Plant-level responses to the China shock at different employment margins

Andreas Hauptmann[*], Hans-Jörg Schmerer[†] and Benjamin Schwanebeck[‡]

March 17, 2022

Abstract

This paper presents an empirical analysis of plant level responses to the China trade shock based upon a DSGE framework with heterogeneous firms, search and matching and employment protection. Our particular focus is on the interplay between the extensive and intensive employment margins. While soaring imports from China are associated with a higher probability of plant closure, incumbent firms react differently. Some surviving firms expand at the intensive margin, other firms contract their employment. Exports have similar effects at both margins. Firms in export oriented industries are less likely to exit and hire more workers at the intensive margin. These findings are supported by the simulation of our DSGE model. Based upon these benchmark results, we study the role of labor market institutions for the trade and employment nexus by simultaneous adjustments in both trade and employment protection costs. Our simulations show that firm selection is the main driver behind higher unemployment in the short-run. In the long-run, trade liberalization lowers unemployment. Employment protection mitigates the former but erodes the latter effect. Lower employment protection is associated with stronger unemployment effects in the short-run. The reducing effects on unemployment also become stronger when firing becomes cheaper.

Keywords: Plant Exit, International Trade, Import China, Worker Data
JEL codes: F14, F15, F16, L6

[*]Institute for Employment Research (IAB), Regensburgerstr. 100, D-90478 Nürnberg, Germany. Email address: andreas.hauptmann@iab.de.

[†]FernUniversität in Hagen, Universitätsstr. 11, D-58097 Hagen, Germany. Email address: hans-joerg.schmerer@fernuni-hagen.de.

[‡]FernUniversität in Hagen, Universitätsstr. 11, D-58097 Hagen, Germany. Email address: benjamin.schwanebeck@fernuni-hagen.de.

1 Introduction

Is China's tremendous economic success in the world responsible for massive plant closure in its export destination countries? Indeed, empirical studies show that soaring imports from China can be associated with massive layoffs and a substantial part of these layoffs are due to plant closure. Autor et al. (2013) motivated the most recent wave of studies dealing with regional labor market effects of the Chinese import shock. Their study shows that relatively more jobs are destroyed in areas more prone to Chinese import competition. Dauth et al. (2014) confirm the negative employment effects based upon German worker data. They extend the empirical setup proposed in Autor et al. (2013) by including both import and export shocks on the regional level. Albeit the massive layoffs associated with imports, net employment effects in Germany were positive during the period covered by their data.

We take their approach to the more disaggregated plant level, which allows assessing potential adjustment margins. Negative employment effects at the extensive margin of plant closure are long run effects with severe implications for the respective plant's labor force. At the intensive margin, a short-run reduction in plants' demand for workers may help preventing plant exit. Declining demand due to the sudden availability of foreign commodities can be neutralized by curbing production, which is associated with layoffs. These adjustment at the intensive margin may help firms surviving the short-run impact of the import shock. Moreover, exits of domestic competitors reduce competition in the medium-run. Incumbent firms are able to expand production when the market becomes less competitive. These adjustments at the intensive margin are likely more pronounced in less productive plants. More precise information about the transmission channels at the plant level can be useful for governments that have to decide about the right remedy against negative demand shocks in the short-run. Governments may react by setting appropriate labor market institutions. The same institutional measure can have opposing effects at different employment margins. Employment protection for instance may help preventing layoffs in the short-run but boost the probability of plant exit in the long-run. Our analysis combines theory and reduced form evidence. Our empirical analysis of plant-level employment responses builds on a DSGE framework akin to Ghironi and Melitz

(2005) and Cacciatore (2014). The advantage of the DSGE framework is the possibility of distinguishing between short- and medium-run effects. We will see that this distinction is important for the intensive employment margin, where short-run effects are different from medium- or long-run effects.

Moreover, the DSGE-framework gives us a good overall measure that allows assessing net-effects. The rate of unemployment accounts for positive and negative employment effects at both margins. Our simulations show that the marginal effect of trade on unemployment is positive in the short-run. Trade promotes unemployment in the short-run and we are able to show that this effect is mainly driven by firm-selection at the extensive margin.

However, firm selection also reduces competition in the medium- and long-run. Incumbent firms start expanding after some time and new firms that are on average larger than the exiting plants enter the market. This explains why the marginal effect of trade on unemployment becomes negative in the medium-run.

However, institutions and the existence of endogenous firm selection matter as we demonstrate in the counter-factual experiments. Lower employment-protection costs motivate firms to fire workers in the short-run associated with even higher unemployment. The long-run unemployment rate is even lower compared to the benchmark. Lower firing-costs motivate surviving firms to hire more workers and there is also slightly more entry due to the lower costs. Higher protection costs shelter workers in the short-run associated with lower unemployment but it also errodes the positive employment effects of trade liberalization in the long-run. The positive short-run effects of trade on unemployment are offset by negative long-run effects. Unemployment hardly changes in the long-run.

Another simulation highlights the role of endogenous firm-exit for the positive unemployment effects in the short-run. Our theoretical contribution is allowing for endogenous exit of firms. We can show that this extension magnifies the positive short-run effects of trade on unemployment.

The theoretical analysis builds upon empirical reduced form evidence for the role of import competition for adjustments at the extensive and intensive employment margins. This analysis 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.

The combination of individual and plant level information allows a very precise identification of plant closures, which is one of the main focus of our study. Most of the earlier studies on potential determinants of plant exits identify exits through missings in the plant identification variable. A plant is coded as exiting plant if the identifier disappears from the data. 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.[1]

At the intensive adjustment margin, we also pay special attention to the Heckman selection problem. The effects of trade on labor demand of a plant can be biased due to plant exit. This bias can be addressed using instruments that determine plant size without affecting exit. However, a plant exit itself is a reduction of size by 100 percent. Put differently, changes at both margins are closely related processes, which makes it difficult to defend the exclusion restriction for all potential instruments we are aware of. A very recent solution to this problem is discussed in D'Haultfoeuilley et al. (2018). The authors suggest quantile regressions in the presence of a selection bias when instruments are not available or inapplicable. Application of their method shows that the significant import effects at the extensive margin do not show up at the intensive employment margin. At the contrary, exports work through both the extensive and intensive margin when the Heckman selection problem is accounted for.

These findings motivate a third regression approach at the intensive margin. Insignificant effects at the intensive import margin can be rationalized by our theoretical considerations derived from the DSGE-model. We expect that incumbent plants down-size their labor demand as immediate response to the import shock. Plant exit reduces competition in the medium run, which allows surviving plants taking over the exiting plants market share. These two opposing effects give rise to an u-shaped pattern of employment adjustments at the intensive margin. It is likely that our regressions capture both the negative and the positive changes in employment as the adjustment paths may be plant-specific.

We adjust our empirical specification accordingly and find evidence that import-competition induces both labor demand contraction and expansion, which is in line with the non-monotonic adjustments described in the DSGE-framework. Effects for exports

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

are unambiguous and positive, which is also in line with the results derived from the DSGE-model simulations.

Related literature. 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 (forthcoming) show that 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).

Own contributions. Hauptmann and Schmerer (forthcoming) investigate the role of measurement issues in plant exit regressions. The common procedure of identifying plant exit through disappearing plant identifiers leads to a systematic bias when estimating the role of import competition on plant exit. 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.

These plants are more likely to provide advanced training to their workers. We argue that severance payments motivate plants to train workers instead of firing them. The cost saving effect of offshoring becomes small or even negative when firing workers is more costly. We provide some evidence using a sub-sample of plants without paying attention to econometric problems as endogeneity and the Heckman selection. Moreover, we neglect the extensive adjustment margin in this study.

