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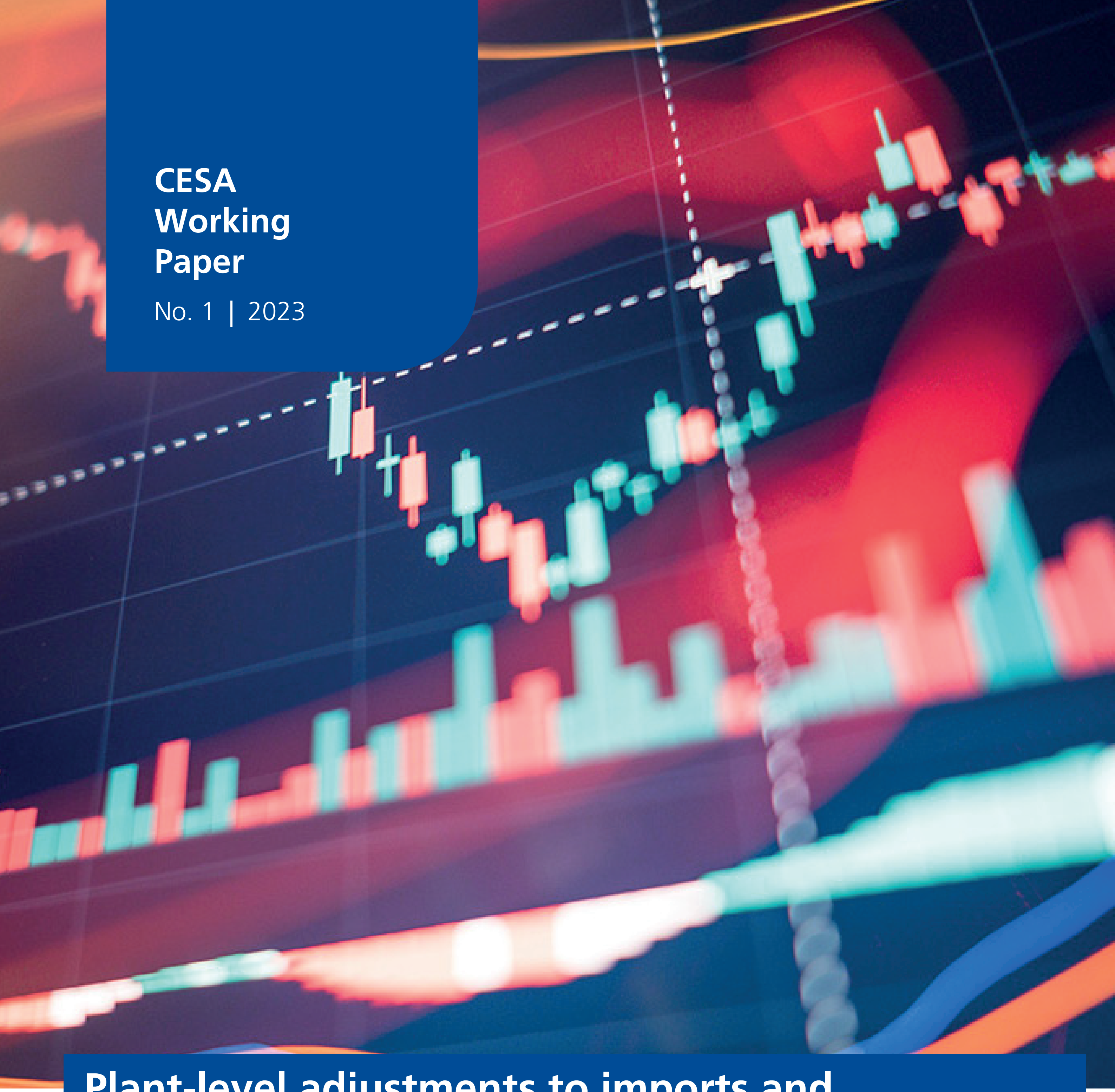

Plant-level adjustments to imports and exports at the extensive margin

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Abstract

This paper presents an empirical analysis of plant level responses to the China trade shock based upon a DSGE framework with heterogeneous firms and productivity shocks. The empirical analysis shows that soaring imports from China are associated with a higher probability of plant closure. By contrast, firms in export oriented industries are less likely to exit. We rationalize these findings by several counter-factual experiments based upon a DSGE framework. Imports always raise the exit rate but the export-effect is ambiguous. More exports fuel competition among domestic rivals associated with more exits. However, this competition effect disappears when the share of exporters is extremely high. The less intuitive reduction in plant exit due to a higher Chinese demand for German manufacturing goods can be explained by another channel: We interact exports with negative productivity shocks. Firms in industries with higher export-intensity are better prepared against negative productivity shocks due to higher demand from Foreign. The negative effects of Chinese imports on plant exit can be offset by the positive interaction effects.

Keywords: Plant Exit, International Trade, Import China, Worker Data

JEL codes: F14, F15, F16, L6

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1 Introduction

Sentiments against globalization are widespread and growing. One popular argument against a higher global interdependency is soaring competition from low income countries e.g, China, associated with massive layoffs at the intensive and extensive employment margins. We are focusing on the latter margin and study the role of foreign and domestic competition for plant closure in both theory and empirics.

Existing research on potential labor market effects of the Chinese trade shock often neglect the role of exports. There are some exceptions e.g., Dauth et al. (2014) or Jäckl (2014), but most papers are focusing on the negative import effects only. This focus may also be due to the common wisdom that imports and exports have the same negative effects on plant exit. The more common theoretical approaches show that both stir competition associated with massive layoffs due to plant closure.

Our reduced form evidence takes into account both imports and exports. The results suggest that firms in sectors more inclined to exports to China are also less likely to exit, whereas import competition raises the exit probability. These results are independent from the respective firm's export or import status. Expanding firms at Home and Foreign put pressure on incumbent firms no matter if they are large or small.

Existing models can explain the sorting into export and the role of productivity for survival when trade induces firm selection. Most prominently, the seminal work by Melitz (2003) provides a framework that explains how trade liberalization stirs firm selection. However, the model is static and countries are symmetric. Disentangling import and export effects at the short run are beyond the scope of Melitz (2003).

We are mainly interested in immediate responses to the China trade shock and restrict the analysis to the 5 years right after China's accession to WTO. The findings presented in the empirical section are then rationalized by studying short run exit responses to trade liberalization in a dynamic model with endogenous plant closure decisions. Introducing endogenous firm exits in the model by Ghironi and Melitz (2005) allows identifying various channels that explain the rather optimistic stylized fact that export shocks are associated with lower exit rates.

Theoretical contribution. Exit in the original model by Ghironi and Melitz (2005) is exogenous. Trade liberalization affects the profitability of existing firms and the investment in new firms but - other than in Melitz (2003) - these firms continue until the exogenous death rate forces them to close shop.[1] This random selection of firms continues until the new equilibrium is reached. Thus, it takes time until the optimal firm distribution emerges in case of an exogenous trade shock. Exit in our augmented Ghironi and Melitz (2005) model is directed to the firms with productivity below the respective survival cutoff. These firms actively decide in favour of an exit if the benefit of selling the firm exceeds the continuation value. Every active firm evaluates this trade off in every period. Firm exit in the original Melitz (2003) model occurred when operational profits become negative without taking into account expected future profits. In contrast to this intratemporal perspective, we model firm exit as an intertemporal decision.

We distinguish between two different channels: The well-known selection channel and a novel productivity-shock channel. The former channel is standard. Trade liberalization raises the cutoff of firm survival associated with higher exit rates. However, the situation becomes more complex if we distinguish between imports and exports. Exports open additional sales-opportunities for incumbent firms associated with soaring competition and upward pressure on wages. Less productive firms no longer find it profitable to operate in the market as the future profits dip below the scrap value that firms obtain when selling their enterprise. Additional sales opportunity benefit all firms that export but competition harms non-exporting firms.

A dominant competition effect is in line with reduced form evidence for the import shock but against the negative results for exports. There are two mechanisms that may attenuate the competition effect in the model. The higher the share of exports, the more firms benefit from additional sales to Foreign. Secondly, the competition effect is fueled by reallocation of workers towards more productive exporters that offer higher wages. Our counter-factual experiments show that implausible high export shares are necessary to explain the optimistic results for the export effect in our motivating evidence.

Thus, we need another channel in addition to the direct effects of trade on exits. We

[1] This can be seen in the equation on page 874 in Ghironi and Melitz (2005), where the firm averages depend on the lower bound of the Pareto distribution of firm productivity.

argue that there is an interaction effect of exports on the impact of other negative shocks unrelated to trade. Negative productivity shocks are one potential source of disturbance that affects all firms independent of their firm productivity. Interacting these negative productivity shocks with the export share in a counterfactual analysis offers another potential explanation for our optimistic export shock findings. Firms in export-oriented industries are larger and therefore better prepared for negative productivity shocks related to reasons going beyond globalization. The more firms export, the larger the difference between the lower exit bound and the continuation value determined by future profits. A negative productivity shock narrows the difference between the lower bound and the incumbent firm's continuation value but the larger the buffer, the less likely is an effective impact of the negative productivity shock in terms of plant exit.

