C. Kurz), msenses@jhu.edu (M.Z. Senses).

[1] About 40% of the U.S. civilian workforce is employed by trading firms, which differ significantly from purely domestic firms in terms of their productivity, size, employment composition, and wages (Bernard et al. (2009)).

[2] Our focus in this paper is on volatility at the firm level and not on aggregate volatility. While firm-level volatility is an important component of volatility at the aggregate level, an increase in the former, depending on the covariance of shocks across firms, could be associated with a decrease, increase, or no change in the latter.

http://dx.doi.org/10.1016/j.jinteco.2015.08.003
0022-1996/Published by Elsevier B.V.

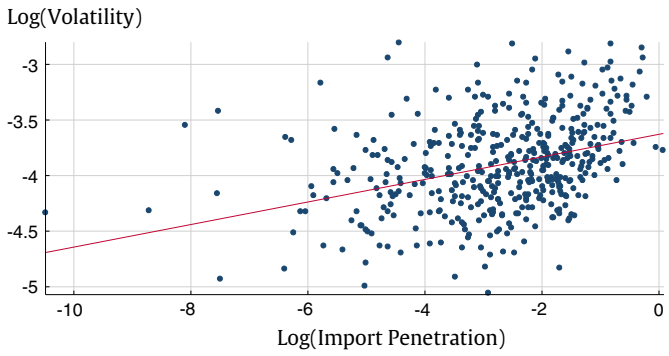

Fig. 1. Industry-level volatility of employment growth rates and import penetration, 1976–2005. Note: Reported values are industry-level volatility of employment growth rates and import penetration, averaged over 1976-2005. The fitted line is: Log(Volatility) = −3.63*** + 0.102***Log(Import Penetration).
Source: Own calculations using the NBER Productivity Database and Schott (2008).

firms operating in countries with imperfectly correlated shocks should be in a better position to diversify and smooth out demand shocks in the domestic market.[3]

The relationship between importing and volatility is similarly ambiguous. A firm that sources inputs from a number of countries can more easily absorb a productivity shock to a particular input by switching to alternate providers compared to a firm that only sources inputs domestically. As a result, a more diversified importing firm would experience *lower* levels of volatility compared to the firm sourcing its inputs domestically.[4] Similarly, a negative relationship between importing and volatility is predicted if imported intermediate usage is associated with the complexity of the production process.[5] Alternately, increased exposure to productivity shocks abroad through the production process would lead to *higher* employment volatility for an importing firm. Likewise, differences in labor-demand elasticities could also lead to higher employment volatility for workers employed by an importing firm.[6] The elasticity of labor demand for firms that engage in offshoring by purchasing intermediate inputs from abroad would be higher, as these firms can more easily substitute imported inputs for domestic workers in response to a wage increase at home. As a result, a given productivity shock will lead to larger employment variations at these firms.

In addition to the mode and intensity of global engagement, the frequency with which a firm participates in international markets also matters for the magnitude of employment volatility.[7] Shifting the source of demand and the structure of production could result in higher levels of volatility for firms that frequently switch from only domestic sales to some exporting and/or to imports from domestic sourcing. Importantly, such frequent switching between domestic and foreign markets (or sources) could itself be an endogenous response to the higher volatility (due to frequent demand and productivity shocks) that these firms face.[8] Trading firms also differ in terms of the number and type of traded products[9] and the number[10] and characteristics of trading partners (such as income level, volatility, and covariance with the United States). These differences introduce a significant degree of heterogeneity in terms of the levels of diversification and exposure across trading firms.[11]

In this paper, we provide a new set of stylized facts on the theoretically ambiguous relationship between employment volatility and the trade exposure of the firm. Instead of testing the predictions of a particular model or highlighting a specific mechanism, we study the association between trade and volatility along multiple dimensions emphasized in the theoretical literature. In our analysis, we use comprehensive data for the U.S. that combines detailed trade and transactions data with longitudinal firm-level data. The detailed information on trading partners, as well as the products traded provided in the linked trade and transactions data, allows us to study in detail the relative contribution of diversification across markets (for final goods) and source countries (for inputs), in terms of number of final products and inputs traded. The distinction is important because shocks can be transmitted through both demand and supply channels for firms, and the magnitude of shocks differs across countries and products. The longitudinal aspect of the data enables us to introduce time series variation into our estimating equations, and to additionally analyze within-firm variation in trade status and volatility through fixed-effects specifications.

Our findings suggest that importers are more volatile, and higher import intensity is associated with higher levels of employment volatility. An importer with average level of import intensity experiences 7% higher levels of employment volatility compared to a non-trader firm. This relationship is mainly driven by firms that switch in and out of importing, and is consistent with higher volatility associated with greater exposure to foreign productivity shocks and, increased substitutability of in-house production with purchases of foreign inputs in response to domestic wage shocks. We find that firms that only export and firms that both export and import, benefit from diversification

[3] Vannoorenberghe (2012) models these channels at the firm level and shows this relationship to be non-monotonic, with an export share threshold below which global sales of exporters are less volatile than that of non-exporters due to the diversification effect. Also see Nguyen and Schaur (2010) on transmission of foreign shocks to the domestic markets through the domestic supply of exporting firms. Both of these models emphasize the substitutability of exports and domestic sales due to convex costs. Relatedly, Caselli et al. (2014) emphasize the diversification channel in the context of macroeconomic volatility and openness. They show that country-wide shocks can bring about sufficiently strong diversification benefits to compensate for the effect of increased sectoral specialization due to trade. The sign and size of the effect of openness on volatility depends on the variance and covariance of shocks across countries, the intrinsic volatility of sectors in which the economy specializes, and the covariance among sectoral shocks and between sectoral and country-wide shocks.

[4] Bergin et al. (2011) make a related point in the context of offshoring, where offshoring insulates both output and employment in the U.S. manufacturing sector against business cycles. While their benchmark model succeeds in generating the greater volatility in the Mexican offshoring sector, it underestimates the degree of employment volatility in the U.S. offshoring sector, which is more volatile than the overall U.S. economy.

[5] For example, in Koren and Tenreyro (2013), firms using a large variety of inputs are less volatile, as each individual variety matters less in production and firms can offset a shock to a particular variety by adjusting the use of other varieties. See also Krishna and Levchenko (2013), which proposes specialization in less complex (and therefore more volatile) sectors as an explanation for the higher level of output volatility experienced in developing countries. Note that volatility of output modeled in the aforementioned papers and employment volatility need not move in the same direction—the association depends on the elasticity of substitution between imported inputs and in-house production.

[6] See, for example, Rodrik (1997), Slaughter (2001), and Senses (2010).

[7] Frequent switching in and out of trading is a commonly observed feature of the data. Eaton et al. (2008) find that roughly half of Colombian exporters did not export during the previous year. Besedes and Prusa (2006) document that more than half of all trade relationships are observed for a single year and approximately 80% are observed for less than five years.

[8] Békés and Muraközy (2012) show that firms facing uncertainty in terms of their future productivity may endogenously choose between variable- and sunk-cost trade technologies, which can yield an equilibrium outcome of temporary trade for some firms and destinations.

[9] For example, firms can import raw materials or intermediate production stages that non-importing firms either produce in-house or source from the domestic market. Shocks to inputs that are complements to employment at the firm could have implications for employment volatility that are quite different than shocks to inputs that are substitutes.

[10] Bernard et al. (2011) show that the distribution of exports across products is highly skewed within firms, and product selection accounts for a substantial proportion of the overall variance of exports.

[11] Related are the models in international real business cycle literature, which study the relationship between trade and the transmission of shocks between two countries. For example, Burstein et al. (2008), Zlate (2010), and Ng (2010) develop models where productivity shocks that are passed through demand channels either increase or decrease co-movement depending on the structure of the trading relationship. For instance, production sharing (complementarity in production) increases co-movement between trading partners, as production in one country increases demand for intermediates from another. Emphasizing supply channels in the transmission of shocks, Johnson (2012) builds an augmented IRBC model with intermediate inputs that pass productivity shocks downstream and finds much of the relationship between trade and co-movement to be driven by correlated shocks between countries.

across destinations with imperfectly correlated shocks and, on average, experience lower levels of volatility, by 2 and 4%, respectively. This relationship is non-linear, with an export share threshold above which exporters are more volatile than non-exporters. These findings continue to hold for alternative measures of volatility and at the industry level.

Consistent with previous studies, we document significant heterogeneity across trading firms in the duration of time and the intensity with which firms trade, the number and type of products they trade, and the number and characteristics of their trading partners. Our results indicate that these factors play an important role in explaining the variation in employment volatility across trading firms. Specifically, firms that engage in trade (exporting or importing) for a longer duration of time experience lower overall volatility. On the other hand, increased trade exposure, in terms of a larger share of inputs (especially from low-income countries) or a larger fraction of output (especially to middle-income countries), is strongly correlated with higher firm-level volatility. In line with the diversification story, we find an increase in the number of export destinations to be associated with lower levels of volatility. By contrast, a higher number of source countries for imports is associated with higher levels of employment volatility at the firm level, in line with country-specific shocks being passed through inputs into the production process. A decomposition of imports reveals that the relationship between import intensity and volatility is mostly driven by manufactured imports, which are more closely associated with offshoring, and not by imports of raw materials or inputs from the non-manufacturing sector. We also find the level and volatility of the GDP of the trading partner, and its distance to the US to be important determinants of firm-level volatility for exporters and importers.

Our paper is not the first to empirically explore the relationship between volatility and trade at the micro level. While much of the previous work links openness either to macroeconomic volatility[12] or to volatility at the industry level,[13] several recent papers have analyzed the relationship between trade status and volatility at the firm level. Abstracting away from variation in export intensity, Buch et al. (2009) find sales growth volatility to be lower for exporters in Germany. Consistent with our findings for employment volatility in the U.S., Vannoorenberghe (2012) documents a non-monotonic relationship between global sales of a firm and export share in France.[14] Nguyen and Schaur (2010) find the volatility impact of exporting to be different for Danish firms that continuously export compared to exporters that do not export every period.

The paper is organized as follows. Sections 2 and 3 present the data and our measures of volatility, respectively. Section 4 establishes and presents the stylized facts on trade and firm-level volatility and verifies them at the industry level. Section 5 presents the sources of volatility, followed by a concluding summary.

2. Data

In this section, we describe the firm- and industry-level data we use in our analysis. Industry identification, age, employment, firm identifiers, and longitudinal links sourced from the Longitudinal Business Database (LBD), which contains annual data on the universe of all private U.S. business establishments with paid employees from 1976 to present.[15] The LBD allows for a detailed analysis of employment dynamics and of the entry and exit of establishments. Importantly, the longitudinal coverage and annual frequency of the LBD allows for the calculation of firm-level volatility, which necessitates consecutive observations over time for each firm.

We aggregate the establishment data from the LBD to the firm level using firm identifiers and link it to the Longitudinal Firm Trade Transactions Database (LFTTD). In addition to individual trade transactions of imports and exports, the LFTTD includes information on the products traded (at the 10-digit Harmonized Schedule (HS) level), the nominal value of the transaction, and the destination countries for exports and source countries for imports.[16] We supplement the merged LBD and LFTTD dataset with detailed information on firm and industry characteristics. Data on firm characteristics such as skill composition, shipments, the number of products produced, and the cost of intermediate inputs are from the Census of Manufactures (CMF), which is collected every 5 years (in years ending in 2 and 7) for the universe of manufacturing establishments. Industry-level data on import penetration, export share, and trade share by country are from Schott (2008).[17] Data on shipments, employment, skill composition, wages, production, and deflators are from the NBER productivity database (Bartelsman et al. (2000)).

Since comprehensive industry- and firm-level data are mostly available only for the manufacturing sector, for the ensuing analysis we restrict our sample to firms operating within the manufacturing sector. We identify a firm as a manufacturing firm if more than 50% of its total employment across all affiliated plants is in this sector.[18] In addition to the availability of detailed data, the manufacturing sector is well-suited for our analysis, as it is more exposed to the competitive pressures and the market opportunities of international trade. Besides, while the share of the manufacturing sector in the total U.S. employment is only about 10%, the contribution of this sector to overall output volatility is substantial (Ramey and Vine (2006)).