2 Theoretical foundation

Melitz (2003) explains how trade liberalization can be linked to plant exit of the least productive firms in the long-run. However, short-run adjustments are beyond the scope of his seminal work. We build our theoretical considerations upon Ghironi and Melitz (2005) and Cacciatore (2014). The former is a dynamic model of trade and firm heterogeneity, which is extended by labor market frictions in the latter. The focus of Cacciatore (2014) is on aggregate unemployment effects of trade liberalization and business cycle movements without discussing potential interaction effects between the extensive and intensive margin. We introduce endogenous plant exits into their framework and calibrate the model towards Europe.

The intuition of the model and the impulse responses to trade liberalization are discussed in this chapter without going into more detail. These plots motivate the reduced form evidence presented in the next chapter. The model itself and the parameters used for the simulation are explained in the model section. Finally, we simulate two counter-factual experiments going beyond the permanent 10 percent reduction in iceberg transportation costs simulated in the benchmark scenario. The first couples trade liberalization to a 50 percent increase and a 50 percent reduction in firing costs. The second experiment demonstrates the role of slackness in iceberg transportation cost adjustments for the main model outcomes. Instead of reducing iceberg transportation costs by 10 percent within one period, the cost parameter is reduced stepwise over a longer time-horizon.

Intuitive description of the model. Firms in Cacciatore (2014) draw a constant productivity from a common distribution when entering the market. At the beginning of period t the exogenous job separation rate destroys a constant fraction of jobs in all firms. Job separation is either due to the exogenous separation shock or due to endogenous layoffs of workers with ability below a certain threshold defined by the firm. Based on the remaining workers in the firm and the development of outer conditions, firms decide about the optimal number of vacancies at the end of period t. All successful matches of vacancies posted in the past will be used in the production in the following period due to the time-to-build lag.

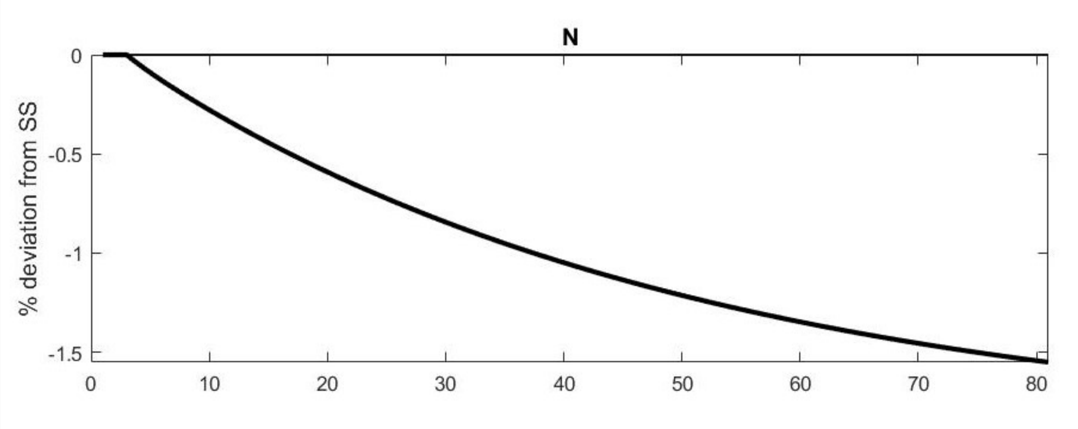
Moreover, firms decide about exiting the market at each period. The exit decision is endogenous. Each period, firms undergo a simple survival analysis by comparing the liquidation value to the continuation value. If the latter is greater than the former, a firm remains in the market. The continuation value is shaped by the outer circumstances of the respective period. Thus, firms take the current situation as good predictor for the future without forecasting potential changes in the future. Access to the world market is the crucial determinant for the continuation value in our analysis. Only the most productive firms can export and falling iceberg transportation costs change the critical productivity-cutoffs determining both the least productive incumbent firm and the least productive exporter. Entry of foreign plants stirs competition but exporting firms can compensate by exporting to Foreign. However, firms have to recruit additional workers before extending production, which takes some time.

The reevaluation of the cost-minimizing number of vacancies and the comparison of the future value of the firm with the opportunity costs of continuing gives rise to the intensive and extensive employment margins. The intensive margin is the evolution of vacancies that translates into firm-specific labor demand, whereas the evolution of the total number of firms gives rise to the net-effects at the extensive margin. See the model section and Cacciatore (2014) for more details on the model.

The following simulation outcomes are based upon the same parameters as proposed by Cacciatore (2014) and Cacciatore and Fiori (2016).

Extensive margin. Adjustments at the extensive margin are driven by plant exits and entries. Figure 1 illustrates the evolution of the total number of firms as response to a permanent reduction in iceberg transport costs by 10 percent.

Figure 1: Trade liberalization and net effects at the extensive margin



This graph depicts the evolution of the number of firms over time. Changes are driven by the net effects of plant exits and entries per period. Exits dominate entries in the periods after the permanent trade shock simulated by a reduction in iceberg transportation costs by 10 percent. The number of firms converges to a lower steady state in the long-run.

The total number of plants is decreasing much faster right after the shock and it converges to a new steady state level, which is around 1.5 percent lower than the initial steady state number of plants.

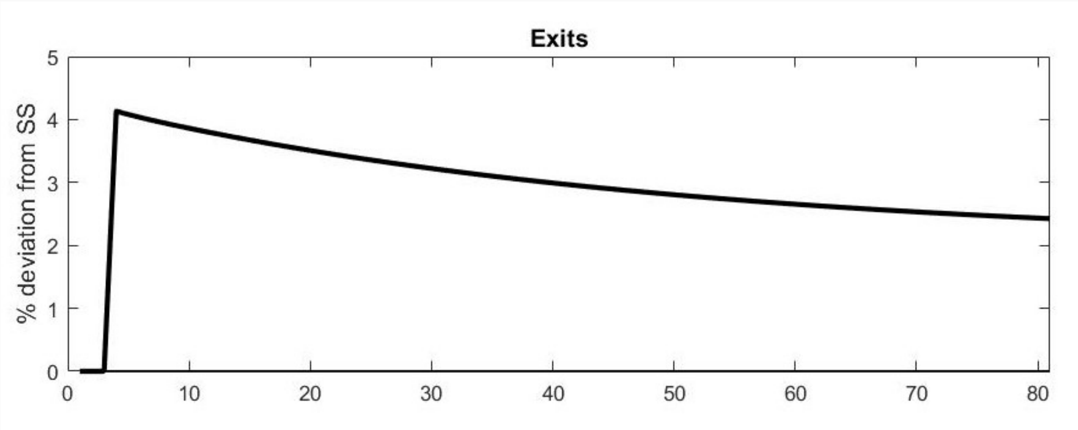
Notice that the non-linear adjustment path of active plants is due to the introduction of an endogenous plant death rate. Without endogenous plant exit, adjustments in the short-run would be linear. In Cacciatore (2014), a constant fraction of plants exits the market until the new steady state is reached.

Figure 2 illustrates the endogenous rate of plant exits as percent-deviation from its initial steady state level. Figure 3 illustrates percent deviation of the plant entries per period from its steady state level. Both variables together shape the total number of plants in the economy depicted in Figure 1.

The number of exits increases by four percent in the first period, followed by continuous adjustments at the extensive margin approaching the new steady state at a plant exit rate of slightly more than 2.5 percent higher than the former steady state exit rate.