A combination of a low competition effect due to a higher share of exports plus this interaction effect can explain why exports reduce the propensity of firm exit in our DSGE model.

Our empirical reduced form analysis on the role of import and export shocks for adjustments at the extensive exit margin is based upon information for the universe of workers subject to social security contributions. The individual worker data can be aggregated to the plant-level. This combination of individual and plant level information allows a very precise identification of plant closures. Most of the earlier studies on potential determinants of plant exits identify exits through dropouts of the plant identification variable from the panel. A plant is coded as exiting plant if the identifier disappears in one period. Hethey-Maier and Schmieder (2013) suggest using administrative worker data for identification of a true plant closure instead. A plant that drops out of the data is supposed to close shop iff a sizable share of its coworkers does not show up in different plants in the following years. We are using this novel approach to identify a true exit.[2]

Moreover, we also investigate the competition channel mentioned above by investigating the intensive margin as additional result. Higher competition should be associated with worker turnover from less productive to more productive firms. For imports we expect that incumbent firms reduce their size by laying off workers. Non exiting firms lose some of their market share to competitors from China. Firms in export oriented firms may expand due

[2] The data is provided by the authors as an extension file to the IAB data.

to additional sales at Foreign or shrink due to heightened competition. Exports reduce the propensity to exit if and only if the competition effect is low. Our additional results at the intensive margin support the relevancy of this channel. The import shock fuels plant-level contraction and expansion, whereas exports fuel expansion but attenuate contraction. We interpret the latter result as evidence against higher competition due to exports.

Related literature. Closely related to our paper, Jäckl (2014) presents an analysis of the heterogeneous effects of imports and exports on plant exits in a model with heterogeneous firms. Jäckl (2014) argues that product differentiation is the main channel that reduces the competition effect and shields firms from foreign competition. She distinguishes between import and export effects by allowing firms to switch industries. Bernard et al. (2006) provide seminal evidence for the role of import competition for plant exits in the US. Their study sheds light on both the extensive and intensive plant margin. At the extensive margin, their paper identifies plant exit as a disappearance of the plant. However, Hauptmann and Schmerer (2020) show that the identification strategy can be problematic as the effects are overestimated. The coefficient associated with imports from China using this common plant closure variable is nearly twice the coefficient obtained from regressions based upon the approach suggested by Hethey-Maier and Schmieder (2013). Inui et al. (2009) study a related question using Japanese plant level data and exit as proposed in Bernard et al. (2006). Their focus is on the role of productivity. For Japan, import competition from China had no significant impact on plant closures. However, in line with Melitz (2003), plant closures are more concentrated in the regime of low-productivity plants.

Their evidence is in line with the findings reported in Bloom et al. (2016). Import competition can be source of plant closure but firms may sort this out by technological change, which explains why competition is causally associated with innovation. In addition to the common approach of identifying plant closure as a dropout of the plant identification number from the data, their study also uses survey data that allows to identify a bankruptcy of the plant. The most recent study on plant exit and exposure to trade is by Rigby et al. (2017). However their focus is on imports from low-wage countries without taking particular stance on the role of China. Their findings support Bloom et al. (2016).

Reinecke and Schmerer (2019) provide an analysis of labor market institutions in

Germany and its impact on plants' adjustments to imports and exports form China in a small sample of German plants. Plants that have to pay severance payments to their workers are less likely to adjust size to the trade shock. Severance payments motivate plants to train workers in order to prevent costly layoffs. The cost saving effect of offshoring becomes small or even negative when firing workers becomes more costly. Reinecke and Schmerer (2019) provide some evidence using a sub-sample of plants without paying attention to econometric problems as endogeneity and the Heckman selection but we neglect the extensive adjustment margin in this study.

2 Empirical strategy and data

The effects at the extensive margin are identified using a linear probability model that fits firm characteristics and the region-specific import and export shock measures to plant exit dummies that take the value 1 if the plant exits.

The data used in our study comprise information about the universe of workers subject to social security contributions in Germany. The individual worker data can be aggregated to the plant-level, which is the basis of the so called IAB Establishment History Panel (BHP). Employers have the obligation to report the social security notification to the federal employment agency on a yearly basis for each individual worker employed by the plant. A common plant identifier assigned to all coworkers employed in a specific plant allows bundling the data from the worker-level to the plant-level. Quality and completeness over a wide array of variables filled with information on the characteristics of the respective plant's workers is guaranteed by law (for more details see Schmucker et al. (2018)). Plant exits can be inferred from the last appearance of a particular establishment identifier but this procedure may overestimate the true number of establishment exits if plants change their identification number for reasons going beyond plant closure. Hethey-Maier and Schmieder (2013) propose a methodology that eliminates this measurement error.[3] Likely, the dropout of a plant is not a "true" plant closure if a large cluster of workers employed by a plant with a disappearing identifier is observed in another plant in one of the following years.[4] However, this method requires a meaningful number of coworkers. We follow the

[3] The outcome of their approach is provided as an extension file to the BHP.
[4] The authors define an establishment exit if the largest clustered outflow of workers is less than 30% relative

authors' suggestion by dropping the smallest establishments with less than 4 workers from the analysis.

Data on international trade are bilateral trade flows based on the UN Comtrade Database.[5]

Table 1 reports the relevant summary statistics.

Table 1: Summary statistics

Variable	Obs	Mean	SD	Min	Max
1= Exit witin 5 years	109,292	0.082	0.274	0.0	1.0
Δ IMP (C)	109,292	0.032	0.099	−0.2	1.6
Δ EXP (C)	109,292	0.034	0.068	−0.1	1.7
Employment (ln)	109,292	2.942	1.187	1.4	10.9
Wage (ln)	109,292	4.202	0.351	−0.0	6.3
Plant age (years)	109,292	16.114	9.259	1.0	26.0
Employment: medium skilled (share)	109,292	0.534	0.291	0.0	1.0
Employment: high skilled (share)	109,292	0.047	0.099	0.0	1.0

Note: The table presents the summary statistics of the variables used in specification (5).

The explanatory variables of interest are import and export shocks at the region/industry level denoted by ΔIMP and ΔEXP. Import competition measures are computed as:[6]

$$\Delta IMP^C_{rjt} = \frac{E_{rjt}}{E_{jt}} \frac{\Delta IM^C_{jt}}{E_{rt}}, \tag{1}$$

and in analogy to import competition we compute export opportunity shocks as

$$\Delta EXP^C_{rjt} = \frac{E_{rjt}}{E_{jt}} \frac{\Delta EX^C_{jt}}{E_{rt}}. \tag{2}$$

The variables ΔIM^C_{jt} and ΔEX^C_{jt} denote the total change in imports and exports from or to China in industry j between t and $t+5$. These changes are multiplied by the regional employment share of the industry (E_{rjt}/E_{jt}) and expressed in per capita employment terms of the region (E_{rt}) at the beginning of the period. Our measure ΔIMP^C_{rjt} therefore captures the regional exposure to changes in Chinese imports per capita. To address endogeneity concerns on simultaneous shocks affecting both the import exposure and plant

to the size of the disappearing establishment identifier and not more than 80% of the successor if the successor constitutes a newly appearing establishment identifier ("atomized death").

5 We utilize that data provided the Observatory of Economic Complexity. For further details see Simoes and Hidalgo (2011).

6 See Autor et al. (2013), Dauth et al. (2014).

survival, we follow the literature and instrument the regional import exposure with changes of import from China to other countries o, i.e.[7]

$$\Delta IMP^{C}_{orjt} = \frac{E_{rjt-5}}{E_{jt-5}} \frac{\Delta IM^{C}_{ojt}}{E_{rt-5}}. \tag{3}$$

$$\Delta EXP^{C}_{orjt} = \frac{E_{rjt-5}}{E_{jt-5}} \frac{\Delta EX^{C}_{ojt}}{E_{rt-5}}. \tag{4}$$

Both measures vary by 0.1 standard deviation (import) and 0.07 standard deviation (export) around their mean values, which are slightly above zero. The variable employment counts the full-time equivalent number of workers employed by the plant. Notice that smaller plants are excluded from the data, which inflates the average size of establishments in our sample. The first moment is roughly twenty full-time workers. The largest plant in the data employs around 22,000 workers. Wages are plant-level averages of hourly incomes paid to workers.

There is no direct information on the year of establishment birth but we are using the information on the number of years the respective plant identifier is included in the data set, which explains why the maximum plant age is 26 years.