In our analysis, we use data spanning 15 years from 1991 to 2005.[19] In the merged LFTTD and LBD dataset, the establishment count ranges from about 390,000 to roughly 460,000 a year, accounting for about 60% of overall imports and exports in the manufacturing sector. The average establishment employment is 45; 20% of establishments are part of a multi-unit firm and 45% are part of firms that have either imported or exported at least once.

[12] There is currently no consensus on the nature of the relationship between aggregate volatility and openness. Newbery and Stiglitz (1984) show that international competition, by posing a limit to price variability, reduces the stabilizing role of prices and exposes an economy to higher output volatility. While increased specialization that follows openness could result in a less diversified production structure, and therefore higher levels of risk in the domestic economy (Rodrik (1998)), it is also possible that country-wide shocks can bring about sufficiently strong diversification benefits to compensate for the effect of increased sectoral specialization due to trade (Caselli et al. (2014)). Moreover, the impact of specialization on aggregate volatility need not be positive, and it depends on the intrinsic volatility of the sectors in which the country specializes. Empirical evidence is similarly mixed. While Easterly, Islam, and Stiglitz (2000), Kose, Prasad, and Terrones (2003), and Di Giovanni and Levchenko (2010) document a positive association, Cavallo (2006), Burgess and Donaldson (2010), and Caselli et al. (2014) find a negative association between openness and aggregate volatility. Relatedly, Di Giovanni and Levchenko (2012) show that trade could raise aggregate volatility by making national output more dependent on idiosyncratic shocks of a handful of large firms.

[13] For example, Di Giovanni and Levchenko (2009) find industries that are more open to international trade to have higher levels of sales volatility, which they attribute to increased exposure to demand and supply shocks. Similarly, Krebs et al. (2010) and Krishna and Senses (2014) find a statistically and economically significant association at the industry level between openness and persistent income risk (variance of unpredictable changes in income) for Mexico and the U.S., respectively. Our analysis of industry-level employment data from the U.S. manufacturing sector for the 1976–2005 period, reported in Fig. 1, suggests a similar positive relationship between openness and employment volatility.

[14] While a higher export share raises the volatility of the global sales of a firm, exporters with an export share less than 10% are slightly less volatile than comparable non-exporters.

[15] See Jarmin and Miranda (2002) for a detailed description of the data.

[16] See Bernard et al. (2010) for more information about the LFTTD.

[17] The data we use are an update of Schott (2008) using the concordances from Pierce and Schott (2009) and Bartelsman et al. (2000). For more detail, see Peter Schott's webpage at http://faculty.som.yale.edu/peterschott/sub_international.htm.

[18] In identifying the industry of an establishment, we use the Fort–Klimek NAICS concordance (1976–2007) to construct time-consistent industry codes (NAICS).

[19] The LFTTD starts in 1992 and the most recent vintage available for this project was 2005. We use LBD employment data for 1991 to construct changes in employment between 1991 and 1992.

Table 1
Descriptive statistics by trader status.

	Full sample		Non-trader		Both		Exporter only		Importer only	
	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.
Employment	49.6	504.3	9.9	23.5	206.4	1168.8	28.8	63.8	24.5	57.1
Skill share	0.2	0.2	0.2	0.2	0.3	0.2	0.3	0.2	0.2	0.2
Age	12.3	7.7	11.0	7.3	15.2	7.9	13.6	7.8	11.3	7.6
Multi-unit status	0.1	0.3	0.0	0.1	0.2	0.4	0.1	0.3	0.1	0.2
Number of products	2.8	2.0	2.6	1.8	3.0	2.1	3.1	2.3	2.7	1.9
Number of countries exported to	1.1	4.0	0.0	0.0	4.9	8.3	1.4	1.1	0.0	0.0
Number of countries imported from	0.4	1.6	0.0	0.0	1.9	3.2	0.0	0.0	1.2	0.6
Number of products exported	1.8	8.9	0.0	0.0	7.8	19.7	1.9	1.7	0.0	0.0
Number of products imported	1.0	7.3	0.0	0.0	5.4	16.5	0.0	0.0	1.9	2.4
Percent of years exported	0.20	0.34	0.00	0.00	0.71	0.31	0.38	0.30	0.00	0.00
Percent of years imported	0.10	0.26	0.00	0.00	0.52	0.35	0.00	0.00	0.30	0.27
Number of firms	331,874		197,526		60,156		63,608		10,584	

Note: Descriptive statistics are calculated over the 15-year window from 1991–2005. All the statistics, except the number of products the firm produces and the skill share, are calculated from the LBD or the LFTTD. Product count and skill share are from the CMF.

Several aspects of our analysis require further modification of the sample. As we describe in detail in the next section, the calculation of employment volatility requires positive employment observations for consecutive years for firms in the sample. To this end, we primarily utilize two separate samples from the merged firm-level data. First, we calculate firm-level volatility for firms that report positive employment for at least five consecutive years over the full 1991–2005 sample period (a 15-year window). The five-year restriction provides sufficient observations to calculate firm-level employment volatility and yet allows us to retain some degree of entry and exit in our sample by including firms that are short-lived. In order to introduce temporal variation in volatility, we also calculate volatility over three 5-year windows: 1991–95, 1996–2000, and 2001–05. We drop outliers by omitting firms with employment levels and employment growth rates at the top and bottom 1 percentiles from both the 5- and 15-year sample windows.

2.1. Descriptive statistics

Table 1 provides basic descriptive statistics for the 15-year window from 1991 to 2005 for the full sample of firms and by trader status. The first two columns contain the means and standard deviations for the full sample of firms. Linking LBD, LFTTD, and CMF, and cleaning the data for outliers results in a sample of 331,874 firms that report at least five years of positive employment. The table includes the descriptive statistics for firm-level employment, skill share (defined as the share of non-production workers in total employment), age,[20] multi-unit status, number of products produced,[21] the number of countries exported to, the number of countries imported from, the number of exported and imported products,[22] and the percent of years a firm exports or imports.[23] The average firm employs 50 workers, 20% of whom are skilled workers. The average age is about 12 years and the average firm produces about three products. The remaining rows of the first two columns of Table 1 summarize trade-related moments. During the 15-year window for the full sample of firms, the average firm exports to 1 country and imports from 0.4 country and exports 1.8 products and imports 1 product.[24] On average, a firm exports 20% of the time it is under operation during the 15-year window and imports 10% of the time. Note that these averages are low, as roughly 60% of firms in the full sample do not trade.

For our baseline analysis, we divide firms into four categories by their trading status: firms that do not engage in trade (non-traders), firms that only export (exporter only), firms that only import (importer only), and firms that both import and export (both) during the 15-year window and each of the three 5-year windows. For the 15-year window, we classify a firm as a "non-trader" if the firm did not export or import during any of the years for which it reported positive employment. Similarly, a firm is an "importer only" ("exporter only") firm if it imported (exported) at least for one year during the 15 years and never exported (imported). A firm is defined as "both" if it engaged in importing and exporting during at least one year within the 15-year window. These categorical variables are also constructed in a similar fashion for the three 5-year windows to allow for the transitions between trading status that are prevalent in the data. According to our classification, about 40% of the 15-year sample consists of firms that engage in trade; 45% of these trading firms engage in both importing and exporting, 47% only export, and 8% only import.

The remaining columns in Table 1 describe firm characteristics by trade status over the 15-year sample. Consistent with previous studies, firms that do not trade are smaller and produce fewer products relative to trading firms. Firms that both import and export are substantially larger and older, employ a higher share of skilled workers, and are more likely to be multi-unit compared to both non-traders and to other trading firms that either only import or only export. These firms, on average, export to five countries (compared to an average of one for exporter-only firms) and import from two countries (compared to one for importer-only firms). The average number of products exported and products imported are about eight and five, respectively (compared to two for exporter-only and importer-only firms). Trading firms do not consistently export or import each period in which they produce: Exporter-only firms export 40% of the time and importer-only firms import 30% of the time.

The cross-tabulations reported in Table 2 suggest that the frequency with which firms engage in trade monotonically increases with the number of trading partners and with the number of products traded, for both exporters and importers. The top panel of Table 2 reports the average fraction of time exporting firms (independent of their import status) engage in exporting, by the number of destination countries and exported products. While firms that export one product to one country export 28% of the time, firms that export at least five products to at least five countries do so almost continuously (97% of the time). Statistics reported in the bottom panel of Table 2 tell a similar story for importers: Firms that import one product from one country do so 36% of the time, while firms that import at least five products from at least five countries do so 96% of the time.

[20] Firm age is calculated as the number of years the firm reported positive employment in the LBD and is top coded at 30 for firms with positive employment for the entire duration of the LBD from 1976 to 2005.

[21] Number of products the firm produces and the skill share are from the CMF and are calculated as an average over the overlapping CMF years.

[22] Both imported and exported products are reported in 10-digit HS classification.

[23] The percent of years a firm exports (imports) is calculated as the number of years an establishment exports (imports) relative to the number of years the establishment reports positive employment within a given window.

[24] For products and countries traded, the medians for the full sample are zero.

Table 2
Percent of time traded by number of products and number of countries.

Panel A. Exporters						
Number of products exported	Number of destination countries					
	1	2	3	4	5+	Total
1	0.28	0.54	0.68	0.75	0.87	0.28
2	0.48	0.62	0.77	0.85	0.91	0.54
3	0.58	0.76	0.82	0.87	0.91	0.71
4	0.63	0.81	0.87	0.90	0.94	0.80
5+	0.68	0.86	0.91	0.92	0.97	0.92
Total	0.37	0.71	0.86	0.91	0.96	0.56
Panel B. Importers						
Number of products imported	Number of source countries					
	1	2	3	4	5+	Total
1	0.36	0.63	0.79	0.83	0.85	0.37
2	0.54	0.72	0.81	0.84	0.90	0.60
3	0.61	0.78	0.87	0.91	0.87	0.73
4	0.66	0.80	0.89	0.91	0.94	0.80
5+	0.74	0.85	0.90	0.93	0.96	0.90
Total	0.43	0.77	0.89	0.92	0.96	0.60

Note: Descriptive statistics are calculated over the 15-year window from 1991–2005 separately for exporters (only exporters and both) and for importers (only importers and both). The percent of years a firm exports (or imports) is calculated as the number of years a firm exports (imports) relative to the number of years the firm reports positive employment.

Table 3 presents the share of firms by trade status for each sample window. Roughly 60% of firms never engage in trade throughout the entire 1991–2005 period. For the three 5-year windows, this share increases by 2 to 4 percentage points depending on the particular period. The increase in the fraction of non-traders is due to firms that trade only once or twice being counted as traders during the entire 15-year window, and identified as non-traders when using shorter intervals.[25] The share of firms in each trade status category does not vary much across time. The majority of firms that trade are either "exporter only" or "both." Roughly 20% of the firms only export and 18% both export and import. Firms that only engage in importing are a small fraction of our sample, at about 3%.

Next, we calculate transition probabilities between trade statuses both at 5-year and annual frequencies. In the top panel of Table 4, we present the transition probabilities between the four trade status categories over three 5-year windows: 1991–95, 1996–2000, and 2001–05. About 75% of firms retain their trading status from one 5-year window to the next. For firms that only export or only import, the likelihood of transitioning to another trade status is substantially higher compared to firms that do both or neither. The year-to-year transition probabilities,[26] reported in the bottom panel of Table 4, are relatively similar, but with lower probabilities of switching between trade statuses for each category (especially for non-traders and importer-only firms). While there appears to be some inertia in trade status in the data, the results in Table 4 also point to significant number of firms that switch. For example, about 35% of firms that only import during the 1996–2000 window report no imports during the next window (and are classified as non-trader), and about 20% of such firms continue importing and start exporting (and are classified as both). While these transition probabilities show some variation across different windows, the magnitudes are roughly similar.

The categorical approach to identifying trade status, while informative, does not differentiate between firms that intensively trade and

[25] According to our classification, a firm that is labeled as a "non-trader" for the 15-year sample will be labeled as non-trader for all the 5-year windows (but not vice versa). Similarly, a firm can be labeled as a "both" firm for the 15-year sample but as a "non-trader" firm for at least one of the 5-year samples if the firm did not engage in international trade during the coverage of the 5-year window.

[26] The year-to-year transitions probabilities are calculated annually and are averaged over the full 15-year panel.

Table 3
Share of firms by trade status.