Intensive margin. Incumbent firms react differently to the trade shock. We have some firms that manage surviving the trade shock through adjustments at the intensive margin. These firms reduce production associated with temporary layoffs as direct response to heightened competition. Imports from Foreign are rising instantaneously, which acts as a sudden competition shock for domestic firms.

Figure 2: Exit rate and trade liberalization

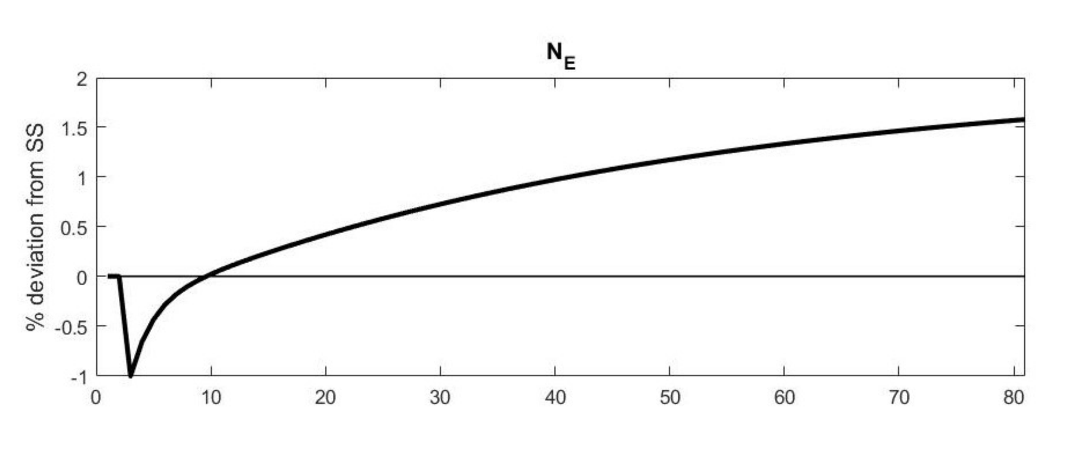


This graph depicts the evolution of exits per period. The absolute values are related to initial steady state values by computing deviations from the initial outcome for the period before the permanent trade shock.

Exporting firms can compensate this negative demand shock by exporting some of the excess supply to Foreign. They are loosing demand from domestic consumers to foreign competitors but they are also facing additional demand for their products from foreign consumers. The net-effect is even positive, which explains why these plants hire additional workers as depicted in Figure 4, which traces the intensive margin for one particular firm, the least productive exporter in the initial steady state.

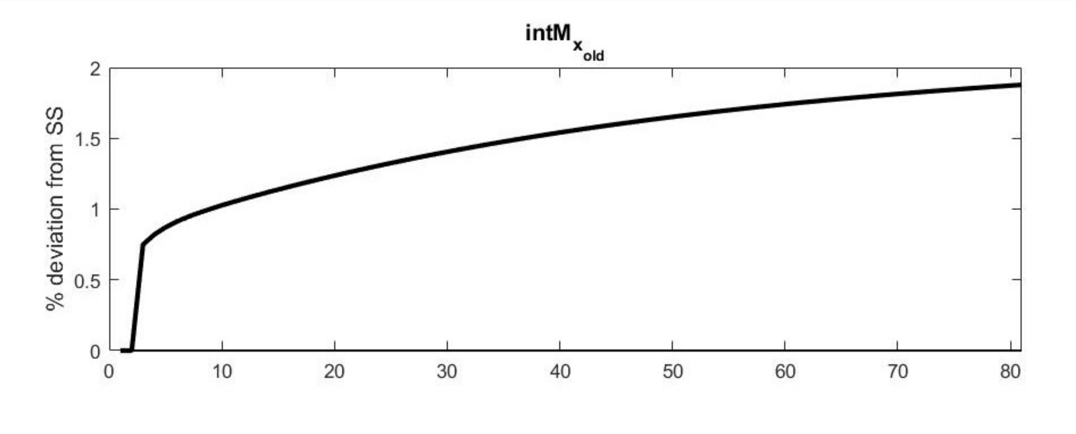
The export-cutoff dips below the productivity of this one particular firm as more firms are able to start exporting. We show the evolution of labor demand for this one particular firm, which is representative for the evolution of labor demand in all other exporting plants as well. However, the effects become stronger in more productive exporters. The

Figure 3: Firm entry and trade liberalization



This graph depicts the evolution of the number of plant entries per period. The absolute values are related to initial steady state values by computing deviations from the initial outcome computed for the period before the permanent trade shock.

Figure 4: The intensive export margin and trade liberalization

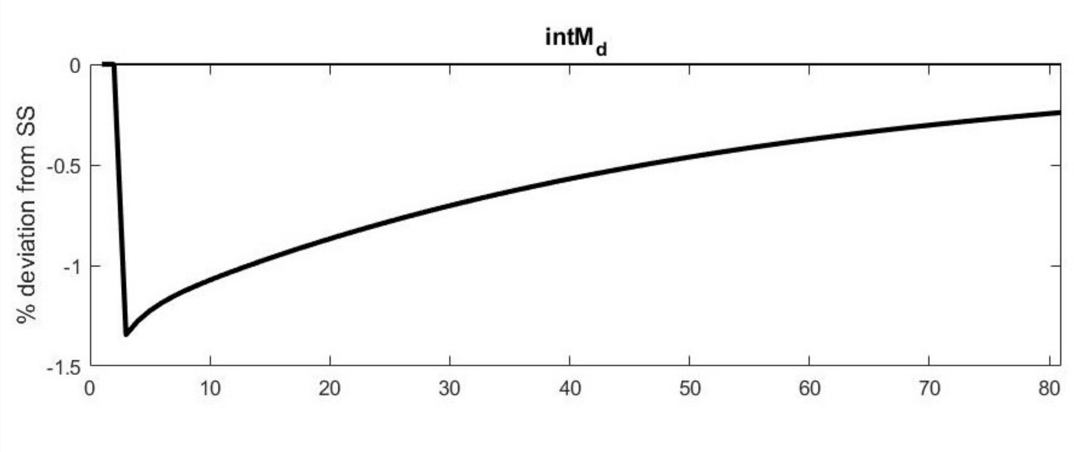


This graph depicts the evolution of the number of workers within the marginal exporting firm before the shock. The plot shows the adjustments at the least productive firm that was able to export in the initial steady state. Labor demand adjustments of this particular firm to the trade shock are as follows: The size of this firm jumps up to a higher level and continues growing to an even higher steady state level.

jump in labor demand is followed by a smooth adjustment towards the new steady state, which is around 2 percent higher than the initial steady state labor demand. The sluggish adjustment over time is due to the slow adjustment at the extensive margin. The more less productive plants exit over time, the less surviving firms compete with each other.

Figure 5 shows the intensive margin of the least productive non-exporter in the new steady-state that is active in both the initial steady state and the new steady state. This particular plant is denoted by $intM_d$.

Figure 5: The intensive domestic supply margin and trade liberalization



This graph depicts the evolution of the number of workers within the marginal domestic supply firm as response to a permanent 10 percent trade shock. We are tracing labor demand adjustments of this particular firm as response to the trade shock. The size of this firm jumps down to a lower level but continues growing to an even higher steady state level.

Non-exporters either shut down or realign their size through the intensive margin to the lower demand for their products. The former is without additional costs, whereas the latter incurs firing costs. Higher firing costs reduce the availability of this second adjustment channel but also protect workers from layoffs due to the trade shock.