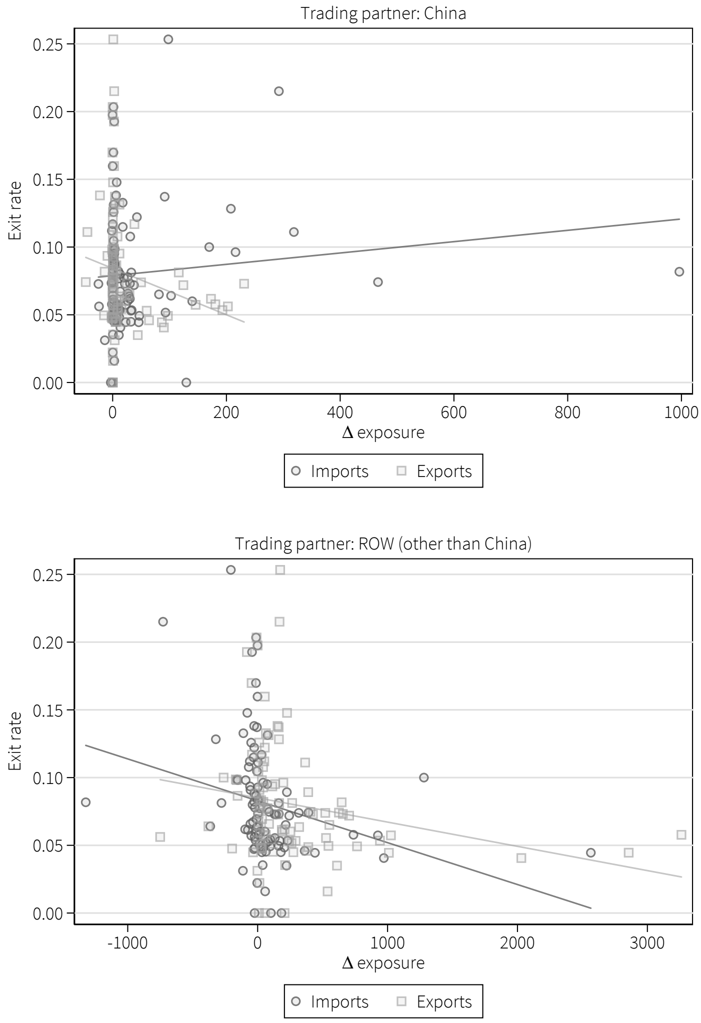
The share of medium- and high-skilled workers is constructed by counting the workers with respective skills. Notice that the information about the workers' skills contains inconsistencies that can be corrected by imputation. See Fitzenberger et al. (2005) for more details. The average share of high-skilled workers employed by plants in our sample is around five percent. Notice, that we focus on manufacturing plants and that the covariates cover the years before China's entry into WTO, which is in the middle of the golden age of offshoring low-skill tasks to China and other emerging economies. Thus, the low high-skill share is reasonably low for this particular period.

2.1 Descriptive evidence

Figure 1 confronts (mean) exit rates of 98 manufacturing industries to the (mean) changes in import/export exposure.

[7] We use the same set of countries as in Dauth et al. (2014), namely Australia, Canada, Japan, Norway, New Zealand, Sweden, Singapore, and the United Kingdom.

Figure 1: Plant exit rates and changes in trade exposure from China



Note: The figures show (mean) exit rates of 3-digit manufacturing industries against the (mean) changes in import and export exposure by trading partner. Base year is the year 2000 and exit rates report the share of plants exiting within the next 5 years. Changes in import/export exposure between 2000-2005.

The changes in trade exposure are calculated for the base year 2000. Trade shocks are industry- and not region-specific. Employment weights are used only in the regression analysis.

Aggregate exit rates depicted in this figure are constructed as the number of closing plants within the 5 years after 2000, related to the total number of existing plants within this particular period. The slope of the import shock (red line) is positive. Firms in industries more prone to Chinese exports reported higher plant closure rates. Replicating the same exercise for trade with the rest of the world yields a different picture as both imports and exports are associated with lower plant closure. This latter result may be driven by offshoring. Soaring imports due to a more intensive use of offshoring may boost firms' competitiveness. The lower probability of plant exit may still be at the expense of massive layoffs at the intensive margin. The first glimpse at the data shows that Chinese imports are indeed different from the average imports of the rest of the world. However, these patterns may be spurious, an issue that will be addressed in an IV regression approach that treats imports and exports as endogenous variables.

2.2 Empirical strategy and results

Empirical strategy. Effects of import competition on plant exit are obtained from estimating

$$EXIT_{ijrt} = C + \alpha_1 \Delta IMP^C_{rjt} + \alpha_2 \Delta EXP^C_{rjt} + \beta X_{ijrt} + \varepsilon_{ijrt}, \tag{5}$$

for plant i in industry j in region r at base year t. The dependent variable $EXIT_{ijrt}$ denotes an indicator variable that takes the value one if a plant exits the market between t and $t+5$. The constant C can be interpreted as the unconditional probability of plant exit captured by the average number of exiting plants over the total number of plants in the respective period. ΔIMP^C_{rjt} denotes the 5-year-difference of import exposure from China between t and $t+5$. The matrix X_{ijrt} includes various plant controls. Special interest is paid to the interpretation of the export shock measure. Year $t = 2000$ is the base year in the regression. This decision is motivated by China's entry into the WTO in 2001. Thus, the analysis focuses on the impact of changes in imports from 2000 till 2005 on plant closures within the same period. Furthermore, controls for plant size in terms of log employment, plant age, the log wage and skill-shares are included in all regressions but coefficients are not reported in the outcome tables.

Results at the extensive margin. Table 2 reports the results for the baseline regression setup. Each column presents the coefficients of interest derived by fitting Ordinary Least Squares and Instrumental Variable regressions to the data. Columns (1) and (2) include the import shock and other covariates only, columns (3) and (4) substitutes the import shock measure by an export opportunity shock, and columns (5) and (6) include import and export shock measures plus all covariates.

Table 2: Plant exit and trade with China

Dependent variable: Plant exit within 5 years						
	(1) OLS	(2) IV	(3) OLS	(4) IV	(5) OLS	(6) IV
Δ IMP (C)	0.062**	0.065**			0.059**	0.068**
	(0.029)	(0.028)			(0.029)	(0.030)
Δ EXP (C)			-0.074***	-0.116***	-0.068***	-0.138***
			(0.024)	(0.034)	(0.024)	(0.038)
Observations	109,292	109,292	109,292	109,292	109,292	109,292
KP F-Stat.		313.345		31.169		15.838

Note: Base year 2000. Changes in import/export exposure between 2000 and 2005. Standard errors in parentheses clustered by region by industry pairs. $^{*}p < 0.10,^{**} p < 0.05,^{***} p < 0.01$. In all columns, the following control variable are included, but not reported: number of employees (ln), median plant wage (ln), plant age (years), the share of medium and highly skilled employees, as well as the constant.

The import shock coefficient is negative and significant. More exposure to imports from China can be associated with a higher probability of plant closure. The F-Statistic from the first stage of the IV regression indicates that the instruments are valid. Including the export shock in columns (3) and (4) yields highly significant coefficients again but the effect goes into the opposite direction. Regressions (5) and (6) confirm the results reported in (1) to (4) by simultaneously including both imports and exports. [8]

Imports from China have negative effects on the probability of plant closure, whereas exports tend to reduce the probability of plant closure.

Table 3 replicates the baseline findings including imports and exports from Eastern Europe and China. Still in line with the stylized facts discussed in the descriptive evidence sub-chapter, the import coefficient is positive but insignificant in column (1). Purging the regressions from the endogeneity bias solves this issue as the coefficients turn negative and significant in column (2). The F-statistics reported at the bottom of the table support validity of our instruments.

[8] Note that the KP F-Stat. is shown for the case when both imports and exports are instrumented.

Table 3: Plant exit and trade with China and Eastern Europe

Dependent variable: Plant exit within 5 years						
	(1) OLS	(2) IV	(3) OLS	(4) IV	(5) OLS	(6) IV
Δ IMP (CEE)	0.003	0.064***			0.025*	0.091***
	(0.013)	(0.023)			(0.015)	(0.029)
Δ EXP (CEE)			-0.034***	-0.046***	-0.042***	-0.071***
			(0.009)	(0.013)	(0.011)	(0.018)
Observations	109,292	109,292	109,292	109,292	109,292	109,292
KP F-Stat.		275.607		64.918		24.569

Note: Base year 2000. Changes in import/export exposure between 2000 and 2005. Standard errors in parentheses clustered by region by industry pairs. $^{*}p < 0.10,^{**} p < 0.05,^{***} p < 0.01$. In all columns, the following control variables are included, but not reported: number of employees (ln), median plant wage (ln), plant age (years), the share of medium and highly skilled employees, as well as the constant.

Columns (3) and (4) affirm the respective results in Table 2 and again the relevant test statistic is above the critical lower threshold. Interestingly, part of the endogeneity bias in column (1)[9] seems to be due to the omitted export shock bias. The import shock coefficient in column (5) is much closer to the *true* import shock coefficient reported in column (2). Compared to (2) and (4), both the import and the export shock coefficients become much stronger when controlling both factors (columns (5) and (6)).

2.3 Summary of the results

Our motivating reduced form evidence reveals robust evidence for a positive effect of import competition on plant exits, which is in line with both expectation and the existing trade models. The more challenging result is the positive coefficient of the export shock measure, which cannot be explained by the more common theories in international economics. As argued in the introduction, the competition effect due to additional sales from foreign firms is akin to the competition effect emerging from expanding exporters. We address this issue using our extended DSGE model sketched below.

[9] The comparison of column (1) and (2) give a rough idea about the endogeneity bias in column (1).