	15-Year window	5-Year window		
	1991–2005	1991–1995	1996–2000	2001–2005
Non-trader	60%	64%	63%	62%
Exporter only	19%	19%	20%	19%
Importer only	3%	3%	3%	3%
Both	18%	14%	15%	16%

Source: Merged LFTTD-LBD sample.

firms that trade only a small fraction of their output or input. In order to take into account this heterogeneity, we also construct measures of intensity of imports and exports for a firm. For export intensity, we calculate the ratio of export value to the value of shipments. The import intensity measure is calculated as the ratio of imports to the cost of materials, where the cost of materials is measured as the cost of parts, fuels, electricity, and contract work incurred by the firm.[27] We decompose the import intensity measure into share of imported manufactured inputs, share of imported non-manufacturing inputs, and share of imported raw materials.[28] We further divide imported manufactured goods into offshoring-related imports and imports of other manufactured goods. Offshored manufactured imports are defined as imports that are within the same 3-digit NAICS as the main industry of the firm, similar to the "narrow measure of outsourcing" used by Feenstra and Hanson (1999). Also included in the offshored category are goods shipped abroad and imported back after further processing under the production sharing provisions (Chapter 98 of the Harmonized Tariff Schedule).

The export and import intensity measures are summarized in detail in Table 5. The top panel reports averages and standard deviations over the entire 15-year window and the bottom panel summarizes the intensity measures conditional on positive values for each measure of interest. On average, about 2% of shipments are exported and 2.7% of total cost of materials are imported. When we only focus on firms that export or import, the average shares are higher, with exports-to-shipments ratio at 5% and the share of imported inputs roughly at 12%. Large standard deviations point to significant heterogeneity across firms in terms of their export and import intensities. The share of imports of non-manufacturing inputs and imports of raw materials are, on average, smaller than the share of imported manufactured inputs.

Table 6 describes the firm-level variation in the duration of time a firm engages in trade, number of trading partners, and number of products traded, by quartiles of trade intensity. The sample is restricted to exporters and importers in the top and bottom panels, respectively. Higher quartiles of export intensity are associated with higher import intensity, larger fraction of time exporting and importing, larger number of destination and source countries, and larger number of products imported and exported. Similarly, higher import intensity is associated with higher export intensity, larger fraction of time exported and imported, larger number of destination and source countries, and larger number of products imported and exported. In light of these figures, which highlight the strong association between different dimensions of firm-level trade exposure, in the analysis that follows we supplement the multivariate regressions relating these characteristics to firm-level volatility, with less parametric descriptives.

[27] For both the import and export intensity measures, the numerators (total imports and exports) are average values calculated over the years for which positive dollar values are reported. Both the value of shipments and cost of materials are from the CMF.

[28] Following the definition employed in Hummels et al. (2011), we use the HTS codes in the LFTTD data to identify raw materials as products with HTS codes 1–15, 25, 26, 27, 31, and 41. Once raw materials are separated from the import data, we concord HTS to NAICS and define manufactured goods as those in NAICS 31–33 categories. Non-manufacturing imports are then defined as imports of inputs that are not raw materials or manufacturing goods (such as printed and published materials, non-raw material agricultural products etc.).

Table 4
Transition probabilities for firm trade status.

Panel A. 5-Year transition probabilities

	Non-trader$_{96\text{-}00}$	Both$_{96\text{-}00}$	Exporter only$_{96\text{-}00}$	Importer only$_{96\text{-}00}$	Non-trader$_{01\text{-}05}$	Both$_{01\text{-}05}$	Exporter only$_{01\text{-}05}$	Importer only$_{01\text{-}05}$
Non-trader$_{91\text{-}95}$	84%	2%	12%	2%	81%	3%	14%	2%
Both$_{91\text{-}95}$	2%	80%	15%	3%	4%	76%	18%	3%
Exporter only$_{91\text{-}95}$	20%	18%	60%	1%	25%	21%	53%	2%
Importer only$_{91\text{-}95}$	29%	27%	13%	30%	35%	27%	17%	21%
Non-trader$_{96\text{-}00}$					89%	1%	8%	2%
Both$_{96\text{-}00}$					3%	77%	17%	3%
Exporter only$_{96\text{-}00}$					25%	14%	59%	2%
Importer only$_{96\text{-}00}$					36%	21%	10%	33%

Note: The transition probabilities for each 5-year panel pair are calculated for firms that reported positive employment during both windows.

Panel B. Year-to-year transition probabilities

	Non trader$_{t+1}$	Both$_{t+1}$	Exporter only$_{t+1}$	Importer only$_{t+1}$
Non trader$_t$	94%	5%	1%	0%
Both$_t$	4%	77%	13%	5%
Exporter only$_t$	26%	9%	64%	1%
Importer only$_t$	27%	18%	6%	49%

Note: The transition probabilities are calculated annually and are averaged over the full 15-year window.

3. Measures of volatility

As we noted before, the estimation of firm-level volatility of employment growth rates requires longitudinal data at an annual frequency. For the 1991–2005 period, we first calculate a time-invariant measure of volatility for firms reporting positive employment for at least 5 consecutive years over the full 15-year window. This measure has the advantage of having most employment growth rates calculated over a long time span, resulting in a more precise measure of firm-level volatility. We also employ a time-varying volatility measure constructed over three 5-year windows, which allows us to explore the robustness of our results to time variation in firm-level volatility and to control for firm characteristics that are fixed over time.

The volatility measures we use capture the variability of growth rates (γ_{ijt}) of employment (E_{it}). For our primary measure of firm-level volatility, we calculate a conditional growth rate of employment given by the estimated residuals from the following specification with log growth rates of employment in firm i at time t as the dependent variable:

$$\gamma_{ijt} = \ln(E_{it}) - \ln(E_{it-1}) = \phi_i + \mu_{jt} + \upsilon_{it}.$$

Table 5
Descriptive statistics for import and export intensity measures.

Variable	Mean	Std dev	Obs
Full sample			
Exports to shipments ratio (export intensity)	1.9%	7.8%	331,874
Imports to cost of materials ratio (import intensity)	2.7%	12.0%	331,874
Manufacturing import intensity	2.6%	11.6%	331,874
Offshoring (narrow measure)	1.5%	9.4%	331,874
Other manufacturing materials	1.1%	7.6%	331,874
Non-manufacturing import intensity	0.0%	1.2%	331,874
Raw materials import intensity	0.1%	2.0%	331,874
Conditional on positive values			
Exports to shipments ratio (export intensity)	5.1%	12.2%	123,726
Imports to cost of materials ratio (import intensity)	11.7%	23.8%	70,709
Manufacturing import intensity	11.5%	24.3%	70,709
Offshoring (narrow measure)	10.1%	22.3%	50,375
Other manufacturing materials	6.8%	17.6%	55,190
Non-manufacturing import intensity	1.6%	8.6%	5882
Raw materials import intensity	4.5%	14.5%	5896

Note: The summary statistics are calculated over the 15-year window (1991–2005). The top and bottom panels report summary statistics for the full sample and conditional on positive values for the variable of interest, respectively.

Firm fixed effects ϕ_i are included to isolate the within-firm effects, and sector-year fixed effects (μ_{jt}) are included to capture sector-specific shocks (such as shocks to factor prices, productivity, or demand) that are common to all firms in a given sector. The estimated residual (υ_{it}) reflects the deviation of employment growth from the firm-average and from the sector-average at time t. Volatility is then calculated as the standard deviation of the residual growth rates for a window of length w[29]:

$$\sigma_i^w = Vol(\gamma_i) = \sqrt{\frac{1}{w-1}\sum \upsilon_{it}^2}.$$

We call this method the "residual" approach.

To ensure robustness of our results, we also calculate the growth rate of employment as the log difference in employment and use this measure to calculate the volatility as the standard deviation of firm employment growth:

$$\sigma_{it}^w = \left[\frac{1}{w-1}\sum_{\tau=0}^{w}\left(\gamma_{i,t+\tau} - \overline{\gamma_{it}}\right)^2\right]^{1/2}$$

where w is the length of the window (5 or 15 years) and $\overline{\gamma_{it}}$ is the average growth rate over the window w.[30]

Table 7 reports summary statistics for the volatility of growth rates estimated using the residual approach[31] for the 15-year window (over the 1991–2005 period) and for the three 5-year windows (1991–95, 1996–2000, and 2001–05) separately for the full sample of firms and by trading status of the firm. Several stylized facts stand out. First, on average, firms that only export, and firms that both export and import, are less volatile compared to firms that only import and firms that do not engage in trade. This is true for both the time invariant measure calculated over 15 years and the time varying measure calculated over three 5-year windows. Second, on average, firm-level volatility does

[29] This measure is very similar to the baseline measure (column (4) in Table 2) used in Vannoorenberghe (2012) (except for the omission of the growth rate of capital not available in our dataset), and the measure from Kalemli-Ozcan et al. (2014), which calculates volatility year-by-year as the absolute value of the residual (υ_{it}).

[30] In unreported results, we also calculate the growth rate of employment of firm i at time t as $\gamma'_{it} = \frac{E_{it}-E_{it-1}}{(E_{it}+E_{it-1})/2}$ following Davis et al. (1996). This measure has the advantage of being bounded and symmetric around zero and allows us to incorporate births and deaths into our analysis. Our main results are robust to using this measure and are available upon request.

[31] Since the two measures of employment volatility are highly correlated at about 0.8, we report the descriptive statistics only for volatility calculated using the residual method.

Table 6
Summary statistics by quartiles of trade intensity.

Panel A. Exporters, by quartiles of export intensity							
Quartiles of export intensity	Import intensity	Fraction of time		Number of countries		Number of products	
		Exported	Imported	Exported to	Imported from	Exported	Imported
1	0.01	0.22	0.06	1.07	0.21	1.23	0.29
2	0.03	0.45	0.16	1.32	0.40	1.84	0.57
3	0.06	0.68	0.27	2.09	0.70	2.86	0.99
4	0.13	0.85	0.45	3.26	1.34	3.92	1.70
Total	0.05	0.56	0.24	1.96	0.67	2.50	0.91
Panel B. Importers, by quartiles of import intensity							
Quartiles of import intensity	Export intensity	Fraction of time		Number of countries		Number of products	
		Exported	Imported	Exported to	Imported from	Exported	Imported
1	0.01	0.28	0.26	1.18	1.07	1.41	1.18
2	0.04	0.48	0.44	1.86	1.28	2.19	1.60
3	0.06	0.60	0.63	2.28	1.84	2.63	2.49
4	0.10	0.69	0.84	2.46	2.74	2.98	3.87
Total	0.06	0.56	0.60	2.09	1.90	2.48	2.57

Note: Descriptive statistics are calculated over the 15-year window (1991–2005) separately for exporters (only exporters and both) and for importers (only importers and both). Import and export intensity are defined as exports (imports) as a fraction of shipments (cost of materials). The percent of years a firm exports (imports) is calculated as the number of years a firm exports (imports) relative to the number of years the firm reports positive employment.

Table 7
Volatility of employment growth rates by time period and by trade status.

15-Year window	1991–2005		
	Mean	Std dev	N
Full sample	0.35	0.25	331,874
Exporter only	0.32	0.24	63,608
Importer only	0.38	0.27	10,584
Both	0.31	0.27	60,156
Non-trader	0.36	0.24	197,526

5-Year windows	1991–1995			1996–2000			2001–2005		
	Mean	Std. dev.	N	Mean	Std. dev.	N	Mean	Std. dev.	N
Full sample	0.30	0.25	180,854	0.28	0.24	203,350	0.29	0.24	190,789
Exporter only	0.27	0.24	34,600	0.26	0.23	39,659	0.26	0.23	35,942
Importer only	0.32	0.27	5155	0.31	0.26	5682	0.31	0.26	5976
Both	0.26	0.26	25,998	0.25	0.25	30,836	0.25	0.24	30,107
Non-trader	0.32	0.25	115,101	0.30	0.24	127,173	0.31	0.24	118,764

Note: Volatility of employment growth rates is calculated using the residual method. The top panel provides the descriptive statistics for the time-invariant measure of volatility calculated over 15-year windows. The bottom panel reports the descriptive statistics separately for three 5-year windows.

not show much time variation for either the full sample of firms or the sub-samples of firms by trading status.