3 Empirical strategy and data

The impulse response plots derived from the DSGE-model motivate our empirical reduced form analysis of the China-shock on German plants labor demand adjustments at both margins. The following table gives an overview over all results derived in both theory and the reduced form analysis.

Table 1: Summary of results

Theoretical evidence		
	Imports	Exports
Extensive margin (short- and medium-run)	Higher exit propensity due to higher plant death rate.	Lower exit propensity due to lower plant death rate.
Intensive margin (short-run)	Reduced labor demand in the short-run.	Higher labor demand due to additional demand from Foreign.
Intensive margin (medium-run)	Recovery of labor demand in the medium-run due to reduced competition.	Firm entry magnifies competition associated with reduced labor demand.
Reduced form evidence		
	Imports	Exports
Extensive margin (benchmark)	Higher exit propensity.	Lower exit propensity.
Intensive margin I (linear model)	Insignificant effects on employment changes in incumbent firms.	Positive and significant effects on employment changes.
Intensive margin II (quantile regressions)	Insignificant effects on employment changes in incumbent firms.	Positive and significant effects on employment changes.
Intensive margin III (sample split)	Signifficantly higher net hirings and higher net firings.	Signifficantly higher hiring rates,

Note: This table presents an overview over the results identified in our analysis.

The effects at the extensive margin are identified using a linear probability model. The effects at the intensive margin are based upon different approaches that fit a linear model, quantile regressions that address the so called Heckman selection problem and a sample-split approach to employment changes. The last approach is motivated by the outcomes of the quantile regression analysis and the outcomes derived from the intensive margin adjustments in our model simulations. Import and export shocks can have opposing effects at the intensive margin depending on firm productivity and timing.

The next section describes the data and the main variables used in the analysis. The empirical strategy is discussed subsequently for each step together with the results.

3.1 Data.

The data 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 is assigned to all coworkers employed in a specific plant. This identification number allows bundling the data from the worker 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 (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 other than plant closure. Hethey-Maier and Schmieder (2013) propose a methodology that eliminates this measurement error.[2] Likely, the dropout of a plant is not a "true" plant closure if a large cluster of workers of a plant with a disappearing identifier is observed in another plant the next year.[3] However, this method requires a meaningful number of coworkers. We follow the 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.[4]

Table 2 reports the relevant summary statistics.

[2] The outcome of their approach is provided as an extension file to the BHP.

[3] The authors define an establishment exit if the largest clustered outflow of workers is less than 30% relative 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").

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

Table 2: 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:[5]

$$\Delta IMP_{rjt}^{C} = \frac{E_{rjt}}{E_{jt}} \frac{\Delta IM_{jt}^{C}}{E_{rt}}, \tag{1}$$

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

$$\Delta EXP_{rjt}^{C} = \frac{E_{rjt}}{E_{jt}} \frac{\Delta EX_{jt}^{C}}{E_{rt}}. \tag{2}$$

Note that ΔIM_{jt}^{C} (ΔEX_{jt}^{C}) denotes the total change in imports (exports) from China of 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_{rjt}^{C} 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 survival we follow the literature and instrument the regional import exposure with changes of import from China in other countries o, i.e.[6]

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

[5] See Autor et al. (2013), Dauth et al. (2014).

[6] 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.

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

Both measures spread by 0.1 standard deviation (import) and 0.07 standard deviation (export) around its mean values, which are both 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 data. The first moment in the sample of included plants 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 but we are using the information on the number of years the respective plant identifier is observed 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 falls into the middle of the time of the first surge in offshoring of low-skill tasks. Thus, the low high-skill share is quite reasonable for this period.

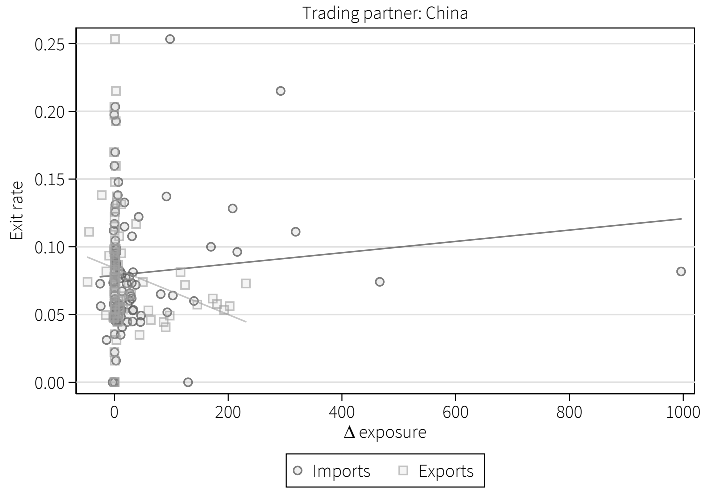
3.2 Descriptive evidence

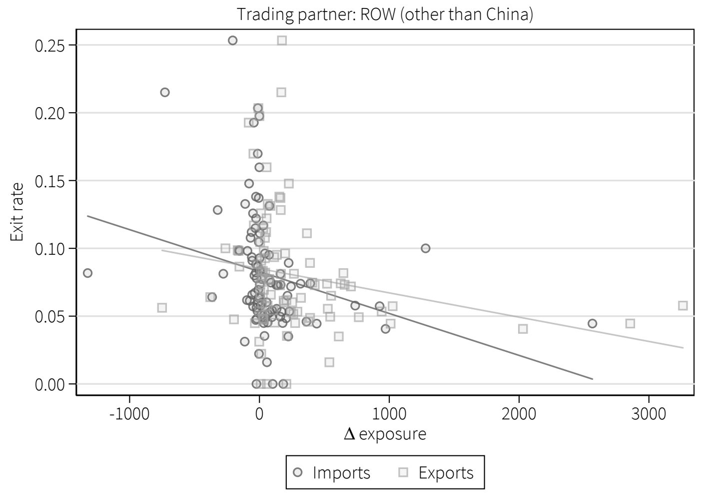
Figure 6 confronts (mean) exit rates of 98 manufacturing industries to the (mean) changes in import/export exposure.

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

Exit rates are constructed as the number of closing plants within the 5 years after 2000, related to the total number of existing plant within this particular period. The slope of the import shock (red line) is positive. Industries penetrated by Chinese exporters reported

Figure 6: 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.

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 firm 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.

3.3 Empirical strategy and results

We subsequently present the empirical models and the respective regression outcomes step by step in the following sub-chapters beginning with the extensive margin analysis. Section 3.3.2 to 3.3.4 are focusing on three different approaches that shed light on the intensive margin adjustments.

3.3.1 Extensive margin I: Plant exits, imports and exports

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

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

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 equal to one if a plant exits 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 $t+5$ and X_{ijrt} include various plant controls. Special interest is paid to the interpretation of the export shock measure. We hypothesize that imports and exports reveal opposite signs. Year $t = 2000$ is our base year 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, we control for plant size in terms of log employment, plant age, the log wage and skill-shares.

Results at the extensive margin. Table 3 reports the results for our baseline regression setup. Each regression fits 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 both import and export shocks plus all covariates.

Table 3: 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 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 import shock yields a negative and significant coefficient. More exposure to imports from China are 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 opposite and also highly significant coefficients. Regressions (5) and (6) confirm the results reported in (1) to (4) by simultaneously controlling for both imports and exports. Imports from China have negative effects on the probability of plant closure, whereas exports tend to reduce the probability of plant closure. The latter result is in line with the employment coefficient[7]: larger firms are generally less likely to close shop. The higher demand from abroad is likely associated with an expansion of domestic production and hiring of new workers. The instruments are still valid as the reported F-Statistic is above the critical threshold.