3 Model

The model employed for rationalizing the stylized facts discussed above is dynamic and allows tracing variables over time. We introduce endogenous exits as in Fasani et al. (2022) to an otherwise standard two-country models based on Ghironi and Melitz (2005) and conduct various counterfactual experiments. The extension in line with Fasani et al. (2022) allows plants to decide about exiting the market during each period next to the entry decision and firms' endogenous sorting into export. Thus, the exit decision is endogenous as well. Each period, firms undergo a simple survival analysis by comparing the liquidation value to the continuation value. If the latter is greater than the former, a firm remains in the market. The continuation value is shaped by the outer circumstances and expectations about the future incomes. This endogenous exit decision is in contrast to the one in Ghironi and Melitz (2005) where an exogenous exit shock hits firms with a certain probability.

The world consists of two countries, Home and Foreign. Foreign variables are denoted using an asterisk. Unless otherwise stated, both countries are assumed to be symmetric in the benchmark scenario. Import and export shocks are analyzed separately, which results in country asymmetries in our counterfactual analyses. In the following, we present the home country model block only.

3.1 Firms

As common in the literature based on Ghironi and Melitz (2005), each producing unit can be thought of as a firm, a producer, a product or a plant. It is assumed that they all coincide and in the following we will use these terms interchangeably. A continuum of monopolistically competitive firms produce different varieties ω by input of labor. These goods can then be sold domestically and abroad and the number of products will be determined endogenously.

Each variety, i.e. product, will be produced by one plant. Prospective entrants are identical prior to market entry and to create new products, they have to bear entry costs f_E in units of effective labor while labor will be the only production factor. Entering plants draw their productivity z from a Pareto distribution $G(z)$ with support on $[z_{min}, \infty)$ and shape parameter α. These different, time-invariant relative technology parameters z lead to plant heterogeneity. However, firms with the same productivity draw would make identical optimization choices. Henceforth, we will drop the variety index ω and identify a plant by its productivity level z.

Due to a time-to-build lag, new entrants $N_{E,t}$ start producing goods in the subsequent period. Let δ_t and $N_{D,t}$ be the exit rate and the stock of firms, then the evolution of firms reads as

$$N_{D,t} = (1 - \delta_t)(N_{D,t-1} + N_{E,t-1}). \tag{6}$$

As we use a similar timing assumption as Fasani et al. (2022), incumbent firms and last-period entrants with the same productivity draw make identical production choices and exit decisions. If a firm chooses to exit the market, households as the ultimate owners receive its liquidation value lv_t that we will specify later on. Hence, at the beginning of the period, firms will compute the present discounted value of expected dividend stream, i.e. the (continuation) value of the firm, to decide whether to continue (or start) production or to exit the market. This survival test leads to an endogenously determined productivity cutoff $z_{D,t}$ that splits firms into profitable ones ($z > z_{D,t}$) and actively exiting ones ($z < z_{D,t}$). Given $z_{D,t}$, the exit rate is defined as $\delta_t = 1 - (z_{min}/z_{D,t})^{\alpha}$. Let $\bar{e}_t$ be the value of the marginal firm. Thus, the exit condition reads

$$\bar{e}_t = \bar{d}_t + E_t\beta_{t,t+1}((1 - \delta_{t+1})(\bar{e}_{t+1}) + \delta_{t+1}lv_{t+1}) = lv, \tag{7}$$

where $E_t\beta_{t,t+1}$ and $\bar{d}_t$ denote the discount factor and total profits of the marginal firm. As households are the owners of the firms, profits are discounted by households' stochastic discount factor $\beta_{t,s} \equiv \beta^{s-t}(u_{C_s}/u_{C_t})$ with u_{C_t} as marginal utility of consumption. Eq. (7) determines $z_{D,t}$.

Regarding the decision to enter the market, free-entry implies that the present discounted equity value of the average firm, $\tilde{e}_t$, must equal the entry cost:

$$\tilde{e}_t = E_t\beta_{t,t+1}((1 - \delta_{t+1})(\tilde{d}_{t+1} + \tilde{e}_{t+1}) + \delta_{t+1}lv_{t+1}) = \varphi_t f_E, \tag{8}$$

where $\tilde{d}_t$ denotes average total profits and ϕ_t is the effective cost of labor. The endogenously determined exit rate also affects the entry decision and therefore changes in δ_t trigger changes in firm dynamics via both entry and exit margins.

The production process can be modeled via two stages. Firstly, firms perform cost minimization. In the second stage, firms take the outcome of the first stage as given and maximize their profits by selling their products at home and abroad.

Let l_t be the quantity of labor within a single firm with productivity z. Z_t denotes aggregate productivity. Then, this firm's output y_t is given by

$$y_t = zZ_t l_t. \tag{9}$$

Real marginal costs of production are given by $\varphi_{z,t} \equiv \varphi_t/z \equiv w_t/(Z_t z)$ with w_t as the real wage. Regarding the decision to export, we assume local currency pricing and flexible prices, so that the law of one price holds. When a plant serves the foreign market, it has to incur per-unit iceberg trade cost τ as well as a per-period fixed cost f_X in units of effective labor for operating in Foreign. It is optimal for firms to set prices at a markup $\theta/(\theta-1)$ over marginal cost $\varphi_{z,t}$, where θ is the elasticity of substitution between varieties. Hence, optimal real prices relative to the destination market's price index are given by

$$\rho_{D,t}(z) = \frac{\theta}{(\theta-1)}\varphi_{z,t}, \qquad \rho_{X,t}(z) = \frac{\tau}{Q_t}\rho_{D,t}(z), \tag{10}$$

with Q_t as the real exchange rate.

However, due to fixed exporting costs, firms need a sufficiently high level of productivity in order to make non-negative profits via exporting. Hence, there will be a cutoff level $z_{X,t}$, endogenously determined, that sort firms into a non-traded goods sector and into exporters.

Given the aforementioned production structure and assuming that firm z exports, profits of that firm from domestic and foreign sales read

$$d_{D,t}(z) = \frac{1}{\theta}(\rho_{D,t}(z))^{1-\theta}C_t, \qquad d_{X,t}(z) = \frac{Q_t}{\theta}(\rho_{X,t}(z))^{1-\theta}C_t^* - \varphi_t f_X. \tag{11}$$

Hence, total profits are given by $d_t(z) = d_{D,t}(z) + d_{X,t}(z)$.

We define the two common average productivity levels for firms serving the domestic market and for exporters:

$$\tilde{z}_{D,t} \equiv \left[\frac{1}{1-G(z_{D,t})}\int_{z_{D,t}}^{\infty} z^{(\theta-1)}dG(z)\right]^{\frac{1}{\theta-1}}, \qquad \tilde{z}_{X,t} \equiv \left[\frac{1}{1-G(z_{X,t})}\int_{z_{X,t}}^{\infty} z^{(\theta-1)}dG(z)\right]^{\frac{1}{\theta-1}}. \tag{12}$$

The share of exporters is then given by $N_{X,t}/N_{D,t} = (1-G(z_{X,t}))/(1-G(z_{D,t}))$. We can now express averages of variables by using these definitions. For instance, average total profits are given by $\tilde{d}_t = \tilde{d}_{D,t} + (N_{X,t}/N_{D,t})\tilde{d}_{X,t}$, where average profits from domestic sales and exports are defined as $\tilde{d}_{D,t} \equiv d_{D,t}(\tilde{z}_{D,t})$ and $\tilde{d}_{X,t} \equiv d_{X,t}(\tilde{z}_{X,t})$.

3.2 Households

Within each country there is a unit-sized continuum of identical infinitely-lived households. The representative household maximizes the utility function

$$E_t\left\{\sum_{s=t}^{\infty}\beta^{s-t}u(C_s,L_s)\right\} = E_t\left\{\sum_{s=t}^{\infty}\beta^{s-t}\left[\frac{C_s^{1-\gamma_C}}{1-\gamma_C} - \chi\frac{L_s^{1+\gamma_L}}{1+\gamma_L}\right]\right\} \tag{13}$$

with the consumption basket C_t, the amount of labor L_t, the discount factor β, the inverse of the elasticity of intertemporal substitution γ_C, a weight on the disutility of work ν, and the inverse Frisch elasticity γ_L. Given the continuum of goods Ω, whereby only a fraction $\Omega_t \in \Omega$ is available at any point t, the consumption basket is defined as

$$C_t = \left[\int_{\omega\in\Omega} c_t(\omega)^{\frac{\theta-1}{\theta}}d\omega\right]^{\frac{\theta}{\theta-1}}, \tag{14}$$

with the corresponding price index:

$$P_t = \left[\int_{\omega\in\Omega} p_t(\omega)^{1-\theta}d\omega\right]^{\frac{1}{1-\theta}}. \tag{15}$$