4. Trade and volatility of growth rates

4.1. Volatility at the firm level

The summary statistics reported in Table 7 point to variation in employment volatility across firms with different trade status. In this section we formally test for such a linkage between trade status of the firm and its volatility. The first set of specifications examines whether trading firms differ in terms of employment volatility after controlling for industry and firm characteristics. We start by estimating the following specification:

$$ln\sigma_{ij,w} = \beta_0 + \beta_1 Exp_{i,w} + \beta_2 Imp_{i,w} + \beta_3 Both_{i,w} + \beta_4 ExpInt_{i,w} + \beta_5 ImpInt_{i,w} + \phi X_{i,w} + \theta Y_{j,w} + \varepsilon_{ij,w} \quad (1)$$

where i indexes the firm, j indexes the industry, and w indexes the window over which the volatility measure ($\sigma_{ij,w}$) and the explanatory variables are calculated ($w = 5$ or 15). The categorical variables we construct take the value of one for firms that are only exporters and not importers (*Exp*), only importers and not exporters (*Imp*), and for firms that engage in both importing and exporting (*Both*), and zero otherwise. The omitted category (*Non-Trader*) includes firms that do not engage in international trade within the window analyzed. The firm-level trade intensity measures are export share (*ExpInt*) and import share (*ImpInt*). $Y_{j,w}$ represents the set of controls at the industry level, including the logarithms of import penetration, export share, industry size (measured as total employment), and the skill share of the industry (measured as the share of non-production workers in total employment); $X_{i,w}$ represents firm-level controls, including multi-unit status, skill share, and logarithms of age and size. The control variables are calculated as the average over w, the window of interest.[32]

The regression results for the 15-year window are reported in Table 8. We start by estimating Eq. (1) including only the categorical variables summarizing firm trade status, along with firm-level controls and industry fixed effects. Within industries, compared to purely domestic firms, we find firms that only export to be less volatile and

[32] For example, consider a firm that reports positive employment for seven consecutive years over the 15-year window ($w = 15$). Then the dependent variable in Eq. (1) is volatility calculated over six growth rates and the trade status is determined during this 7-year period. The intensity measures are calculated as average imports and average exports as a fraction of the average cost of materials and shipments over the 7 years, respectively. The firm-level controls are averaged over the one or two Economic Censuses covered during the 7-year life cycle of this firm.

Table 8
Volatility of employment growth rates and detailed trade status at the firm-level over 15 years.

	(1)	(2)	(3)	(4)
Both	−0.075**	−0.032**		−0.065**
	(0.004)	(0.004)		(0.004)
Exporter only	−0.042**	−0.020**		−0.025**
	(0.003)	(0.003)		(0.003)
Importer only	0.036**	0.066**		0.051**
	(0.007)	(0.007)		(0.007)
Import intensity			0.144**	0.176**
			(0.011)	(0.012)
Export intensity			0.078**	0.149**
			(0.018)	(0.019)
Firm employment	−0.030**	−0.019**	−0.026**	−0.018**
	(0.002)	(0.002)	(0.001)	(0.002)
Multi-unit status	−0.028**	−0.039**	−0.049**	−0.045**
	(0.006)	(0.006)	(0.006)	(0.006)
Skill share	0.054**	−0.269**	−0.306**	−0.275**
	(0.011)	(0.017)	(0.017)	(0.017)
Age	−0.118**	−0.129**	−0.127**	−0.127**
	(0.002)	(0.002)	(0.002)	(0.002)
Number of products	−0.116**	−0.144**	−0.141**	−0.142**
	(0.003)	(0.003)	(0.003)	(0.003)
Import penetration		0.017**	0.016**	0.016**
		(0.002)	(0.002)	(0.002)
Export share		−0.024**	−0.026**	−0.024**
		(0.002)	(0.002)	(0.002)
Industry size		−0.004**	−0.002	−0.004**
		(0.001)	(0.001)	(0.001)
Industry skill share		0.061**	0.052**	0.056**
		(0.010)	(0.010)	(0.010)
N	331,874	331,874	331,874	331,874
R^2	0.06	0.04	0.04	0.04

Note: The dependent variable in each specification is firm-level volatility of employment growth rates calculated using the residual method over the 15-year window. Robust standard errors are reported in parentheses. Column 1 includes industry fixed effects at 6 digit NAICS level.
* Denotes significance at the 5% level.
** Denotes significance at the 1% level.

firms that only import to be more volatile; firms that engage in both importing and exporting are less volatile. Employment volatility is lower for larger, older, and single-unit firms, and for firms with higher skill share.[33] Interestingly, firms that produce a wider range of products are also less volatile, presumably due to the diversification of demand shocks. The results related to trade status do not change when we replace industry fixed effects with industry-level controls in column 2. Higher estimated employment volatility for firms operating in industries with high import penetration and low export share is broadly consistent with Slaughter (2001) and Krishna and Senses (2014), which document a negative relationship between import penetration and labor demand elasticities and individual income risk, respectively. Firms in larger industries are less volatile, whereas firms in industries with a higher share of skilled workers are more volatile.

Specifications estimated in columns 1 and 2 assume that the volatility impact of exporting is the same for a firm that exports an infinitesimal share of its output and a firm that exports a large share. But this need not be the case. For example, if exchange rate fluctuations or foreign demand shocks are propagated through the export channel, then a larger fraction of output dedicated to foreign demand might result in an increase in the ease and speed at which shocks are transmitted to the firm. In order to account for such heterogeneity in the impact of trading on employment volatility, we replace the categorical trade status variables with share of exports in total sales and share of imports in total cost at the firm level and report the results in column 3. Both the share of exports and the share of imports have a significant and positive association with firm-level employment volatility.

In column 4, we include the share of exports and imports together with the categorical variables to account for any intrinsic differences between trading and non-trading firms, and to allow for a non-monotonic impact of trading on firms. We continue to find both import and export shares to be associated with higher firm-level volatility, with no change in the signs and the degree of significance of the categorical trade status variables. While an importer with average level of import intensity experiences 7% higher levels of employment volatility compared to a non-trader firm, volatility for the average exporter is 2% lower. In addition, firms that both export and import are 4% less volatile than non-trading firms.

The association between export status and volatility is non-monotonic: Volatility is higher for firms that export more than 17% of their total sales compared to firms that do not export, or export a smaller share; exporters with export share less than 17% are less volatile compared to non-exporters.[34] A non-monotonic association between export intensity and volatility is consistent with the framework in Vannoorenberghe (2012), in which monopolistically competitive firms face market-specific demand shocks and convex costs. In this model, as long as home and foreign shocks are not perfectly correlated, there exists an export share below which global sales of exporters are less volatile than that of non-exporters due to the diversification effect.[35] Our findings for the U.S. suggests that the diversification effect that works to reduce volatility when the domestic and foreign shocks are not perfectly correlated is important for many exporters, given that the average export share is 5%.

Table 9 reports estimation results from several additional specifications that support the general robustness of our results. First, we introduce time-variation to Eq. (1) and use the employment volatility measures calculated over three 5-year windows as the dependent variable. The specifications are estimated with and without sector-window fixed effects ($\delta_{j,w}$) and with and without firm fixed effects (α_j). The controls at the firm level ($X_{i,w}$) and industry level ($Y_{j,w}$) are calculated as averages over each 5-year window. The estimation results from these specifications are reported in the first four columns of Table 9. The results reported in column 1 without the intensity measures are consistent with those for the 15-year panel: Relative to firms that do not trade, exporters are less volatile, importers are more volatile, and firms that both import and export are less volatile. Column 2 introduces the export and import intensity measures. The results again are similar to those reported in Table 8 for the 15-year panel. The relationship between employment volatility and import and export intensities are positive and significant, and the inclusion of continuous measures of import and export intensities does not change the sign or the significance of the categorical variables. Estimates reported in column 3 suggest that our results are robust to the inclusion of sector effects (at 5-digit NAICS level) that vary across windows. Column 4 of Table 9 introduces firm

[33] Note that the negative association between volatility and the share of skilled workers in a firm holds only after controlling for skill composition at the industry level. Excluding industry skill share in Eq. (1), as in column 1, results in a positive firm skill-volatility relationship.

[34] The export intensity threshold, above which exporters become more volatile than non-exporters, is calculated from point estimates reported in column 4 as 0.025/0.149. The non-linear relationship between exporting and volatility is a robust finding in our dataset. As will be demonstrated in later tables, it continues to hold when the specification is estimated for the full sample of firms, for the sub-sample of trading firms, and, both for temporary and permanent exporters. These results are also robust to allowing for the impact of age and size to be non-linear (by including these variables in quadratic form or by including indicator variables for each size and age quintile) and to introducing export and import intensities in quadratic form without the indicator variables.

[35] Specifically, prediction 3 in Vannoorenberghe (2012) suggests exporters with small openness levels should be less volatile than comparable non-exporters, as they benefit from a diversification effect (independent of the assumptions on the variance of both markets). However, if foreign markets are more volatile than the home market, or if the export activity is inherently volatile, openness should be positively correlated with volatility. The empirical findings for French firms similarly point to a non-monotonic relationship between exporting and volatility of the growth rate of firm sales: While on average the association between the export share and global sales volatility at the firm level is positive, the volatility is lower for firms with an export-to-sales ratio of less than 10% (Vannoorenberghe (2012)).

Table 9
Volatility of employment growth rates and detailed trade status at the firm-level-robustness.

	Firm-level								Establishment-level		
	Residual method					Log differences			Residual method		
	5-Year windows				15-Year balanced	15-Year	5-Year windows		15-Year	5-Year windows	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Both	−0.058**	−0.093**	−0.085**	−0.022**	−0.019**	−0.010*	0.013**	−0.015*	−0.069**	−0.074**	−0.030**
	(0.004)	(0.004)	(0.004)	(0.006)	(0.006)	(0.004)	(0.004)	(0.007)	(0.004)	(0.007)	(0.006)
Exporter only	−0.055**	−0.061**	−0.057**	−0.011**	−0.023**	−0.036**	−0.041**	−0.010*	−0.026**	−0.037**	−0.014**
	(0.003)	(0.003)	(0.003)	(0.004)	(0.005)	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)	(0.004)
Importer only	0.031**	0.015*	0.02**	0.005	0.023*	0.023**	0.025**	0.012	0.041**	0.036**	0.0001
	(0.006)	(0.006)	(0.006)	(0.008)	(0.010)	(0.006)	(0.006)	(0.009)	(0.007)	(0.007)	(0.008)
Import intensity		0.144**	0.146**	0.043**	0.180**	0.148**	0.134**	0.043	0.065**	0.100**	0.046**
		(0.009)	(0.010)	(0.017)	(0.018)	(0.011)	(0.010)	(0.019)	(0.011)	(0.011)	(0.018)
Export intensity		0.154**	0.166**	0.065**	0.121**	0.094**	0.166**	0.090**	0.022	0.112**	0.049*
		(0.013)	(0.014)	(0.021)	(0.027)	(0.016)	(0.013)	(0.023)	(0.018)	(0.016)	(0.022)
N	574,993	574,993	574,993	574,993	103,884	321,292	548,411	548,411	352,990	629,008	629,008
R^2	0.09	0.09	0.09	0.06	0.17	0.20	0.23	0.20	0.08	0.10	0.07
Industry-level controls	NO	NO	NO	YES	NO	NO	NO	YES	NO	NO	YES
Sector-window fixed effects	NO	NO	YES	YES	NO	NO	YES	YES	NO	YES	YES
Firm fixed effects	YES	YES	YES	YES	NO	NO	YES	YES	NO	YES	YES

Note: Each specification includes industry fixed effects at the 6 digit NAICS level and (unreported) covariates at the firm-level including multi-unit status, size, skill share, age, and the number of products. First two columns include window fixed effects, while rest of the 5-year window specifications include sector-window fixed effects (at the 5-digit NAICS level). Robust standard errors are reported in parentheses.
* Denotes significance at the 5% level.
** Denotes significance at the 1% level.

fixed effects in order to control for any unobserved firm-level heterogeneity that is time-invariant. The estimates are broadly consistent with our previous results, although the estimated coefficients are smaller and, in the case of sole importers, no longer statistically different from zero. The lack of significance for sole importers is not particularly surprising, as the coefficients in the fixed effects specifications are identified off variation over time in trade status. As we reported in Table 5, only a limited number of firms in our sample are sole importers, and the number of firms switching in and out of this category is similarly small. Given the limited time series variation in the data, we view the specifications with firm-fixed effects as mainly robustness checks.