[7] Not reported but detailed results are available upon request.

Table 4: 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.

Table 4 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. Columns (3) and (4) affirm the respective results in Table 3 and again the relevant test statistic is above the critical lower threshold. Interestingly, part of the endogeneity bias in column (1)[8] 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)).

3.3.2 Intensive Margin I: Linear labor demand adjustments

Employment effects at the intensive margin are identified in three different setups. The first model discussed in this sub-section replicates the model employed for the extensive margin analysis for different measures of net employment changes in the respective plant.

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

Empirical strategy. Adjustments at the intensive employment margin can be captured by *i*) changes in the absolute number of workers within the plant, *ii*) percent changes in plant-level employment, and *iii*) log changes in employment. We fit the benchmark regression model to these three measures using

$$EMP_{ijrt} = C + \alpha_1 \Delta IMP^C_{rjt} + \alpha_2 \Delta EXP^C_{rjt} + \beta X_{ijrt} + \varepsilon_{ijrt}. \tag{6}$$

The covariates included in these regressions are similar to the ones included in the benchmark regression for the extensive margin but we exclude size controls.

Results. Table 5 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 5: Intensive margin adjustments and trade with China

Dependent variable: Employment changes within 5 years						
	Absolute change		Relative change		Log change	
	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS	(6) 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.

3.3.3 Intensive Margin II: Quantile Regression Approach

Empirical strategy. 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

$$Q_{Y^*|x(\tau)} = X_1'\beta_1 + \beta_0 + X_2'\beta_2(\tau) \tag{7}$$

to the data.

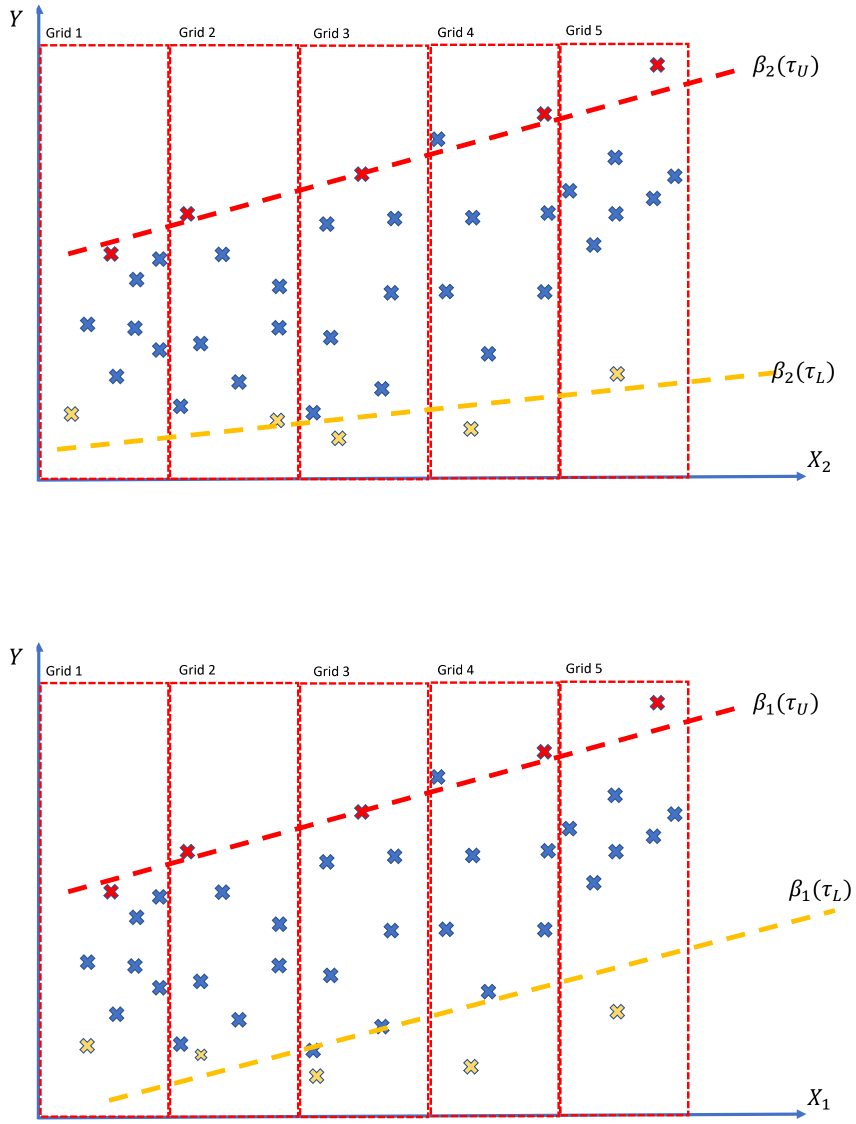
The latent variable Y^* is the true change in employment comprising information on both observable changes in employment of incumbent plants and counterfactual changes in employment of exiting plants. Coefficients of the control variables in matrix X_2 can differ across quantiles. Thus, each quantile 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

$$\lim_{y \to \infty} P(D = 1|X = x, Y^* = y) = h \quad . \tag{8}$$

allows identification of unbiased estimates at the upper bound of the intensive employment margin. Equation (8) 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 7 illustrates the quantile regression approach under assumption (8). 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 7: 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:

$$\hat{\beta}_1(\tau_n) - \hat{\beta}_1(l\tau_n) = 0 \tag{9}$$

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

$$T_J(l) = [(1/l) - 1]^2(\hat{\beta}_1(\tau_n) - \hat{\beta}_1(l\tau_n))'\hat{\Omega}^{-1}(\hat{\beta}_1(\tau_n) - \hat{\beta}_1(l\tau_n)) \quad . \tag{10}$$

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.[9]

Results. The results for the selection approach are reported in Table 6. 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.

[9] 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 6: 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. Thus, we implement a third approach that identifies the effects at intensive margin separately for expanding and contracting plants using information about plants' net hiring and firing rates.

3.3.4 Intensive Margin III: hirings and firings

Empirical strategy. We fit the benchmark regression setup separately to the sample of contracting and expanding plants. The former contains all plants that contract their workforce indicated by $\Delta Employment < 0$, whereas the latter contains all plants that do not change their workforce or expand in the period after the shock.[10]

$$\begin{aligned} CONTRACT_{ijrt} &= \alpha_1 \Delta IMP^C_{rjt} + \alpha_2 \Delta EXP^C_{rjt} + \beta X_{ijrt} + \varepsilon_{ijrt}, \quad (11) \\ EXPAND_{ijrt} &= \alpha_1 \Delta IMP^C_{rjt} + \alpha_2 \Delta EXP^C_{rjt} + \beta X_{ijrt} + \varepsilon_{ijrt}, \quad (12) \end{aligned}$$

The vector X contains the usual controls.

Results. Table 7 reports the results for imports and exports. The dependent variable is log employment changes. Results for absolute changes and change rates are available upon request. Regression (1) and (2) reveal the expected signs. The import shock magnifies both employment contractions and expansions. Positive net employment changes are more pronounced in segments with more import-competition. The dependent variable in (2) is always negative. The negative coefficient of the import shock variable indicates that the negative employment changes are magnified by the import shock. The higher the import shock, the stronger the employment adjustments at the intensive margin.

The export shock reveals similar coefficients for both expanding and contracting plants. Expanding plants expand more in industries more exposed to exports. Contracting plants in more export oriented industries react less. Their contraction rates are lower. Including both imports and exports simultaneously yields similar results.