We allow households to save in two forms: shares x_t in a mutual fund of domestic firms and risk-free Home, B_t, and Foreign bonds, $B_{*,t}$, which can be traded within and between both countries paying the the real returns $r_t, r_{*,t}$ between $t-1$ and t. Thus, we abstract from international savings in firm shares and assume incomplete international asset markets. We follow one of the approaches in order to have steady-state determinacy by introducing bond adjustment costs.[10] Shares in the mutual fund pay the average total profit of all surviving firms and are priced at the current value of the average firm, $(\tilde{d}_t + \tilde{e}_t)$. Exiting firms transfer their liquidation value lv_t to their owner, i.e. the households. During t, the household accumulates new shares of incumbent firms, x_t and invest in entering ones $N_{E,t}$ priced at $\tilde{e}_t$. The flow of funds in real terms reads

$$\begin{aligned} C_t + \tilde{e}_t(x_t + N_{E,t}) + B_{t+1} + Q_t B_{*,t+1} + \frac{\xi}{2}B_{t+1}^2 + \frac{\xi}{2}Q_t B_{*,t+1}^2 \\ = (1+r_t)B_t + (1+r_t^*)Q_t B_{*,t} + [(1-\delta_t)(\tilde{d}_t + \tilde{e}_t) + \delta_t lv_t](x_{t-1} + N_{E,t-1}) + w_t L_t + T_t \end{aligned} \quad (16)$$

As already mentioned above, household's income is composed on Bond returns, returns on the mutual fund, wage income, and lump-sum rebates of the bond adjustment costs, $T_t^f = \xi/2(B_{t+1}^2 + Q_t B_{*,t+1}^2)$. Maximizing the households utility function subject to the flow of funds constraint yields the Euler equations for bond holdings and share holdings:

$$1 + \xi B_{t+1} = (1+r_t)E_t\beta_{t,t+1}, \quad (17)$$

$$1 + \xi B_{*,t+1} = (1+r_t^*)E_t\beta_{t,t+1}Q_{t+1}/Q_t, \quad (18)$$

$$\tilde{e}_t = E_t\beta_{t,t+1}[(1-\delta_{t+1})(\tilde{d}_{t+1} + \tilde{e}_{t+1}) + \delta_{t+1}lv_{t+1}]. \quad (19)$$

3.3 Equilibrium

Labor market clearing reads

$$Z_t L_t = \tilde{\rho}_{d,t}^{-\theta} C_t \tilde{z}_{D,t}^{-1} N_{D,t} + \tau_t \tilde{\rho}_{x,t}^{-\theta} C_t^* \tilde{z}_{X,t}^{-1} N_{X,t} + f_X N_{X,t} + f_E N_{E,t} \quad (20)$$

The equilibrium price index is given by

$$1 = \tilde{\rho}_{d,t}^{1-\theta} N_{D,t} + \tilde{\rho}_{x,t}^{*1-\theta} N_{X,t}^*. \quad (21)$$

Market clearing for bonds implies: $B_{t+1} + B_{t+1}^* = 0$ and $B_{*,t+1} + B_{*,t+1}^* = 0$. Furthermore, $x_{t-1} = x_t = 1$ Combining the market-clearing conditions with household's flow of

[10] See Schmitt-Grohé and Uribe (2003) for the approaches.

funds constraint leads to the following net foreign asset equation:

$$B_{t+1} - B_t + Q_t(B_{*,t+1} - B_{*,t}) = CA_t \equiv r_t B_t + Q_t r_t^* - B_{*,t} + TB_t, \tag{22}$$

where the trade balance $TB_t \equiv Q_t \tilde{\rho}_{x,t}^{1-\theta} C_t^* N_{X,t} - \tilde{\rho}_{x,t}^{*1-\theta} C_t N_{X,t}^*$ is given by total exports minus total imports.

3.4 Calibration

In our simulation exercise, we assume symmetric countries before the trade shock and study the dynamics of a permanent 10 percent decrease in the iceberg trade cost either at home, τ_t, or abroad, τ_t^*. Thus, countries become asymmetric due to the partial trade liberalization.

For most of the parameters we follow, among others, Cacciatore and Fiori (2016) and use conventional values. The time interval is a quarter. The household discount factor β is 0.99 and implies a steady-state risk-free rate of roughly 4.1 percent per year. The risk aversion parameter γ_c is set to 2 as well as the inverse of the Frisch elasticity of the labor supply, γ_L. The weight on the disutility of work is set to 0.1 in order to have a steady-state labor supply of 1. Bond adjustment costs are calibrated in a standard way, $\xi = 0.0025$, to induce steady-state determinacy. Entry cost f_E are set to 3.4 in order to meet regulation and R&D expenditures of roughly 4 percent of GDP as in Cacciatore and Fiori (2016).

We calibrate the values for the elasticity of substitution between goods and the shape parameter of the Pareto distributions, i.e. $\theta = 2.5$, $\alpha = 2.1$, to meet the distributions in our data. The lower bound z_{min} is normalized to one. In order to have a yearly steady-state exit rate of 2 percent as in our data, lv is set to 1.248.

The rest of the model's parameters follows standard trade models. A fixed exporting cost of $f_X = 0.0368$ leads to a share of exporting firms of 20 percent in the steady state as a benchmark. The iceberg transportation cost τ is set to 1.369 to have a trade-to-GDP ratio of 0.5.

4 Counterfactual experiments

We are using the calibration of the model to *i*) show the differences to workhorse trade models, *ii*) study the role of endogenous firm selection due to import and export shocks and *iii*) analyze the interaction of trade with changing economic conditions for plant exits captured by negative productivity shocks.

4.1 Comparison between our extension, Melitz (2003) and Ghironi and Melitz (2005)

Although Melitz (2003) introduces fixed costs of production resulting in an exit cutoff, this static model does not allow analyzing the dynamics of the exit rate due to permanent or transitory shocks. Varying the iceberg transportation costs and therefore changing the value of the average profit would lead to different equilibria with different exit rates. However, it is only possible to compare these different equilibria without knowing what will happen during the transition from one to another steady state. Our model allows for this kind of analysis.

Furthermore, transferring the Melitz model into a dynamic setting as, for instance, in Hamano and Zanetti (2017) is based on the assumption that the fixed costs are some kind of operational costs paid every period. In order to determinate the exit cutoff, operational, i.e. per-period, profits must be zero. As a result, the exit decision is an intratemporal optimization problem instead of an intertemporal one as in our model.

Traditional Melitz-type dynamic trade models, which are more or less all based on Ghironi and Melitz (2005), are at odds with the empirical evidence outlined in section 2 due to a fixed exogenous exit rate. After a trade liberalization shock, import competition leads to fewer entries and a decline in the number of firms. A fixed exit rate would then lower the number of exits as the number of firms slowly shrinks over time. In Figures 2 and 3 we compare our model (HSS) to the one of Ghironi and Melitz (2005) (GM) by showing the responses of key variables to trade integration. In order to compare both models, we add endogenous labor supply to GM and calibrate the GM-model to match the steady state of our model. Hence, all shown variables start at the same equilibrium. The responses are percentage deviations from the steady state.