We then re-estimate Eq. (1) for a balanced panel of 103,884 firms that report positive employment for the entire sample of 15 years. While this is a biased sample of older and larger firms, given the well-documented empirical regularity that the firms that engage in international trade are both larger and more likely to survive compared to their domestic counterparts, arguably this selected group of firms may indeed provide a more appropriate comparison group. In the next three columns (columns 6–8), we present estimation results with the log difference measure of volatility (calculated using the standard deviation of the log differences in employment) as the dependent variable. Columns 9–11 report results with volatility of employment growth calculated at the establishment level (instead of the firm level) as the dependent variable.[37] We find all these estimates to be consistent with our previous findings.[38]

Our findings point to significant variation in volatility across trading firms. Nonetheless, the next set of results reported in Table 10 abstracts away from this variation and focuses on overall trade openness in order to ensure the comparability of our findings with previous empirical studies at the sector/country level.[39] In doing so, we create an indicator variable that takes a value of one if the firm engages in international trade and zero otherwise, and we replace the import and export intensity measures with a measure of overall trade intensity.[40] Consistent with earlier studies (such as Di Giovanni and Levchenko (2009)), we find overall trade openness to be associated with higher levels of volatility. As before, the impact is estimated to be non-linear: Firms with low levels of openness are less volatile than non-traders, and firms with high levels of openness are more volatile than non-traders.

4.2. Permanent versus temporary traders

In the preceding analysis, we identified the trade status of a firm in a given window regardless of the frequency with which the firm traded. However, the employment dynamics for firms that periodically trade could be quite different from firms that continually engage in international markets. The top (bottom) panel of Table 11 provides cross tabulations of volatility of employment growth rates for exporters (importers) by quartiles of the fraction of time firm exports (imports) and by quartiles of export (import) intensity. The numbers in parenthesis represent the share of firms in a particular cell. For a given quartile of export intensity, average volatility decreases almost monotonically by the fraction of time firm exports. The same is true for the relationship between volatility and quartiles of import intensity, and fraction of time firm imports. By comparison, given the fraction of time exported or imported, employment volatility increases with higher quartiles of export or import intensity.

We further explore the association between employment volatility and the duration of trading by first restricting our attention to firms that export (but do not import) in each year that they report positive levels of employment ("permanent exporters"), firms that import (but do not export) in each year that they report positive levels of employment ("permanent importers"), firms that import or export in each year that they report positive levels of employment ("permanent both"), and firms that never export or import ("non-trader") during

[37] In this specification, the trade status and intensity measures continue to be at the firm level since this data sources from the LFTTD. Accordingly, the standard errors are clustered at the firm level.
[38] We also estimate Eq. (1) with volatility of (real) wage growth as the dependent variable and find our results to be similar to our findings for volatility of employment growth. These results are available upon request.
[39] We thank an anonymous referee for this suggestion.
[40] Note that this measure is not identical to the measures used at the sector level. While firm-level imports measure all imports of a given firm regardless of sector, imports reported at the sector level is the value of goods imported in a given sector. Hence, when we aggregate imports at the firm level to sector level (as we do in Section 4.2), this measure will be different than sector-level imports—the former measures the total value of imported inputs to the sector, and the latter measures the total value of final goods imported of this sector. There is no such distinction for the export measure.

Table 10
Volatility of employment growth rates and trader status at the firm-level.

	15-Year window			5-Year windows			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Trade intensity	0.119**		0.133**	0.096**		0.124**	0.046**
	(0.009)		(0.009)	(0.007)		(0.007)	(0.012)
Trader		−0.015**	−0.025**		−0.046**	−0.056**	−0.009*
		(0.003)	(0.003)		(0.002)	(0.003)	(0.004)
Observations	331,874	331,874	331,874	574,993	574,993	574,993	574,993
R-squared	0.04	0.04	0.04	0.09	0.09	0.09	0.03

Note: Each specification includes industry fixed effects at the 6 digi NAICS level and (unreported) covariates at the firm-level including multi-unit status, size, skill share, age, and the number of products. All 5-year window specifications include time fixed effects and time-varying industry characteristics, and last column includes firm fixed effects. Robust standard errors are reported in parentheses.
* Denotes significance at the 5% level.
** Denotes significance at the 1% level.

Table 11
Volatility of employment growth rates by quartiles of trade intensity and fraction of time traded.

Panel A. Exporters

Volatility (*firm share*)		Quartiles of fraction of time exported				
		1	2	3	4	Total
Quartiles of export intensity	1	0.31	0.28	0.28	0.22	0.30
		(0.15)	(0.07)	(0.01)	(0.00)	(0.24)
	2	0.38	0.33	0.29	0.23	0.32
		(0.06)	(0.10)	(0.07)	(0.02)	(0.25)
	3	0.40	0.37	0.33	0.24	0.32
		(0.02)	(0.06)	(0.09)	(0.08)	(0.26)
	4	0.43	0.43	0.40	0.27	0.33
		(0.01)	(0.03)	(0.07)	(0.15)	(0.26)
Total		0.34	0.34	0.34	0.26	0.32
		(0.24)	(0.26)	(0.25)	(0.26)	(1.00)

Panel B. Importers

Volatility (*firm share*)		Quartiles of fraction of time imported				
		1	2	3	4	Total
Quartiles of import intensity	1	0.33	0.35	0.28	0.25	0.32
		(0.07)	(0.04)	(0.03)	(0.00)	(0.14)
	2	0.36	0.35	0.29	0.25	0.32
		(0.05)	(0.07)	(0.09)	(0.03)	(0.23)
	3	0.40	0.39	0.34	0.26	0.33
		(0.02)	(0.06)	(0.13)	(0.09)	(0.30)
	4	0.45	0.46	0.41	0.32	0.36
		(0.00)	(0.02)	(0.09)	(0.21)	(0.33)
Total		0.35	0.37	0.34	0.30	0.33
		(0.15)	(0.18)	(0.33)	(0.34)	(1.00)

Note: Values in parenthesis are the fraction of firms in each cell.

the 15-year or 5-year windows.[41] Firms that switch in and out of trading within a window are omitted from this sample. Estimation results for the 15-year window and the 5-year windows with and without firm fixed effects are reported in Table 12. While our findings for firms that always only export and firms that always do both are similar to our previous findings, the sign on the categorical variable for firms that always only import is now negative and significant. This suggests that our previous finding of importers being more volatile than firms that do not trade is mainly driven by firms that import periodically. We find this to be the case when we further decompose the categorical variables into permanent and temporary exporters, importers, and firms that do both. Specifically, we identify a firm as a "temporary exporter" if the firm exports at least once but not for every year it reports positive employment, and never imports. Temporary importers and both are defined in an analogous fashion. For both permanent and temporary traders, the signs of the categorical variables for export only and both remain negative, but the magnitude of the estimated negative coefficient is an order of magnitude bigger for firms that do not switch in and out of trading. Permanent exporters are less volatile compared to non-traders, independent of the intensity of their exports; temporary exporters with more than 20% of sales shipped abroad, experience higher levels of volatility. While permanent importers experience a lower level of employment volatility, firms that switch in and out of import markets experience a higher level of employment volatility. This confirms that the positive association between importing and volatility is mainly driven by temporary importers.[42] These findings highlight the importance of controlling for the duration of trading in the firm-level analysis that follows.

4.3. Volatility at the industry-level

A drawback of the previous analysis is that the calculation of firm-level volatility of employment growth rates requires sufficiently long time series data for a given firm. Restricting the sample to longer-lived firms abstracts away from the component of volatility due to entry and exit and introduces a sample selection problem. Specifically, about one-half of the firms that reported positive employment for at least one year during 1991–2005 are excluded from our final sample based on the criterion that volatility is calculated over four consecutive growth rates.[43] In order to test whether our previous results are due to sample selection, we aggregate the firm-level data by trade status and calculate volatility by industry and by trade status. This approach not only allows us to incorporate shorter-lived organizations and entry and exit into the analysis, but it also allows for some degree of comparability of our results to previous sectoral-level volatility studies.

We start by aggregating firm-level employment by industry (6-digit NAICS level), year, and trade-status (non-trader, exporter only, importer only, and both exporter and importer)[44] and calculate volatility of employment growth rates for each industry by trade status over 15-year and 5-year windows. We then estimate a specification similar to (1) at the industry level:

$$ln\sigma_{j,w} = \alpha_0 + \alpha_1 Exp_{j,w} + \alpha_2 Imp_{j,w} + \alpha_3 Both_{j,w} + \alpha_4 ExpInt_{j,w} + \alpha_5 ImpInt_{j,w} + \theta Y_{j,w} + \alpha_j + t_w + u_{j,w} \quad (2)$$

[41] Besedes and Prusa (2006) document that the survival rate of a trade relationship decreases rapidly in the first four to five years and remains reasonably stable after that. Four years of consecutive trading (for 5-year windows) is therefore presumably long enough to be considered as permanent.

[42] A similar approach is taken in Nguyen and Schaur (2010) where marginal exporters experience higher sales volatility relative to non-traders, while permanent exporters do not differ from non-traders in Denmark.

[43] This problem is not unique to our paper and is prevalent in studies of firm-level volatility. Davis et al. (2007) highlight the importance of including smaller and shorter-lived organizations in volatility analysis.

[44] We abstract away from year-to-year switches in trade status and use time-invariant measures of trade status constructed over 15-year windows. We do this to avoid introducing spurious volatility at the industry-trade status level due to firms switching between trade statuses.

Table 12
Volatility of employment growth rates and detailed trade status at the firm-level.

	15-Year window	5-Year windows		15-Year window	5-Year windows	
	(1)	(2)	(3)	(4)	(5)	(6)
Permanent exporter	−0.406**	−0.218**	−0.066**	−0.336**	−0.189**	−0.053**
	(0.012)	(0.006)	(0.017)	(0.012)	(0.005)	(0.007)
Temporary exporter				−0.039**	−0.034**	−0.009*
				(0.004)	(0.003)	(0.004)
Permanent importer	−0.283**	−0.129**	−0.079	−0.264**	−0.137**	−0.068**
	(0.034)	(0.015)	(0.041)	(0.033)	(0.015)	(0.019)
Temporary importer				0.022**	0.033**	0.007
				(0.007)	(0.007)	(0.008)
Permanent both	−0.546**	−0.265**	−0.149**	−0.409**	−0.234**	−0.142**
	(0.014)	(0.008)	(0.029)	(0.011)	(0.007)	(0.010)
Temporary both				−0.110**	−0.078**	−0.036**
				(0.005)	(0.004)	(0.006)
Import intensity	0.308**	0.179**	0.020	0.273**	0.230**	0.080**
	(0.024)	(0.013)	(0.029)	(0.013)	(0.010)	(0.017)
Export intensity	0.321**	0.307**	0.143**	0.202**	0.255**	0.086**
	(0.039)	(0.019)	(0.040)	(0.019)	(0.014)	(0.021)
N	211,640	419,348	419,348	331,874	574,993	574,993
R^2	0.05	0.08	0.04	0.07	0.09	0.06
Time fixed effects	NO	YES	YES	NO	YES	YES
Industry-level controls	NO	YES	YES	NO	YES	YES
Sector-window fixed effects	NO	YES	YES	NO	YES	YES
Firm fixed effects	NO	NO	YES	NO	NO	YES

Note: Robust standard errors are reported in parentheses. Each specification includes industry fixed effects at the 6 digit NAICS level and (unreported) covariates at the firm-level including multi-unit status, size, skill share, age, and the number of products. In addition, the results over 5-year windows include time fixed effects and (unreported) time-varying covariates at the industry-level including size, skill share, import penetration and share of exports.
* Denotes significance at the 5% level.
** Denotes significance at the 1% level.

where $\sigma_{j,w}$ is the volatility of industry j calculated over window w and α_j are industry fixed effects. Industry-level export and import intensities ($ExpInt_{j,w}$ and $ImpInt_{j,w}$) are calculated as the share of exports in shipments and the share of imports in total cost of materials, respectively.[45] In alternate specifications, we replace export and import intensities with overall trade intensity ($TradeInt_{j,w}$), calculated as the sum of exports and imports as a share of shipments. The 5-year window specification also includes industry-level controls, $Y_{j,w}$, such as shipments and skill share, and time fixed effects (t_w).