[10] An alternative approach that yields comparable results is interacting all variables with an indicator variable that takes the value 1 for expanding and 0 for contracting plants.

Table 7: Intensive margin adjustments and trade with China (split-sample)

Dependent variable: Log employment changes within 5 years						
	Δ EMP > 0			Δ EMP < 0		
	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS	(6) OLS
Δ IMP (C)	0.073***		0.076***	-0.121***		-0.115***
	(0.022)		(0.022)	(0.029)		(0.029)
Δ EXP (C)		0.053**	0.061**		0.166***	0.157***
		(0.027)	(0.027)		(0.037)	(0.036)
Observations	32,989	32,989	32,989	44,531	44,531	44,531
R^2	0.134	0.134	0.135	0.010	0.010	0.011

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.

4 Model

This section describes the model used in all simulations. The small open economy considered here is modeled by assuming a negligible size for one of the countries (the Home country) in a two-country DSGE model framework. Hence, the Foreign economy is unaffected by the dynamics of Home.

4.1 Production

The production process can be modeled via two vertically integrated stages. By doing so, we follow Cacciatore et al. (2015) and subsequent literature that split the production structure into multiple stages to simplify the implementation of labor market frictions in the form of search and matching in otherwise standard two-country models based on Ghironi and Melitz (2005) with an endogenous number of producers and sorting into non-exporting firms and exporters. In the first stage, i.e. the upstream sector, a unit mass of perfectly competitive firms produce intermediate goods by using labor as sole input. These agents choose the amount of jobs, posted vacancies and the cutoff job-productivity level. In the second stage, i.e. the downstream sector, monopolistically competitive firms produce different varieties by using intermediate goods as inputs. These final goods can be sold domestically and abroad. The number of firms in the downstream sector will be determined endogenously.

4.1.1 Intermediate goods production

While labor is the sole input factor, each producer relies on a continuum of jobs, whereby each job is performed by one worker.[11] Each job is prone to a random disturbance which can be interpreted as job-specific productivity or worker's ability. Each period, this productivity a_t will be an i.i.d. draw from a common distribution. As in Helpman et al. (2010), we assume a Pareto distribution with c.d.f. $H(a)$, support on $[a_{min}, \infty]$, and shape parameter σ. Let L_t be the quantity of jobs within the firm. Then, overall output $y_{I,t}$ of the representative intermediate goods producer is given by

$$Y_t^I = L_t \frac{1}{1 - H(a_t^c)} \int_{a_t^c}^{\infty} a dH(a) \equiv \tilde{a}_t L_t, \tag{13}$$

with the weighted average job productivity $\tilde{a}_t$. $\tilde{a}_t = \frac{\sigma}{(1-\sigma)} a_t^c$ can be derived due to the assumption imposed above. The cutoff job-productivity level a_t^c splits jobs into profitable ones ($a_t > a_t^c$) and ones ($a_t < a_t^c$), where the continuation value is less than the cost of separation. In this case, where firms actively terminate a job, they have to pay a firing cost F in real terms.[12] Besides this endogenously determined fraction of terminated jobs, $H(a_t^c)$, jobs can also be exogenously separated from the firm. The corresponding fraction is $\bar{\lambda}$. In this case, firms do not have to pay firing costs.

Following the standard Diamond-Mortensen-Pissarides framework, we model job creation via matching frictions. Hiring new workers requires vacancy posting. Firms post a vacancy at a real cost κ in consumption units. At the aggregate level, unemployed workers U_t and vacancies V_t match according to the following technology $M_t = \chi U_t^{\epsilon} V_t^{1-\epsilon}$, with $0 < \epsilon < 1$ and matching efficiency χ. Hence, firms fill a vacancy at a rate $q_t \equiv M_t/V_t$, whereas unemployed workers find a job at a rate $\iota_t \equiv M_t/U_t$. Due to the assumption that new matches become active in the next period, firm-specific new hires in t are given by $q_{t-1} v_{z,t-1}$, with $v_{z,t-1}$ as posted vacancies of a firm with productivity z.

[11] As in Cacciatore (2014), firms are assumed to be large regarding the employment of a continuum of jobs. However, compared to whole economy, the size of a firm is negligible.

[12] The firing cost does not depend on job-specific productivity.

Given the aforementioned hiring and firing process, the evolution of employment at the firm level reads

$$L_t = (1 - \lambda_t)(L_{t-1} + q_{t-1}V_{t-1}), \tag{14}$$

where $\lambda_t \equiv \bar{\lambda} + (1 - \bar{\lambda})H(a^c_{z,t})$ describes the total separation rate within the firm. At the end of period t after production has taken place, incumbents face a survival test that we will specify later on. When leaving the market, all of a firm's workers (re)enter the unemployment pool in the next period. On the other hand, since separation takes place prior to production and hiring, all separated workers in period t immediately reenter the unemployment pool and are available in the matching process during the same period t and could therefore become active again in $t + 1$.

As households are the owners of the firms, costs are discounted by households' stochastic discount factor $\beta_{t,s} \equiv \beta(u_{C_s}/u_{C_t})$ with u_{C_t} as marginal utility of consumption. In addition, firms take the endogenously determined death rate δ_t as given. Every period, throughout the production process, firms has to pay fixed operational costs f_D in consumption units. This modeling approach follows Melitz (2003) and leads to an endogenously determined productivity cutoff $z_{D,t}$ that splits firms into profitable ones ($z > z_{D,t}$) and into actively exiting ones ($z < z_{D,t}$). However, we will depart from Melitz (2003) and follow Rossi (2019) by assuming that operational costs are paid to the households as they are the owners of the firms.[13]

An incumbent firm with productivity z chooses $\{l_{z,t}, v_{z,t}, a^c_{z,t}\}$ in order to minimize the expected discounted value of costs given by

$$E_t \left\{ \sum_{s=t}^{\infty} \beta_{t,s} \prod_{j=1}^{s-t} (1 - \delta_{t+j}) \left[\tilde{w}_{z,s} l_{z,s} + \kappa v_{z,s} + H(a^c_{z,s})(1 - \lambda^x)(l_{z,s-1} + q_{s-1}v_{z,s-1})F \right] \right\}, \tag{15}$$

where $\tilde{w}_{z,t} \equiv [1 - H(a^c_{z,t})]^{-1} \int_{a^c_{z,t}}^{\infty} w_t(a) dH(a)$ denotes the job-productivity weighted average wage, subject to (13) and (14), taking wages $w_t(a)$ as given for computational convenience.[14]

[13] As households receive f_D every period until the firm exits the market, the discounted accumulated amount of these payments could be interpreted as the liquidation value of the firm. Hence, the decision to exit, i.e. the "survival test", can be interpreted as a comparison between the continuation value, i.e. profits, and the liquidation value.

[14] Wages will be the result of a surplus-splitting rule. Abstracting from bargaining within firms is a common assumption in DSGE models with monopolistically competitive firms and search and matching as labor market frictions. See Cacciatore (2014) for a discussion on this issue.