Figure 2: Home Trade liberalization

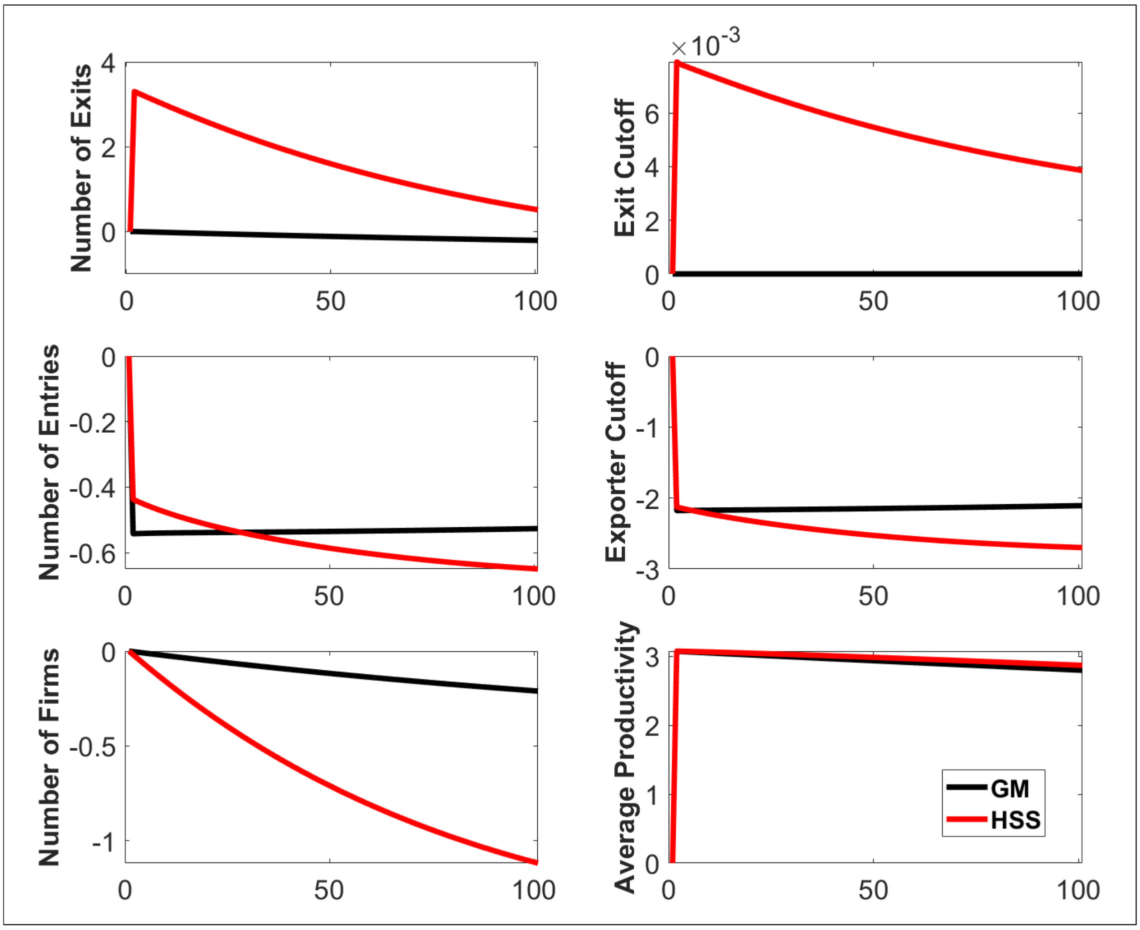


Figure 2 depicts the responses to a permanent 10 percent reduction in the "Home" iceberg transportation costs, τ_t, that domestic exporters have to bear when serving the foreign market. As more firms start to export and exporters expand their production, they compete with domestic non-exporters for the input factor labor. This export competition effect increases the costs for non-exporters which leads to fewer entries and more exits. Hence, the number of firms decreases. However, in the GM model the number of exits actually decreases as described above. As the exit decision is absent in the GM framework, the export competition effect is weaker in comparison to our model. We observe a cleansing effect due to the increased export competition. As more firms with low levels of productivity exit and fewer firms enter the market, the drop in the number of firms is larger and more prolonged. Due to the cleansing effect, even more firms find it profitable to export and the increase in the average productivity is slightly larger. However, this increase is mainly driven by the reduction in τ_t as it directly affects average productivity.

Figure 3: Foreign Trade liberalization

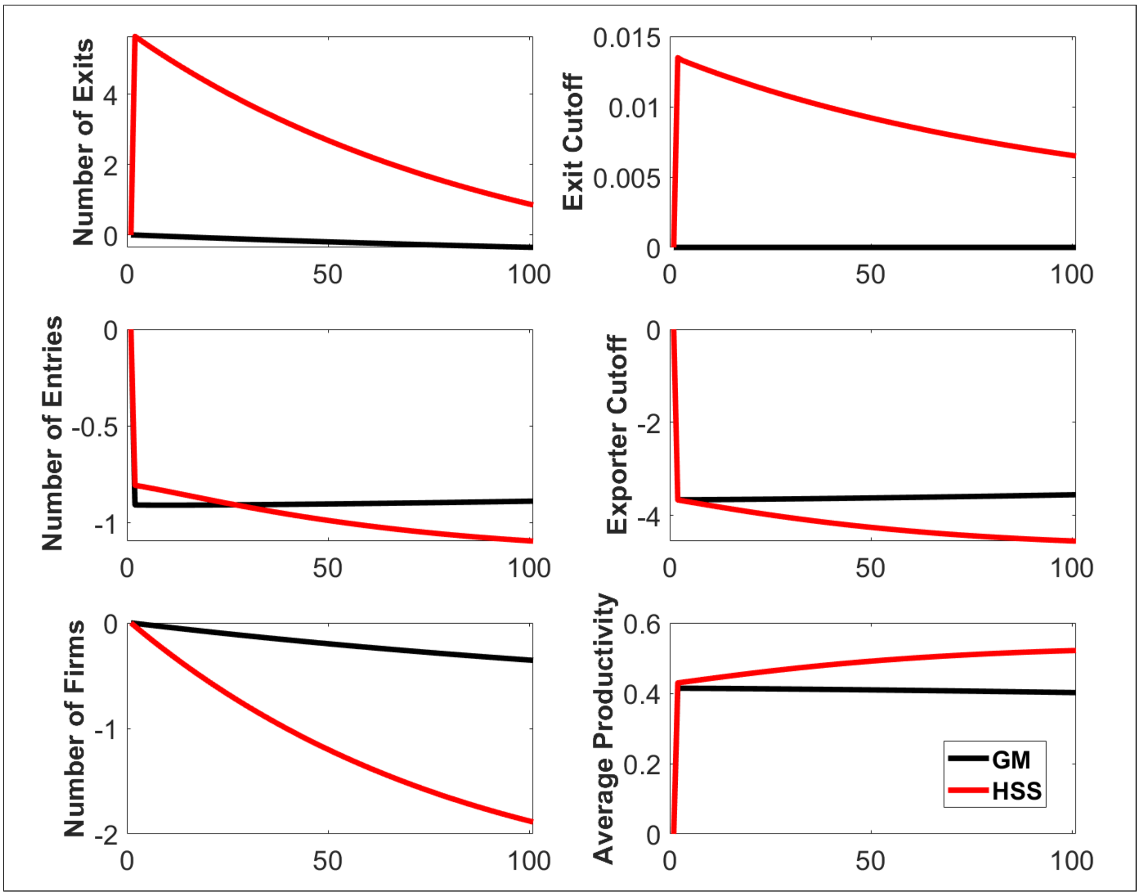
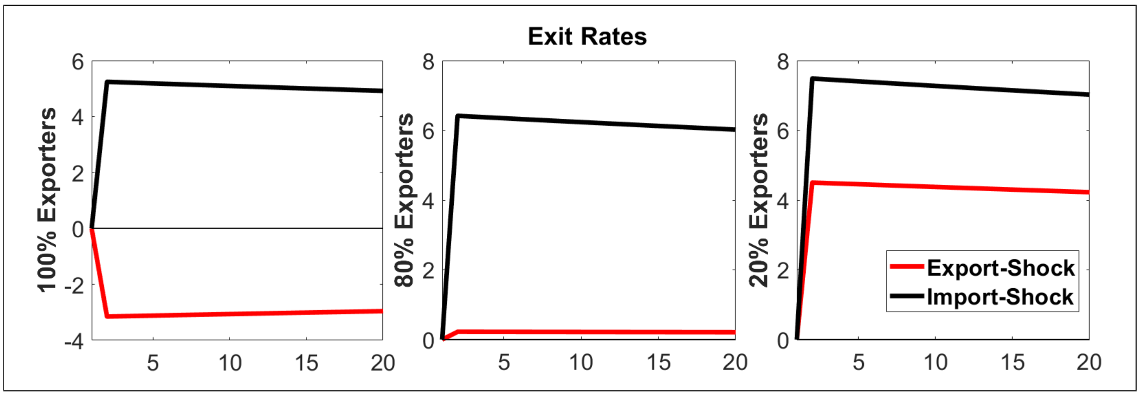


Figure 3 shows the responses to a permanent 10 percent reduction in the "Foreign" iceberg transportation costs, τ_t^* which leads to more foreign firms that serve the domestic market. The responses are qualitatively similar to the former scenario. However, the adjustments in the number of exits and entries (and therefore adjustment in the number of firms) are nearly twice as large compared to the reduction in τ_t. In the GM framework, the increased import competition leads to fewer entries and a shift in production to exporters. This effect is also present in our model. However, the additional cleansing effect in our model leads to quantitatively rather strong differences between the models. As above, more firms with low levels of productivity exit and even fewer firms enter the market which results in a large and prolonged drop in the number of firms. This cleansing effect leads to an increase in the average productivity that is almost twice as large compared to GM.

4.2 The role of endogenous firm selection

Figure 4 depicts the exit rate. The first panel shows the responses to trade liberalization without export market selection as all firms are exporters, while the second one includes this type of selection with an exporter share of roughly 80 percent. In the last panel, this share is 20 percent. The dashed black line represents the import shock, i.e. a 10 percent reduction in τ_t^*, while the solid red line depicts the export shock responses, i.e. responses to a 10 percent reduction in τ_t^*. Each time, the respective other iceberg transport costs remain at the benchmark level. Thus, each figure compares two different and independent simulation outcomes. Notice that these changes are computed as deviations from the steady state.

Figure 4: Trade Liberalization and Firm Selection



With no competition among firms within the respective segment, all firms are exporters and benefit from the export shock or equally suffer from competition from abroad. In the case of the export shock, exporters benefit from lower iceberg transport costs. Thus, the exit rate is decreasing, which is in line with our reduced form evidence. A positive import shock on the other hand raises the exit rate of domestic firms. Foreign firms take over some market share. The domestic firms' iceberg transport costs do not change but lower domestic sales reduce the stream of future profits. Thus, the liquidation value is exceeding the expected future profits for some of the exporting firms followed by a higher exit rate.

A rather modest decrease of the export share to 80 percent is enough to increase the export effect up to zero. This exercise underpins the relevance of the competition and the resulting cleansing effect for our analysis. The effect of import competition on exits becomes stronger and the negative effect for the export shock disappears.

A more realistic export share of 20 percent increases the effects described above. Both export and import shocks increase the exit rate due to the competition and cleansing effect from a shift in production towards exporters and more competitors form abroad serving the domestic market.

4.3 Interaction effects of trade and productivity shocks

Trade may have direct and indirect effects on firm exit in the presence of other external shocks unrelated to trade. We summarize negative shocks from different provenances by modelling a negative productivity shock that drives down the expected future profits towards the lower survival ceiling. Whether firms remain in the market depends on the size of the buffer between profits and liquidation value. The question remains, whether these effects are short-lived or persistent over a longer period. Using a DSGE model, we are able to analyze this issue in more detail.