Table 13 reports the industry-level results. The first three specifications allow for volatility to vary across both trade status and industry for a given window (of 15 years in columns 1–5 and 5 years in columns 6–8). The estimation results for windows of both durations are consistent with our previous findings at the firm level: Industry-level employment volatility associated with employment changes in importing firms is higher compared to that associated with non-traders, and the volatility from exporting firms is lower. Also as before, in a given sector, the volatility due to firms that both import and export is lower than volatility associated with those firms that do not trade. Both export and total trade intensities are positively associated with industry-level volatility, although these coefficients are less precisely estimated at the industry level (and the coefficients on import intensity are insignificant). These findings are in line with the positive association at the industry level between output volatility and trade intensity documented in Di Giovanni and Levchenko (2009). Overall, the consistency of the firm- and industry-level results provides assurance that our previous findings are not an artifact of a sample selection problem.[46]

5. Sources of volatility for trading firms

The previous section documented the relationship between employment volatility and trade status of the firm after controlling for various sources of heterogeneity at the firm- and industry-level. In this section, we focus on factors that contribute to the differential level of employment volatility experienced by trading firms. We first investigate the relationship between employment volatility and the number of products traded, the number of countries a firm trades with, and the duration of time a firm participates in foreign markets. Next, we decompose the share of imports into share of imported manufactured inputs, imported raw materials, and other imports, and we examine separately their relationship with employment volatility. Finally, we focus on the destination and source countries for exports and imports, and we study the trade-volatility relationship by first decomposing the share of imports and exports by income levels of the trading partner and then by estimating separately the impact of country characteristics such as output volatility, GDP, distance to the U.S. and covariance with the U.S. We restrict our attention in Section 5 to only trading firms, which include firms that only export, firms that only import, and firms that do both during the 15- and 5-year windows.[47]

5.1. Country and product counts

As we have discussed in Section 2, there is a great degree of heterogeneity in terms of both the number of traded products and trading partners: The average trading firm exports to three countries and imports from two (with standard deviations of 6.11 and 2.98, respectively) and exports and imports about five products (with standard deviations of 14.07 and 15.26, respectively). Firms trade roughly about half the time they report positive employment. The series of bivariate OLS regressions summarized in Table 14 suggests that these characteristics of the firm are related to its volatility. Here, each cell

[45] For each year and industry, exports and imports are aggregated from the firm-level data (LFTTD) and averaged across window w. Export and import intensity measures are then calculated using the industry-level value of shipments and cost of materials from the NBER Productivity Dataset averaged across window w.

[46] We also conducted the industry-level analysis on volatility of the growth rate of real wages and the growth rate of the number of firms for each industry and trade-status category. The results, available upon request, are similarly consistent with our findings for employment volatility.

[47] We also estimated variants of the specifications reported in this section separately for firms that are only importers, only exporters, and firms that do both. The results are very similar to those reported in Tables 16–19 and are available upon request.

Table 13
Volatility of employment growth rates and trade status at the industry-level.

	15-Year windows					5-Year windows				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Both	−0.598***	−0.594***	−0.592***			−0.668***	−0.668***	−0.668***		
	(0.051)	(0.044)	(0.044)			(0.045)	(0.045)	(0.045)		
Exporter only	−0.183***	−0.183***	−0.18***			−0.194***	−0.194***	−0.19***		
	(0.043)	(0.038)	(0.038)			(0.039)	(0.039)	(0.039)		
Importer only	0.525***	0.487***	0.487***			0.471***	0.471***	0.471***		
	(0.046)	(0.041)	(0.041)			(0.044)	(0.044)	(0.044)		
Import intensity		−0.119		−0.22			0.199		0.307	
		(0.178)		(0.179)			(0.176)		(0.344)	
Export intensity		1.592***		1.05***			−0.457		0.446	
		(0.369)		(0.357)			(0.367)		(0.679)	
Trade intensity			0.63***		0.277*			0.057		0.715*
			(0.159)		(0.164)			(0.221)		(0.365)
N	1534	1534	1534	389	389	4493	4493	4493	1153	1153
R^2	0.66	0.25	0.25	0.06	0.06	0.43	0.43	0.43	0.58	0.58
Time fixed effects	NO	NO	NO	NO	NO	YES	YES	YES	YES	YES
Industryfixed effects	YES	YES	YES	NO	NO	YES	YES	YES	YES	YES

Note: Each specification includes additional (unreported) covariates at the industry-level including size and skill share. Robust standard errors are reported in parentheses.
* Denotes significance at the 10% level.
** Denotes significance at the 5% level.
*** Denotes significance at the 1% level.

reports the estimated coefficient of the single explanatory variable from a specification with volatility of employment growth rates calculated over the 15-year window as the dependent variable. The explanatory variables are measures of trade intensity, duration of trade, and the number of traded products and countries. We estimate these simple regressions for the full sample of trading firms (columns 1 and 2) and for firms that engage in both exporting and importing (columns 3 and 4), with and without other firm-level controls for multi-unit status, skill share, age, and size. We find a positive association between volatility and export and import intensity. The association between volatility and the duration of trade, number of products, and the number of destination countries for exports is negative. The estimated coefficients on the number of products imported and the number of source countries for imports are small and not robust across columns. Since firm characteristics such as size and age are correlated with trade exposure of the firm, the magnitude of the estimated coefficients typically declines when we control for additional firm characteristics, but volatility continues to differ significantly across firms with differing levels of exposure to trade.

Table 14
Employment volatility by various firm characteristics.

	All traders		Both	
	(1)	(2)	(3)	(4)
Export intensity	0.185**	0.089**	0.254**	0.134**
	(0.018)	(0.018)	(0.021)	(0.020)
Import intensity	0.224**	0.131**	0.317**	0.187**
	(0.011)	(0.011)	(0.012)	(0.012)
Number of products				
Imported	−0.001**	0.001**	−0.001**	0.001**
	(0.000)	(0.000)	(0.000)	(0.000)
Exported	−0.003**	−0.000	−0.002**	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Number of countries				
Imported from	−0.011**	0.003**	−0.008**	0.004**
	(0.001)	(0.001)	(0.001)	(0.001)
Exported to	−0.013**	−0.005**	−0.011**	−0.004**
	(0.000)	(0.000)	(0.000)	(0.000)
Percent years imported	−0.101**	−0.048**	−0.108**	−0.062**
	(0.006)	(0.005)	(0.008)	(0.008)
Percent years exported	−0.306**	−0.194**	−0.422**	−0.27**
	(0.005)	(0.005)	(0.009)	(0.008)
Firm-level controls	NO	YES	NO	YES
Observations	134,348	134,348	60,156	60,156

Note: Robust standard errors are reported in parentheses. Firm-level controls include multi-unit status, skill share, age, and size. Sample employed ranges from 1991–2005 (15 year). All traders include full sample of trader firms; both includes firms that both import and export.
* Denotes significance at the 5% level.
** Denotes significance at the 1% level.

Table 15 provides a cross tabulation of the volatility of employment growth rates by the number of trading partners and the number of traded products for exporters in panel A and for importers in panel B; the numbers in parentheses represent the proportion of the firms in a particular cell. We find that 38% of exporting firms export one product to one destination, and 13% of firms export more than five products to more than five countries. The latter group of firms has the lowest level of volatility. Volatility decreases with the number of products exported—this is true overall and by the number of destination countries (except for firms that export to only one destination). Firms that export to one country are more volatile on average than firms that export to more than five countries, although this relationship is not monotonic. Panel B restricts the sample to importing firms and summarizes volatility by the number of source countries and the number of imported products. 41% of importing firms import one product from one source country and 11% of firms import more than five products from more than five countries. Holding the number of products fixed, we find volatility to be significantly lower for firms importing from at least five countries compared to those that import from only one source country.

To explore this heterogeneity further, we re-estimate Eq. (1) and include the number of products traded, the number of countries a firm trades with, and the fraction of time a firm exports or imports (calculated as the number of years a firm reports positive exports (or imports) divided by the number of years it reports positive levels of employment). Each specification also includes share of exports and imports, as well as the full set of firm-level controls and fixed effects, as described earlier.[48] The estimation results are reported in Table 16 for the 15-year windows in column 1 and for the 5-year windows with and without firm fixed effects in columns 2 and 3.[49] We find the share of both exports and imports to be positively associated with employment volatility, mirroring our previous findings. Several additional results stand out. First, holding trade intensity constant, higher fraction of time spent trading by a firm is associated with lower levels of firm volatility. This effect is larger in

[48] The inclusion of trade status dummies in each specification does not qualitatively change the findings reported in section 5.
[49] To preserve space, the estimated coefficients on firm-level controls and time varying industry-level controls (for the 5-year window analysis) are not reported in Table 16. These results are consistent with those reported in Table 8 and are available upon request.

Table 15
Volatility of employment growth rates by number of traded products and trading partners.

Panel A. Exporters							
Volatility (*firm share*)		Number of destination countries					
		1	2	3	4	5+	Total
Number of products exported	1	0.33	0.35	0.37	0.35	0.31	0.33
		(0.38)	(0.01)	(0.00)	(0.00)	(0.00)	(0.39)
	2	0.32	0.32	0.35	0.33	0.30	0.32
		(0.15)	(0.06)	(0.01)	(0.00)	(0.00)	(0.22)
	3	0.33	0.30	0.31	0.33	0.29	0.31
		(0.04)	(0.04)	(0.01)	(0.00)	(0.01)	(0.10)
	4	0.33	0.30	0.30	0.31	0.29	0.31
		(0.02)	(0.02)	(0.01)	(0.01)	(0.01)	(0.06)
	5+	0.35	0.31	0.29	0.28	0.27	0.29
		(0.02)	(0.02)	(0.02)	(0.02)	(0.13)	(0.22)
Total		0.33	0.31	0.31	0.30	0.28	0.32
		(0.61)	(0.15)	(0.06)	(0.04)	(0.15)	(1.00)
Panel B. Importers							
Volatility (*firm share*)		Number of source countries					
		1	2	3	4	5+	Total
Number of Products Imported	1	0.34	0.34	0.33	0.35	0.29	0.34
		(0.41)	(0.01)	(0.00)	(0.00)	(0.00)	(0.42)
	2	0.34	0.32	0.31	0.34	0.30	0.34
		(0.11)	(0.05)	(0.01)	(0.00)	(0.00)	(0.17)
	3	0.36	0.33	0.30	0.29	0.27	0.34
		(0.03)	(0.04)	(0.01)	(0.00)	(0.00)	(0.09)
	4	0.37	0.32	0.32	0.27	0.23	0.33
		(0.01)	(0.02)	(0.01)	(0.00)	(0.00)	(0.05)
	5+	0.41	0.35	0.32	0.34	0.31	0.33
		(0.03)	(0.05)	(0.05)	(0.04)	(0.11)	(0.27)
Total		0.34	0.33	0.32	0.33	0.31	0.33
		(0.60)	(0.17)	(0.08)	(0.04)	(0.11)	(1.00)

Note: Values in parenthesis are the fraction of firms in each cell.

Table 16
Volatility of employment growth rates and the number of trading partners, the number of traded products and percent of years traded.