The Lagrange multiplier on the constraint (13), $\varphi_{z,t}$, is equivalent to the real marginal cost of production. Combining the first-order conditions for employment and the number of vacancies leads to the following equation describing job creation:

$$\frac{\kappa}{q_t} = E_t \left\{ \beta^F_{t,t+1} \left[(1-\lambda_{z,t+1})(\varphi_{z,t+1} z \tilde{a}_{z,t+1} - \tilde{w}_{z,t+1} + \frac{\kappa}{q_{t+1}}) - (1-\lambda^x) H(a^c_{z,t+1}) F \right] \right\}, \tag{16}$$

where $\beta^F_{t,t+1} \equiv \beta_{t,t+1}(1-\delta_{t+1})$. At the optimum, the marginal cost of posting a vacancy, κ, is equal to the expected present discounted ($\beta^F_{t,t+1}$) benefit of a filled (q_t) vacancy that either survives job destruction $(1-\lambda_{z,t+1})$ or gets actively terminated by the firm in $t+1$. In the latter case, the firm has to incur the firing cost F. In the former case, the benefits are generated in the next period due to the time-to-build assumption. Here, a match generates an average marginal revenue product ($\varphi_{z,t+1} z \tilde{a}_{z,t+1}$), savings on future postings (κ/q_{t+1}), but has to be paid at the wage $\tilde{w}_{z,t+1}$ on average.

Given the first-order conditions for employment and vacancies, the one for the cutoff level $a^c_{z,t}$ leads to the following equation describing job destruction:

$$\varphi_{z,t} z a^c_{z,t} = w_{z,t}(a^c_{z,t}) - F - \frac{\kappa}{q_t}. \tag{17}$$

Equation (17) determines $a^c_{z,t}$ by stating that the benefit of the marginal job must be zero. At the optimum, the marginal revenue product of the threshold worker must be equal to the corresponding wage cost net of firing and replacement costs. Note that some jobs will not be terminated although the marginal product is lower than the wage due to the savings in firing and replacement costs. Ceteris paribus, a higher (lower) firing cost allows for more (fewer) "unprofitable" workers to be employed by lowering (increasing) the threshold $a^c_{z,t}$.

Wage Setting. We assume that wages $w_{z,t}(a)$ are an outcome of an individual Nash bargaining process between workers and firms where the surplus of a match will be split between both parties. Let $\eta \in (0,1)$ be the bargaining power of the worker, then the wage is given by[15]

$$w_{z,t}(a) = \eta \left[\varphi_{z,t} z a + (1 - (1-\lambda^x) E_t \beta^F_{t,t+1}) F \right] + (1-\eta)\varpi_t, \tag{18}$$

[15] See Cacciatore (2014) for the derivation.

where the term in brackets on the right-hand side reflects the gain for the firm in form of the marginal revenue product plus savings in firing cost in period t minus possible firing cost in period $t+1$, while the the outside option of the worker, ϖ_t, reads

$$\varpi_t = \frac{-u_{L_t}}{u_{C_t}} + u_b + E_t \beta^F_{t,t+1} \int_{z_{min}}^{\infty} \frac{\iota_t v_{z,t}}{V_t} (1 - \lambda_{z,t+1}) \tilde{J}^W_{z,t+1} dG(z). \tag{19}$$

Here, the first two terms on the right-hand side represents the real value of unemployment in form of leisure and unemployment benefits u_b. The third term corresponds to the expected present discounted value of searching and finding a job at firm z with probability $\iota_t v_{z,t}/V_t$, surviving job destruction $(1 - \lambda_{z,t+1})$ and receiving the average surplus $\tilde{J}^W_{z,t+1}$ after the time-to-build lag. The average surplus for the worker from a match is given by the following Bellman equation

$$\tilde{J}^W_{z,t} = \tilde{w}_{z,t} - \varpi_t + E_t \beta^F_{t,t+1} (1 - \lambda_{z,t+1}) \tilde{J}^W_{z,t+1}, \tag{20}$$

where the last term is the continuation value of the match.

4.1.2 Export Decision

As common in the literature based , each firm can be thought of as a producer, a product, or a plant. It is assumed that they all coincide and in the following we will use these terms interchangeably when referring to production. A continuum of monopolistically competitive firms produce different varieties ω by using labor as sole input. Prior to market entry, prospective entrants are identical and face the same entry cost $f_{E,t}$.[16] Entering firms 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 firm heterogeneity. However, firms with the same productivity draw would make identical optimization choices. However, the probability that two firms draw the same productivity is zero. Henceforth, we will drop the variety index ω and identify a firm by its productivity level z.

Given the cost minimization, firms maximize their profits by setting product prices. This part of the model follows Ghironi and Melitz (2005). We assume local currency pricing

[16] We will define this cost later on.

and flexible prices, so that the law of one price holds. When a firm chooses to export, it has to incur per-unit iceberg trade cost τ as well as a per-period fixed cost f_X in consumption units for operating in the foreign market. It is optimal for firms to set prices as a markup $\theta/(\theta-1)$ over marginal cost $\varphi_{z,t}$, where θ is the elasticity of substitution between goods. Hence, optimal real prices relative to the destination market's price index are given by

$$\rho_{D,t}(z) = \frac{\theta}{(\theta-1)}\varphi_{z,t}, \qquad \rho_{X,t}(z) = \frac{\tau}{Q_t}\rho_{D,t}(z), \tag{21}$$

with Q_t as the real exchange rate.

We split firm z's profits $d_t(z)$ into a portion from domestic sales, $d_{D,t}(z)$, and, if the firm chooses to export, into a portion from these sales, $d_{X,t}(z)$. Given the optimal real prices (21), profits can be written as

$$d_{D,t}(z) = \frac{1}{\theta}(\rho_{D,t}(z))^{1-\theta}Y_t^C - f_D, \qquad d_{X,t}(z) = \frac{Q_t}{\theta}(\rho_{X,t}(z))^{1-\theta}Y_t^{C*} - f_X, \tag{22}$$

with Y_t^C, Y_t^{C*} as aggregate demand from Home and Foreign. 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 by $z_{X,t} = \inf\{z : d_{X,t} > 0\}$, that sort firms into a non-traded good sector and into exporters. We assume a parametrization for the Pareto distribution that prevents corner solutions, so that only a fraction of all firms are exporters.

4.1.3 Extensive Margin and Firm Averages

Following the argumentation in Cacciatore (2014), it can be shown that all firms choose the same cutoff job-productivity level $a_{z,t}^c = a_t^c$ and therefore pay the same average wage $w_{z,t} = w_t$. Under the assumptions that the job-productivity draws are independent of z and costs due to hiring and firing are linear, the outside option is identical for all firms. Hence, it is optimal to choose one particular a_t^c irrespectively of z. As a result, marginal costs are linear in z, i.e. (16) implies $\varphi_{z,t} \equiv \varphi_t/z$. Thus, the choices of any two firms only depend on their relative productivity levels. As in Ghironi and Melitz (2005), we define the two common average productivity levels for firms serving the domestic market and for exporters:

$$\tilde{z}_{D,t} \equiv \left[\frac{1}{1-G(z_{D,t})}\int_{z_{D,t}}^{\infty} z^{(\theta-1)}dG(z)\right]^{\frac{1}{\theta-1}}, \tilde{z}_{X,t} \equiv \left[\frac{1}{1-G(z_{X,t})}\int_{z_{X,t}}^{\infty} z^{(\theta-1)}dG(z)\right]^{\frac{1}{\theta-1}}. \tag{23}$$

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 $\tilde{d}_{X,t} \equiv d_{X,t}(\tilde{z}_{X,t})$. The share of exporters is given by $N_{X,t}/N_t = 1-G(z_{X,t})/(1-G(z_{D,t})$, while N_t firms are active in Home within a period.