The negative productivity shock is interacted with the export share, i.e. the number of domestic exporters relative to all domestic firms, and the import share, i.e. the number of foreign exporters in relation to all domestic firms. Therefore, we simulate a decrease in aggregate productivity (TFP), Z_t, with an autocorrelation coefficient of 0.9 and a standard error of 0.01, and compute the exit rate due to the shock conditional on specific shares of exporters and importers.[11]

In Figure 5, we show the impulse responses of the corresponding exit rates due to the productivity shock in relation to a shock hitting the country in autarky.

We can see that an export share of 20 or 50 percent leads to persistently lower increases in the exit rate compared to the autarky scenario. The higher the export share the lower is the exit rate. This indicates that being able to create profits from sales abroad leads to a lower vulnerability to adverse shocks. We interpret this as the aforementioned buffer. This effect seems to be persistent.

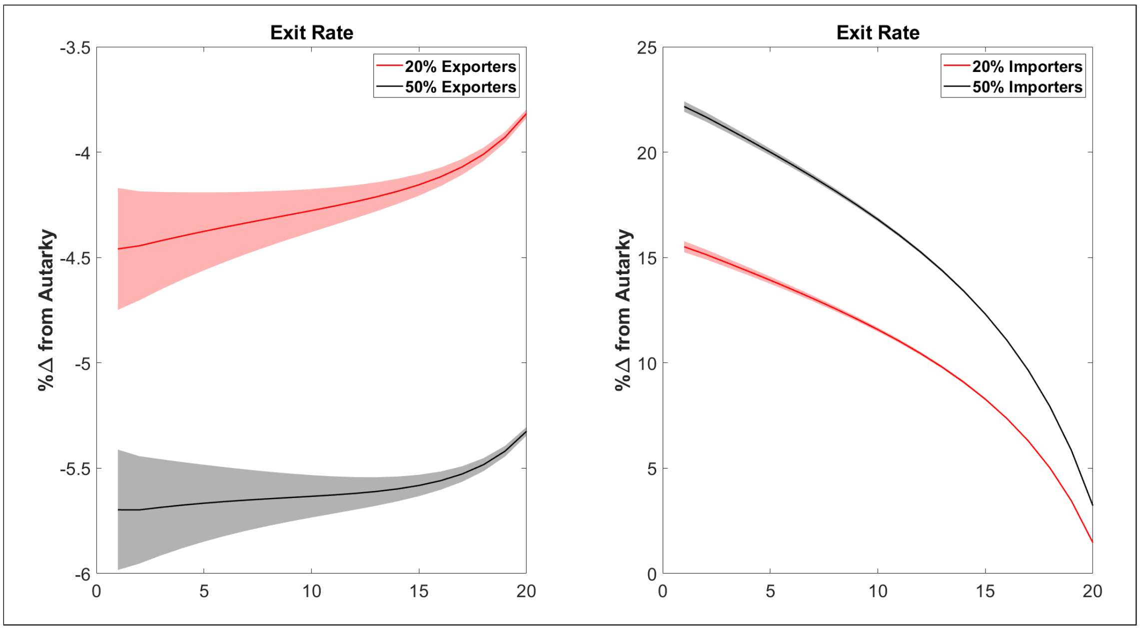
In contrast, when we change the share of importers to 50 or 80 percent, we can see that the severity of the negative TFP shock strongly increases with this share compared to the autarky scenario. The higher the importer share, the higher the competition effect and

[11] We adjust the shares by setting the fixed exporting costs, f_X and f_X^*, to corresponding values.

the larger is the exit rate in response to a negative productivity shock. These effects are relatively prolonged as it takes several years for the differences to vanish.

The competition effect is key for understanding these outcomes as it drastically lowers the size of the buffer between profits and the liquidation value. In order to explain the optimistic view on the export shock, this effect must be small.

Figure 5: Exit rates after TFP shock for different shares of exporters and importers



The 99 percent confidence bands shown in figure 5 are constructed by replicating the analysis 1000 times with random productivity shocks.

5 Conclusion

We present first evidence on the counter-acting effects of import and export shocks from China on the exit probability of firms in an interdependent world. Soaring imports are associated with a higher probability of plant exit. The exit propensity is lower in segments more prone to exports. These findings are rationalized by studying short run exit responses to trade liberalization in a dynamic model with endogenous plant closure decisions.

We distinguish between two different channels: The well-known selection channel and a novel productivity-shock channel. While trade liberalization fuel a dominant competition effect in our model, our counter-factual experiments show that implausible high export shares are necessary to explain the optimistic results for the export effect in our motivating evidence. We argue that there is an interaction effect of exports on the impact of other negative shocks unrelated to trade that offers another potential explanation for our optimistic export shock findings. Firms in export-oriented industries are larger and therefore better prepared for negative productivity shocks. The more firms export, the larger the difference between the lower exit bound and the continuation value determined by future profits. A negative productivity shock narrows the difference between the lower bound and the incumbent firm's continuation value but the larger the buffer, the less likely is an effective impact of the negative productivity shock in terms of plant exit. A combination of a low competition effect due to a higher share of exports plus this interaction effect can explain why exports reduce the propensity of firm exit in our DSGE model.

Further research must be done in understanding the role of this interaction. As labor market frictions directly affect the competition effect of trade (see, for instance, Cacciatore (2014)), they could also be critical for the exit decision of firms under trade liberalization. Another interesting aspect would be the consideration of offshoring decisions due to trade or productivity shocks as in Zlate (2016).

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A Competition effects of imports and exports

This section describes some additional results for the intensive margin. We were arguing that the effects at the intensive margin can be interpreted as indirect measures of the change in competition due to the import and export shocks. More competition should be reflected in worker churning across firms. Some firms should expand, whereas other firms should expand. Another possibility is that competition is not within one labor market segment but between. Firms may be recruiting workers from industries or regions where firms are exiting. We are analyzing the intensive margin in three different steps.

The first model discussed in this appendix replicates the model employed for the extensive margin analysis without doing the sample spilt.

Table 4 reports the coefficients of interest for imports and exports explaining absolute changes in employment (regressions (1) and (2)), employment growth (regressions ((3) and (4)), and log changes in employment (regressions (5) and (6)).

Imports are significant in (1) and (2), exports are positive and significant in all specifications except of specification (2). From this exercise we learn that the effects at the intensive margin are not robust. Several problems may explain why the linear model fails in this particular application. Firstly, the absolute changes may be driven by outliers. Larger plants should react more to the import shock than smaller firms. The results indicate that neutralizing the size effect is important but the results turn insignificant. The coefficient for imports is insignificant but exports are associated with labor demand expansions, which is in line with what we expect.

Table 4: Intensive margin adjustments and trade with China

Dependent variable: Employment changes within 5 years						
	Absolute change		Relative change		Log change	
	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	OLS	OLS	OLS	OLS	OLS
Δ IMP (C)	-12.324***	-10.994***	0.056	0.069	-0.028	-0.013
	(4.087)	(3.964)	(0.045)	(0.045)	(0.031)	(0.031)
Δ EXP (C)		33.638*		0.337***		0.388***
		(17.682)		(0.094)		(0.068)
Observations	86,745	86,745	86,745	86,745	86,745	86,745
R^2	0.009	0.009	0.016	0.016	0.048	0.052

Note: Base year 2000. Changes in import/export exposure between 2000 and 2005. Standard errors in parentheses clustered by region by industry pairs. $^{*}p < 0.10,^{**} p < 0.05,^{***} p < 0.01$. In all columns, the following control variables are included, but not reported: number of employees (ln), median plant wage (ln), plant age (years), the share of medium and highly skilled employees, as well as the constant.

The impact of the import shock works mainly through the extensive margin. Firms that survive soaring competition or exit but adjustments at the intensive margin are not systematic as indicated by this first empirical analysis. However, higher export demand for domestically produced goods is associated with expansions in employment. Those firms are less likely to exit in competitive markets and they expand their workforce. The first result is surprising, whereas the second result is more in line with common wisdom. Institutions may explain the insignificant results for German plants. Employment protection is binding for the majority of firms in our sample. Realigning employment as a response to heightened competition would put additional severance payment costs to the firm. Most plants may decided keeping their redundant workers or instead exit the market completely.

Another problem may be due to the selection of incumbent firms, which neglects hypothetical adjustments in exiting plants.

A.0.1 Intensive Margin: Quantile Regression Approach

Missing information about the counterfactual employment changes in exiting plants is a systematic selection of observations. These hypothetical changes in employment of exiting plants are latent but controlling for the survival probability can solve this issue in a Heckman selection regression approach. However, appropriate instruments are hard to come by. A good instrument must be correlated with the exit dummy but uncorrelated with size. Exit is a one hundred percent change in size, which implies that valid instruments hardly exist as exit and employment changes are two closely related issues.

D'Haultfoeuilley et al. (2018) propose a different method that builds upon quantile regressions by fitting

$$Q_{Y^*|x(\tau)} = X_1'\beta_1 + \beta_0 + X_2'\beta_2(\tau) \tag{23}$$

to the data.