	15-Year window	5-Year windows	
	(1)	(2)	(3)
Import intensity	0.091**	0.090**	0.054**
	(0.015)	(0.011)	(0.018)
Export intensity	0.264**	0.279**	0.091**
	(0.021)	(0.015)	(0.023)
Percent years imported	−0.047**	−0.030**	−0.047**
	(0.009)	(0.006)	(0.010)
Percent years exported	−0.209**	−0.149**	−0.064**
	(0.007)	(0.006)	(0.009)
Number of countries			
Exported to	−0.009**	−0.009**	−0.006**
	(0.001)	(0.000)	(0.001)
Imported from	0.023**	0.019**	0.005
	(0.002)	(0.002)	(0.003)
Number of products			
Exported	0.002**	0.002**	0.001**
	(0.000)	(0.000)	(0.000)
Imported	−0.001	−0.001**	−0.001
	(0.000)	(0.000)	(0.000)
N	134,348	213,955	213,955
R^2	0.13	0.14	0.10
Industrylevel controls	NO	YES	YES
Sector-window fixed effects	NO	YES	YES
Firm fixed effects	NO	NO	YES

Note: Robust standard errors are reported in parentheses. Each specification includes industry fixed effects at the 6 digit NAICS level and (unreported) covariates at the firm-level including multi-unit status, size, skill share, age, the number of products and the fraction of time importing and exporting. In addition, the results over 5-year windows include time fixed effects and (unreported) time-varying covariates at the industry-level including size, skill share, import penetration and share of exports.
* Denotes significance at the 5% level.
** Denotes significance at the 1% level.

the case of exporting but is also significant for importers: An additional year of trading lowers volatility by 3% for exporters and 0.7% for importers.[50] Importantly, these results hold not just relative to non-traders but also relative to other trading firms, and hold both in the cross-section and within firms. While the negative relationship between frequency of trading and volatility could reflect the impact of a more stable ordering and sales environment for continuously trading firms, it could also result from an endogenous technology choice by firms facing uncertainty in terms of their future productivity, which may yield an equilibrium outcome of temporary trade (as in Békés and Muraközy (2012)).

Second, controlling for trade intensity, the fraction of time traded, and the number of products traded, we find that volatility is higher for firms that use imported inputs sourced from more countries and lower for firms that export to a larger number of destination countries. A one standard deviation increase in the number of trading partners is associated with about a 5% decrease in exporter volatility and about a 6% increase in volatility for importers. For exporters, this result is consistent with a diversification story, with firms exporting to more countries diversifying away country-specific demand shocks (see, for example, Caselli et al. (2014)). In contrast, the result for importers indicates that holding the number of imported inputs constant, the more countries the firm imports from, any diversification effect is dominated by an increase in country-specific shocks to which a firm is subject. This result is consistent with country-specific shocks being passed through inputs into the production process, as documented in Di Giovanni and Levchenko (2010), Johnson (2012), and in Boehm et al. (2015).[51] Lastly, controlling for trade intensity, time traded, and the number of countries traded with, we find the number of exported products to be positively associated with firm-level volatility.[52]

5.2. Decomposing imports

Our previous results consistently suggest that a higher share of imported inputs is associated with higher levels of firm-level employment volatility. Note that, since the firms that report import usage in our sample are not "pure wholesalers,"[53] the imports of these manufacturing firms are inputs that are either substitutes or complements in the production process. Imported inputs could subject firms to additional volatility as exogenous fluctuations in commodity prices and foreign supply shocks are transmitted through imports. An additional source of volatility is the increased labor demand elasticities due to increased possibility of substitution between imported inputs and employment within the firm (as in Rodrik (1997), Slaughter (2001), and Senses (2010)).

In order to analyze the particular channels through which imports impact firm-level volatility, we decompose each firm's share of imports into the share of imported manufactured goods, imported raw materials, and other imported inputs (that are neither manufactured goods, nor raw materials) and replace share of imports in Eq. (1) with the detailed classification of imports. We then further decompose imported

[50] An increase of one year is equivalent to an increase in the percent years traded by 0.2 during the 5-year window.
[51] This finding is also broadly consistent with increased labor demand elasticities (and hence responsiveness of employment) as a result of substitution possibilities for domestic labor with availability of more suppliers.
[52] In addition, for a sub-sample of firms that engage in both exporting and importing, we decompose the export intensity and import intensity measures following Bernard, Jensen, Redding, and Schott (2012) into the logarithms of the number of products, number of countries, the intensive margin of average product-country trade, and a density term. This slightly more structural approach yields results fully consistent with those reported in Table 16. These results are available upon request.
[53] "Pure wholesalers," as defined by Bernard et al. (2010), are firms that employ 100% of their workforce in the wholesale and the retail sector.

Table 17
Volatility of employment growth rates and decomposition of firm-level imports.

	15-Year window	5-Year windows			
	(1)	(2)	(3)	(4)	(5)
Export intensity	0.239**	0.241**	0.231**	0.226**	0.056*
	(0.022)	(0.022)	(0.016)	(0.015)	(0.025)
Import intensity					
Manufactured inputs	0.234**		0.161**		
	(0.020)		(0.014)		
Offshoring (narrow measure)		0.182**		0.127**	−0.001
		(0.024)		(0.017)	(0.034)
Other manufacturing inputs		0.315**		0.207**	0.006
		(0.031)		(0.020)	(0.039)
Raw materials	0.227	0.228	0.113	0.099	0.244
	(0.119)	(0.119)	(0.084)	(0.075)	(0.138)
Non-manufacturing inputs	0.360*	0.366*	0.254	0.262	−0.172
	(0.169)	(0.169)	(0.155)	(0.137)	(0.233)
N	131,422	131,422	205,774	205,774	205,774
R^2	0.13	0.13	0.14	0.14	0.10
Industry-level controls	NO	NO	YES	YES	YES
Sector-window fixed effects	NO	NO	YES	YES	YES
Firm fixed effects	NO	NO	NO	NO	YES

Note: Robust standard errors are reported in parentheses. Each specification includes industry fixed effects at the 6 digit NAICS level and (unreported) covariates at the firm-level including multi-unit status, size, skill share, age, the number of products, and the fraction of time importing and exporting. In addition, the results over 5-year windows include time fixed effects and (unreported) time-varying covariates at the industry-level including size, skill share, import penetration and share of exports.
* Denotes significance at the 5% level.
** Denotes significance at the 1% level.

Table 18
Volatility of employment growth rates and income levels of trading partners.

	15-Year window	5-Year windows	
	(1)	(2)	(3)
Export intensity			
Low income countries	−0.282	0.191	−0.165
	(0.494)	(0.421)	(0.573)
Middle income countries	0.269**	0.338**	0.049
	(0.081)	(0.052)	(0.063)
High income countries	0.220**	0.204**	0.052
	(0.026)	(0.019)	(0.030)
Import intensity			
Low income countries	0.710**	0.452*	0.293
	(0.225)	(0.191)	(0.263)
Middle income countries	0.216**	0.238**	0.095**
	(0.029)	(0.023)	(0.035)
High income countries	0.125**	0.092**	0.037
	(0.023)	(0.016)	(0.028)
N	131,779	209,164	209,164
R^2	0.13	0.14	0.10
Industry-level controls	NO	YES	YES
Sector-window fixed effects	NO	YES	YES
Firm fixed effects	NO	NO	YES

Note: Robust standard errors are reported in parentheses. Each specification includes industry fixed effects at the 6 digit NAICS level and (unreported) covariates at the firm-level including multi-unit status, size, skill share, age, the number of products, the fraction of time importing and exporting, and import share of raw materials. In addition, the results over 5-year windows include time fixed effects and (unreported) time-varying covariates at the industry-level including size, skill share, import penetration and share of exports.
* Denotes significance at the 5% level.
** Denotes significance at the 1% level.

manufacturing inputs into "offshored" manufactured imports and general manufactured imports.[54]

Table 17 contains the results with the import decomposition separately for the 15-year and 5-year windows. As before, the share of exports is positively and significantly associated with firm-level volatility in all specifications. For the share of imports, we find imported manufacturing inputs, which are more closely associated with offshoring, to be the main source of the positive relationship. One standard deviation increase in manufactured import intensity, results in 6% higher volatility, whereas the shares of imported raw materials and other inputs do not have a statistically significant impact on volatility. Further decomposition of the share of imported manufactured inputs to imports due to "offshoring" and imports of other manufactured inputs suggest that both of these components contribute positively to firm-level volatility with a slightly higher coefficient on the latter (resulting in 4 and 6% increase in volatility, respectively in response to a one standard deviation increase in each component).[55]

We also conduct a more detailed decomposition of import intensity using the BEA's end-use commodity classification system. The unreported results for imports suggest that all end-use categories are significantly and positively associated with employment volatility, except foods, feeds, and beverages (0)—a category with a high share of non-manufactured goods and raw materials. Interestingly, automotive products maintain the largest coefficient, consistent with the findings of Ramey and Vine (2006), which document the disproportionate contribution of this sector to macroeconomic volatility.

5.3. Country characteristics

Next, we test whether the relationship between firm-level volatility and trade intensity is related to the characteristics of the firm's trading partners. For example, if the magnitude or frequency of demand or productivity shocks are larger for a particular set of countries, then firms that trade with these countries would be differentially impacted compared to firms that trade with countries that experience a more stable economic environment. To analyze this further, we start by decomposing the share of exports and imports based on the level of development of the trading partners of the firm, which is documented to be associated with the level of volatility in those countries.[56]

Table 18 presents the results linking firm-level volatility to the level of development of the trading partners for both imports and exports. In this specification, we replace the shares of non-raw material exports and imports in Eq. (1) with share of exports and imports from low-income countries, middle-income countries, and high-income countries.[57] The reported specifications all include controls for firm and industry characteristics and the share of raw materials. As before, the analysis is performed for trading firms.

The estimation results suggest that exports to middle- and high-income destinations contribute positively to volatility at the firm level, while the share of exports to low-income countries do not have a statistically significant impact. We find the share of imports from countries of all three income categories to be associated with higher volatility, with the contribution to volatility decreasing with the level of income of the country. In all three specifications, the estimated magnitude is the biggest for the share of imports from low-income countries, lower for

[54] We define "offshored" imports as those that are within the same 3-digit NAICS industry as the final good produced by the firm and products that are exported for further processing under Chapter 98 of the Harmonized Tariff Schedule. Chapter 98 of the Harmonized Tariff Schedule, or the production sharing provisions, allows imports that have U.S. content to enter the United States with reduced or no duties.

[55] The positive association between offshoring and employment volatility is consistent with a relative increase in labor demand elasticity in industries that engage in offshoring documented in Senses (2010).

[56] For example, Koren and Tenreyro (2007) find that the volatility of country-specific macroeconomic shocks falls with development.

[57] The countries are classified according to the World Bank classification of countries based on per capita income. For the full list of countries in each group, please see: http://data.worldbank.org/about/country-classifications.

Table 19
Firm-level volatility and characteristics of trading partners.

	15-Year window	5-Year windows	
	(1)	(2)	(3)
Export intensity	0.218**	0.221**	0.059
	(0.023)	(0.018)	(0.030)
Import intensity	0.197**	0.175**	0.076**
	(0.015)	(0.011)	(0.021)
Export partner			
Volatility	−0.023*	0.000	0.011
	(0.009)	(0.006)	(0.008)
Distance from the U.S.	0.030**	0.016**	−0.008
	(0.007)	(0.006)	(0.010)
Covariance with the U.S.	44.532	23.423	31.669
	(48.352)	(24.437)	(29.845)
GDP	−0.026**	−0.035**	−0.006
	(0.009)	(0.007)	(0.012)
Import partner			
Volatility	0.070**	0.019**	0.001
	(0.008)	(0.004)	(0.006)
Distance from the U.S.	−0.036**	−0.034**	−0.019
	(0.007)	(0.006)	(0.010)
Covariance with the U.S.	−66.347	−34.889	−9.488
	(41.399)	(18.852)	(23.687)
GDP	0.020**	−0.027**	0.001
	(0.006)	(0.004)	(0.008)
N	59,436	86,027	86,027
R^2	0.15	0.15	0.08
Industry-level controls	NO	YES	YES
Sector-window fixed effects	NO	YES	YES
Firm fixed effects	NO	NO	YES

Note: Robust standard errors are reported in parentheses. Each specification includes industry fixed effects at the 6 digit NAICS level and (unreported) covariates at the firm-level including multi-unit status, size, skill share, age, the number of products, the fraction of time importing and exporting, and import share of raw materials. In addition, the results over 5-year windows include time fixed effects and (unreported) time-varying covariates at the industry-level including size, skill share, import penetration and share of exports.
* Denotes significance at the 5% level.
** Denotes significance at the 1% level.

the share of imports from middle-income countries, and the lowest for imports from high-income countries.[58]

Our next set of results relates firm volatility to additional country-specific factors for the trading partner of the firm, including the level of GDP, output volatility, the distance to the United States, and the covariance of output with the United States.[59] Each of these measures is calculated as a weighted average at the firm level with the share of imports or exports from each country as weights. For example, the volatility of the import partner of a particular firm is the average of annual GDP volatility of each country the firm imports from, weighted by the share of imports of this firm from each country over the period that volatility is calculated. Each specification includes the aforementioned array of fixed effects and controls.

The results of this analysis can be found in Table 19. The first column presents the 15-year results and the last two columns present the results from the 5-year specifications, with and without firm fixed effects. We find that the further away a firm's export destinations, the higher the estimated firm-level volatility. The longer time lag and higher transaction costs of shipping to distant destinations could introduce difficulties for inventory management, and hence, lumpy production and shipments, resulting in higher levels of volatility. We also find that, after controlling for other country characteristics, the higher the level of average income of the firm's export partners, the lower the estimated firm-level volatility. The estimated coefficient on the covariance term is positive, while statistically insignificant.[60] For import-partner characteristics, our findings suggest that firms that import from more volatile countries and from countries that are closer, on average have higher firm-level volatility.

6. Conclusion

In this paper, we document a new set of stylized facts on the theoretically ambiguous relationship between the volatility of employment growth and the trade exposure of a firm. We find that an importer with average level of import intensity, experiences 7% higher levels of employment volatility compared to a non-trader firm. This relationship, which is mainly driven by firms that switch in and out of importing, suggests that the effect on volatility of greater exposure to foreign productivity shocks, dominates the benefits from diversification and from the complexity of the production process for these firms. These results are also consistent with models that highlight differences in elasticity of labor demand in importing firms, and firms that source their inputs domestically. A higher elasticity for importers, will result in higher variation in employment, if these firms can more easily substitute imported inputs for domestic workers in response to a wage increase at home.

We find that firms that only export, and firms that both export and import, benefit from diversification across destinations with imperfectly correlated shocks and, on average, experience lower levels of volatility, by 2 and 4%, respectively. This relationship is non-linear, with an export share threshold (of 17%) above which exporters are more volatile than non-exporters. Our findings suggest that, as long as a firm's overall exposure is not too large, exporting affords firms the ability to diversify their demand sources across countries and products, and is not an inherently volatile process that exposes domestic firms to substantial foreign market volatility.

The high degree of variation across trading firms, in terms of the frequency and intensity with which they trade, the number and type of products traded, and the number and characteristics of trading partners, plays an integral role in explaining employment volatility. Specifically, the longer a firm engages in trade, either by importing or exporting, the lower its employment volatility. While frequent switching between domestic and foreign destination and source countries could cause higher volatility, it may itself be an endogenous response to frequent demand and productivity shocks. By contrast, for both importers and exporters, an increase in the intensity of trade, in terms of a larger share of inputs (especially from low-income countries) or a larger fraction of output (especially to middle-income countries), is strongly related to higher employment volatility. In line with the diversification hypothesis, we find an increase in the number of export destinations to be associated with lower levels of volatility. A higher number of source countries for importers is associated with higher levels of employment volatility, broadly consistent with country-specific shocks being passed through inputs into the production process. A decomposition of imports reveals that the relationship between import intensity and volatility is mostly driven by manufactured imports, which are closely associated with offshoring, and not by imports of raw materials or non-manufactured inputs. Lastly, for both exporters and importers, we find trading partner characteristics such as the level and volatility of GDP and the distance from the United States to be important determinants of volatility.

[58] A t-test of the equivalence of the estimated coefficients for imports from the low- and middle-income countries and imports from the high- and middle-income countries is rejected at the 1% level of significance. These results complement the findings in Bernard et al. (2006) of a negative association between imports sourced from low-wage countries and plant survival, output, and employment growth.

[59] The data for the country-level volatility, covariance with the United States, and the level of GDP are sourced from the Penn World Tables at pwt.econ.upenn.edu/php_site/pwt70/pwt70_form.php. The distances to the United States are from Andrew Rose's website at http://faculty.haas.berkeley.edu/arose/datagravstataWEO.zip.

[60] While insignificant, a positive coefficient is consistent with a higher co-movement between the U.S. firm and its trading partners restricting the ability of the firm to diversify demand shocks using export markets.

The new stylized facts we document in this paper point to considerable heterogeneity in the volatility of employment growth among firms that differ in terms of the level of engagement in international trade, the type of products they trade, and the characteristics of their trading partners. We hope that our empirical findings for the U.S. will serve to guide the emerging theoretical literature in developing a unified theoretical framework considering the links between trade and firm-level volatility, and its impact on the aggregate economy.

References

Bartelsman, Eric J., Becker, Randy, Gray, Wayne, 2000. The NBER-CES manufacturing industry database. National Bureau of Economic Research Working Paper Series, No. 205.

Békés, Gábor, Muraközy, Balázs, 2012. Temporary trade and heterogenous firms. J. Int. Econ. 87 (2), 232–246.

Bergin, Paul R., Feenstra, Robert C., Hanson, Gordon H., 2011. Volatility due to outsourcing. J. Int. Econ. 85, 163–173.

Bernard, Andrew, Bradford Jensen, J., Schott, Peter K., 2006. Survival of the best fit: exposure to low-wage countries and the (uneven) growth of US manufacturing plants. J. Int. Econ. 68, 219–237.

Bernard, Andrew B., Bradford Jensen, J., Schott, Peter K., 2009. Importers, exporters, and multinationals: a portrait of firms in the U.S. that trade goods. In: Dunne, T., Jensen, J.B., Roberts, M.J. (Eds.), Producer Dynamics: New Evidence from Micro Data. University of Chicago Press.

Bernard, Andrew, Bradford Jensen, J., Redding, Stephen J., Schott, Peter K., 2010. Wholesalers and retailers in US trade. Am. Econ. Rev. 100 (2), 408–413 (American Economic Association, May).

Bernard, Andrew, Redding, Stephen, Schott, Peter K., 2011. Multi-product firms and trade liberalization. Q. J. Econ. 126 (3), 1271–1318.

Bernard, Andrew B., Bradford, Jensen J., Redding, Stephen J., Schott, Peter K., 2012. The Empirics of Firm Heterogeneity and International Trade, Annual Review of Economics. Annual Reviews 4 (1), 283–313 (07).

Besedes, Tibor, Prusa, Thomas, 2006. Ins, outs, and the duration of trade. Can. J. Econ. 39 (1), 266–295.

Boehm, Christoph, Flaaen, Aaron, Pandalai-Nayar, Nitya, 2015. Input Linkages and the transmission of shocks: firm-level evidence from the 2011 Tohoku Earthquake. working paper.

Buch, Claudia M., Döpke, Jörg, Strotmann, Harald, 2009. Does export openness increase firm-level output volatility? World Econ. 32 (4), 531–551.

Burgess, Robin, Donaldson, Dave, 2010. Can openness mitigate the effects of weather shocks? Evidence from India's famine era. Am. Econ. Rev. 100 (2), 449-5.

Burstein, Ariel, Kurz, Christopher, Tesar, Linda, 2008. Trade, production sharing, and the international transmission of business cycles. J. Monet. Econ. 55 (4), 775–795.

Caselli, Francesco, Koren, Miklos, Lisicky, Milan, Tenreyro, Silvana, 2014. Diversification through trade. Working Paper.

Cavallo, Eduardo, A., 2006. Trade, gravity and sudden stops: on how commercial trade can increase the stability of capital flows. IDB Working Paper.

Davis, Steven J., Haltiwanger, John C., Schuh, Scott, 1996. Job Creation and Destruction. MIT Press.

Davis, Steven J., Haltiwanger, John, Jarmin, Ron, Miranda, Javier, 2007. Volatility and dispersion in business growth rates: publicly traded versus privately held firms. In: Acemoglu, Daron, Rogoff, Kenneth, Woodford, Michael (Eds.), NBER Macroeconomics Annual 2006.

Di Giovanni, Julian, Levchenko, Andrei, 2009. Trade openness and volatility. Rev. Econ. Stat. vol. 91 (3), 558–585 (August).

Di Giovanni, Julian, Levchenko, Andrei, 2010. Putting the parts together: trade, vertical linkages, and business cycle comovement. American Economic Journal: Macroeconomics 2 (2), 95–124.

Di Giovanni, Julian, Levchenko, Andrei, 2012. Country size, international trade, and aggregate fluctuations in granular economies. J. Polit. Econ. 120 (6), 1083–1132.

Eaton, Jonathan, Eslava, Marcela, Kugler, Maurice, Tybout, James, 2008. The margins of entry into export markets: evidence from Colombia. In: Helpman, Elhanan, Marin, Dalia, Verdier, Thieery (Eds.), The Organization of Firms in a Global Economy. Harvard University Press, Cambridge, MA, p. 2008.

Easterly, William, Islam, Roumeen, Joseph, Stiglitz, 2000. Shaken and stirred: explaining growth volatility. Annual World Bank Conference on Development Economics.

Feenstra, Robert C., Hanson, Gordon H., 1999. "The impact of outsourcing and high-technology capital on wages: estimates for the U.S.", 1972–1990. Q. J. Econ. 114, 907–940.

Hummels, David, Jorgensen, Ramus, Munch, Jakob, Xiang, Chong, 2011. The wage effects of offshoring: evidence from Danish matched worker-firm data. NBER Working paper 17496.

Jarmin, Ron S., Miranda, Javier, 2002. The longitudinal business database. CES Working Paper 02–17.

Johnson, Robert, 2012. Trade in intermediate inputs and business cycle comovement. NBER Working Paper No. 18240.

Kalemli-Ozcan, S., Sorensen, B., Volosovych, V., 2014. Deep financial integration and volatility. J. Eur. Econ. Assoc. 12, 1558–1585.

Koren, Miklos, Tenreyro, Silvana, 2007. Volatility and development. Q. J. Econ. vol. 122 (1), 243–287 (MIT Press, 02).

Koren, Miklos, Tenreyro, Silvana, 2013. Technological diversification. Am. Econ. Rev. 103 (1), 378–414.

Kose, Ayhan M., Prasad, Eswar S., Terrones, Marco E., 2003. How Does Globalization Affect the Synchronization of Business Cycles? Am. Econ. Rev. 93 (22), 57–63.

Krebs, Tom, Krishna, Pravin, Maloney, William, 2010. Trade policy, income risk, and welfare. Rev. Econ. Stat. 92 (3), 48-467.

Krishna, Pravin, Levchenko, Andrei A., 2013. Comparative advantage, complexity and volatility. J. Econ. Behav. Organ. 94, 314–329.

Krishna, Pravin, Senses, Mine Z., 2014. International trade and labor income risk in the United States. Rev. Econ. Stud. 81 (1), 186–218.

Newbery, David M.G., Stiglitz, Joseph E., 1984. Pareto inferior trade. Rev. Econ. Stud. vol. 51 (1), 1–12.

Ng, Eri C.Y., 2010. Production fragmentation and business-cycle comovement. J. Int. Econ. vol. 82 (1), 1–14 (September 2010).

Nguyen, Daniel X., Schaur, Georg, 2010. Cost linkages transmit volatility across markets. EPRU Working Paper Series 2010-03.

Pierce, Justin, Schott, Peter, 2009. A concordance between ten-digit U.S. harmonized system codes and SIC/NAICS product classes and industries. NBER Working Paper No 15548.

Ramey, Valerie A., Vine, Daniel J., 2006. Declining volatility in the U.S. automobile industry. Am. Econ. Rev. 96 (5), 1876–1889.

Rodrik, Dani, 1997. Has Globalization Gone Too Far? Institute for International Economics, Washington DC

Rodrik, Dani, 1998. Why do more open economies have bigger governments? J. Polit. Econ. 106 (5), 997–1032.

Schott, Peter K., 2008. The relative sophistication of Chinese exports. Econ. Policy, CEPR, CES, MSH vol. 23 (53), 5–49 (01).

Senses, Mine Z., 2010. The effects of offshoring on the elasticity of labor demand. J. Int. Econ. vol. 81 (1), 89–98 (May).

Slaughter, Matthew J., 2001. International trade and labor — demand elasticities. J. Int. Econ. vol. 54, 27–56 (June).

Vannoorenberghe, Gonzague, 2012. Firm-level volatility and exports. J. Int. Econ. vol. 86 (1), 57–67.

Zlate, Andrei, 2010. Offshore production and business cycle dynamics with heterogeneous firms. International Finance Discussion Papers 995. Board of Governors of the Federal Reserve System, U.S.