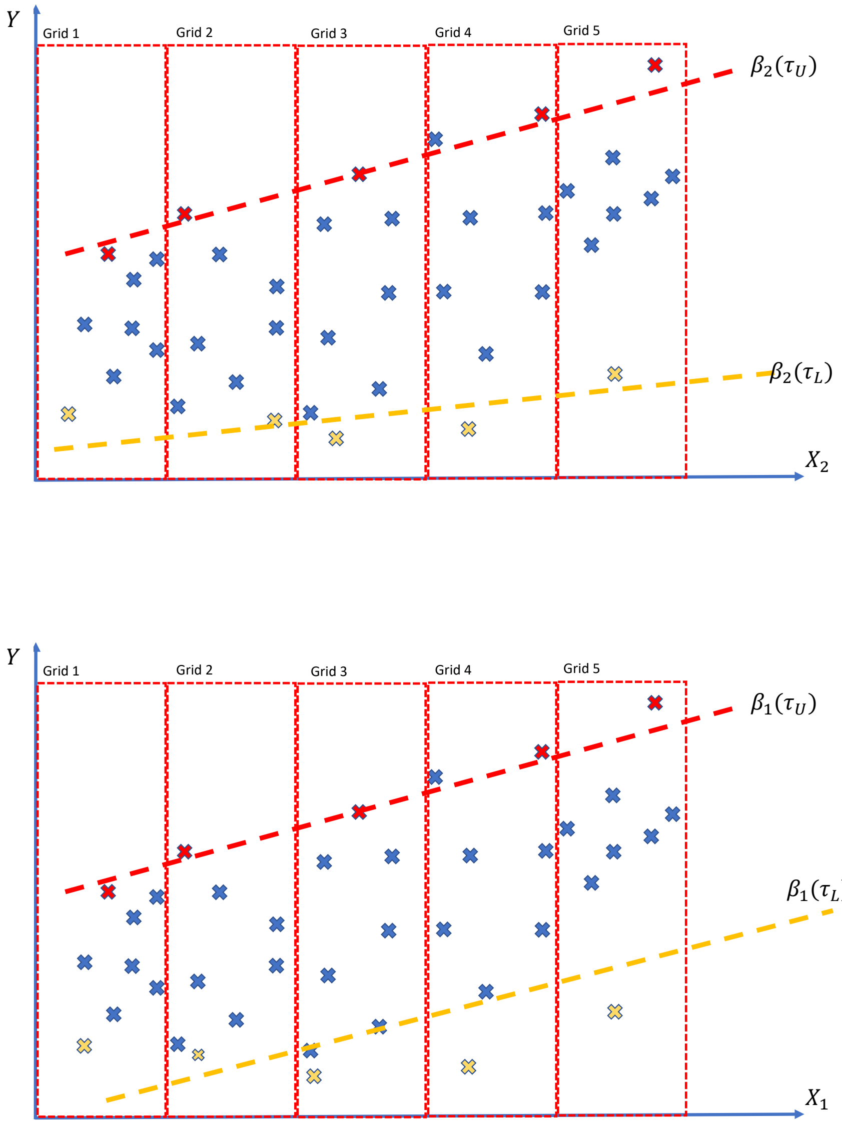
The latent variable Y^* is the true change in employment comprising information on both observable changes in employment of incumbent plants and counterfactual changes in employment of exiting plants. Coefficients of the control variables in matrix X_2 can differ across quantiles. Thus, each quantile τ has its own vector of coefficients denoted by $\beta_2(\tau)$. Identification of a common effect of the variable of interest requires similar effects across all quantiles and its coefficient is stored in β_1. This assumption together with the assumption that

$$\lim_{y \to \infty} P(D = 1|X = x, Y^* = y) = h \quad . \tag{24}$$

allows identification of unbiased estimates at the upper bound of the intensive employment margin. Equation (24) implies that the selection probability must converge to a constant value h when y goes to infinity. Notice that y is the observable change in employment of incumbent plants in our application. The selection probability must be independent of the covariats at the upper quantiles of the distribution. We need to argue that the covariates have zero explanatory power for the probability of survival when plants expand their employment by large amounts.

Figure 6 illustrates the quantile regression approach under assumption (24). The data is partitioned into different grids of equal size. The number of grids considered in this intuitive illustration is set to 5 for the sake of clarity. Each grid contains eight observations. The upper panel illustrates the scatter plot for the data in the Y, X_2 space, whereas the lower plot illustrates the data for y and X_1. The latter is the variable of interest for which coefficients across all quantiles must be equal, whereas coefficients for X_2 are allowed to differ across quantiles.

Figure 6: Illustration of the quantile regression approach



Note: This figure illustrates the quantile regression approach for the variable of interest X_1 (lower panel) and another covariate X_2 (upper panel) for the highest and the lowest quantile. The data is partitioned into five grids of equal number of observations. Within each grid the highest outcome of Y is chosen for τ_U and the lowest outcome of Y is chosen to represent the lowest percentile τ_L. The respective coefficients are represented by the dashed lines. Coefficients for the variable of interest are identical at both quantiles, whereas the coefficients for the control x_2 are different at both quantiles.

The regression-lines are fitted to one observation per grid. The selection issue can be avoided when the coefficients at the top of the distribution are independent of the selection problem and when these coefficients are representative across the whole distribution. This crucial assumption can be tested by replicating the estimation procedure at different percentiles. Coefficients must be equal across the whole distribution, which is the case in the illustration. The upper and the lower regression lines have the same slope. Thus, the marginal effects at both the upper and the lower percentiles are identical.

The graphical illustration above demonstrates why the common slope of β_1 across all quantiles is important for identification. The assumption can be be tested using a simple Hansen J-test statistic. The difference between the coefficient of interest at two different quantiles must be close to zero:

$$\hat{\beta}_1(\tau_n) - \hat{\beta}_1(l\tau_n) = 0 \tag{25}$$

The variable τ_n identifies the upper quantile used for identification of the unbiased result of X_1 on y. The coefficient identified within this particular quantile can be compared to any other coefficient identified by $l\tau_n$, where l is a number between 0 and 1. The Sargan J-statistic reads

$$T_J(l) = [(1/l) - 1]^2(\hat{\beta}_1(\tau_n) - \hat{\beta}_1(l\tau_n))'\hat{\Omega}^{-1}(\hat{\beta}_1(\tau_n) - \hat{\beta}_1(l\tau_n)) \quad . \tag{26}$$

The distance between the two coefficients is weighted using the estimated variance-covariance matrix $\hat{\Omega}$. The term $[(1/l) - 1]^2$ takes values between zero and 1. The test statistic approaches zero for values of l close to 1.[12]

Results. The results for the selection approach are reported in Table 5. Regression (1) and (2) include absolute employment changes as dependent variable explained by imports and exports. Regression (3) and (4) are based upon employment growth rates, and regressions (5) and (6) include log changes in employment as dependent variables. The p-value of the Hansen test are reported in the last line. Coefficients of the variable of interest are similar enough when the H0 cannot be rejected.

[12] The value l is obtained from a maximization problem that solves $l^* = \arg\max_l l \times [\ln l]^2 \times (1 - l) \approx 0.2$.

Table 5: Intensive margin adjustments and trade with China

Dependent variable: Employment changes within 5 years						
	Absolute change		Relative change		Log change	
	(1) SEL	(2) SEL	(3) SEL	(4) SEL	(5) SEL	(6) SEL
Δ IMP (C)	0.569	0.577*	0.040	0.064**	0.034	0.030*
	(0.389)	(0.348)	(0.030)	(0.028)	(0.023)	(0.017)
Δ EXP (C)	.	7.879***	.	0.374***	.	0.302***
		(0.522)		(0.031)		(0.021)
Observation	86,745	86,745	86,745	86,745	86,745	86,745
J-test (p-value)	0.312	0.000	0.040	0.067	0.021	0.095

Note: Base year 2000. Changes in import/export exposure between 2000 and 2005. $^{*}p < 0.10,^{**}p < 0.05,^{***}p < 0.01$. In all columns, the following control variables are included, but not reported: number of employees (ln), median plant wage (ln), plant age (years), the share of medium and highly skilled employees, as well as the constant. SEL implements quantile regressions that account for the selection problem. Standard errors are computed by bootstrapping with 50 replications.

All regressions yield insignificant results for the import-shock. Firms do not react to the import shock as expected. The effects of exports at the intensive margin are in line with what we expect. Firms expand their workforce as a reaction to the positive export shock. The Hansen test rejects the HO when fitting the quantile regressions to absolute changes in employment. We are focusing on log employment changes in the remainder of the discussion of the intensive margin.

Our theoretical considerations have shown that the intensive margin effects of imports are ambiguous. Firms have to realign their labor demand to the loss of demand to foreign competitors in the short run. However, domestic rivals are exiting, which spurs demand for remaining incumbents. These two opposing effects may explain why the intensive margin effects of imports on labor demand are insignificant. It is likely that some firms expand and others contract. The negative effects should be stronger in less productive firms right after the shock. The positive effects are likely more pronounced in more productive plants in the medium or long run.

The quantile regression approach helps identifying the effect of exports at the intensive margin but effects of imports are non linear and therefore difficult to capture by the two approaches discussed so far.

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Plant-level adjustments to imports and exports at the extensive margin

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