We assume that due to a time-to-build lag, new entrants $N_{E,t}$ start producing goods in the subsequent period. As mentioned above, prospective entrants face a sunk cost defined as $f_{E,t} = f_E + \kappa\tilde{v}_{E,t}$, where vacancies posted by new entrants, $\tilde{v}_{E,t} = (\tilde{l}_t + q_t\tilde{v}_t)/q_t$, are identical to incumbents with the same productivity.[17]

Firms will enter the market as long as their present discounted equity value is larger than the entry cost. Free-entry implies that the present discounted equity value of the average firm, $\tilde{e}_t$, must equal $f_{E,t}$:

$$\tilde{e}_t = E_t\beta^F_{t,t+1}(\tilde{d}_{t+1} + \tilde{e}_{t+1}) = f_{E,t}. \tag{24}$$

Prior to production, both incumbents and new firms has to pay the fixed operational cost. Hence, both will compute the present discounted value of expected dividends, i.d. the equity value, to decide whether to start producing or exiting the market. The cutoff $z_{D,t}$ splits firms into profitable ones ($e_t(z) > 0$, i.e. $z > z_{D,t}$) and into actively exiting ones ($e_t(z) < 0$, i.e. $z < z_{D,t}$). Thus the cutoff level is given by the exit condition:

$$e_t(z_{D,t}) = E_t\beta^F_{t,t+1}(\tilde{d}_{t+1} + e_{t+1}(z_{D,t+1})) = 0. \tag{25}$$

Given $z_{D,t}$, the exit rate is defined as $\delta_t = 1-(z_{min}/z_{D,t})^{\alpha}$. The endogenously determined exit rate affects both the labor market conditions and the entry decision while the latter is also dependent on labor market outcomes. Hence, changes in δ_t trigger changes in firm dynamics and labor market outcomes.

[17] This follows the same logic as above, firms with the same productivity z are symmetric.

Finally, the evolution of firms reads

$$N_t = (1 - \delta_t)(N_{t-1} + N_{E,t-1}). \tag{26}$$

4.2 Households

Within each country there is a unit-sized continuum of identical infinitely-lived households. We follow much of the literature on search and matching and assume more or less the standard approach regarding the labor supply side: Labor supply is determined by the matching process and not by households' optimization choice. Furthermore, households can be understood as large extended families with a unit-sized continuum of members who either work and receive wage income or are unemployed and receive unemployment benefits. We assume perfect consumption insurance within a family which leads to no differences in consumption between members of the household. Hence, we are able to work with a representative household.[18]

The representative household maximizes the utility function

$$E_t \left\{ \sum_{s=t}^{\infty} \beta^{s-t} u(C_s, L_s) \right\} = E_t \left\{ \sum_{s=t}^{\infty} \beta^{s-t} \left[\frac{C_s^{1-\gamma}}{1-\gamma} - \nu L_s \right] \right\} \tag{27}$$

with the consumption basket C_t, the amount of employed workers L_t, the discount factor β, the inverse of the elasticity of intertemporal substitution, γ, and the disutility of work, ν. 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

$$C_t = \left[\int_{\omega \in \Omega} c_t(\omega)^{\frac{\theta-1}{\theta}} d\omega \right]^{\frac{\theta}{\theta-1}}, \tag{28}$$

with the corresponding price index:

$$P_t = \left[\int_{\omega \in \Omega} p_t(\omega)^{1-\theta} d\omega \right]^{\frac{1}{1-\theta}}. \tag{29}$$

We allow households to save in two forms: shares x_{t+1} in a mutual fund of domestic firms and risk-free Home, B_t, and Foreign bonds, $B_{*,t}$, which can be traded within and

[18] See Andolfatto (1996), Merz (1995), and the subsequent literature.

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.[19] Shares in the mutual fund pay the average total profit of all domestic firms and are priced at the current value of the average firm, $(\tilde{d}_t + \tilde{e}_t)N_t$. During t, the household accumulates new shares x_{t+1} of $N_t + N_{E,t}$ firms priced at $\tilde{e}_t$. The flow of funds in real terms reads

$$\begin{aligned} C_t + \tilde{e}_t(N_t + N_{E,t})x_{t+1} + B_{t+1} + Q_t B_{*,t+1} + \frac{\xi}{2}B^2_{t+1} + \frac{\xi}{2}Q_t B^2_{*,t+1} = \\ = (1+r_t)B_t + (1+r^*_t)Q_t B_{*,t} + (\tilde{d}_t + \tilde{e}_t)N_t x_t + \tilde{w}_t L_t + u_b(1-L_t) + T^f_t - T^g_t \end{aligned} \tag{30}$$

As already mentioned above, household's income is composed on Bond returns, returns on the mutual fund, wage income, unemployment benefits and lump-sum rebates of the bond adjustment costs, $T^f_t = \xi/2(B^2_{t+1} + Q_t B^2_{*,t+1})$, minus lump-sum taxes from the government, $T^g_t = u_b(1-L_t)$. Maximizing the households utility function subject to the flow of funds constraint yields the Euler equations for bond holdings and share holdings:

$$1 + \xi B_{t+1} = (1+r_t)E_t\beta_{t,t+1}, \tag{31}$$

$$1 + \xi B_{*,t+1} = (1+r^*_t)E_t\beta_{t,t+1}Q_{t+1}/Q_t, \tag{32}$$

$$\tilde{e}_t = E_t\beta_{t,t+1}(1-\delta_{t+1})(\tilde{d}_{t+1} + \tilde{e}_{t+1}). \tag{33}$$

4.3 Equilibrium

Total employment reads $L_t = N_t\tilde{l}_t$ while unemployment is $U_t = 1 - L_t$, whereby U_t is also the unemployment rate. Aggregate Vacancies are given by $V_t = (N_t + N_{E,t})\tilde{v}_t + N_{E,t}\tilde{l}_t/q_t$. By combining these equations, we can derive the law of motion for aggregate employment $L_t = (1-\lambda^{tot}_t)(L_{t-1} + q_{t-1}V_{t-1})$, where $\lambda^{tot}_t = 1-(1-\lambda^x)(1-H(a^c_{z,t}))(1-\delta_t)$ is the overall separation rate due to exogenous separation, endogenous firing, and endogenous firm exit.

Labor market clearing reads

$$\tilde{a}_t L_t = \tilde{\rho}^{-\theta}_{d,t} Y^C_t \tilde{z}^{-1}_{D,t} N_t + \tau_t \tilde{\rho}^{-\theta}_{x,t} Y^{C*}_t \tilde{z}^{-1}_{X,t} N_{X,t} \tag{34}$$

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

The equilibrium price index is given by

$$1 = \tilde{\rho}_{d,t}^{1-\theta} N_t + \tilde{\rho^*}_{x,t}^{1-\theta} N_{X,t}^* \tag{35}$$

and aggregate demand reads

$$Y_t^C = C_t + f_E N_{E,t} + f_X N_{X,t} + \kappa V_t + \frac{H(a_t^c)}{1 - H(a_t^c)} F \tag{36}$$

Market clearing for bonds and shares implies: $B_{t+1} + B_{t+1}^* = 0$, $B_{*,t+1} + B_{*,t+1}^* = 0$, and $x_t = x_{t+1} = 1$. Combining the market-clearing conditions with household's flow of funds constraint leads to the following net foreign asset equation:

$$B_{t+1} - B_t + Q_t(B_{*,t+1} - B_{*,t}) = CA_t \equiv r_t B_t + Q_t r_t^* - B_{*,t} + TB_t, \tag{37}$$

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

4.4 Calibration

In our simulation exercise, we assume symmetric countries and study the dynamics of a permanent 10 percent decrease in the iceberg trade cost τ. The shock hits both countries. When we simulate a simultaneous change in both iceberg transportation costs and firing costs, we change F by 10 percent.

For most of the parameters we follow, among others, Cacciatore (2014) and 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 is set to one. Bond adjustment costs are calibrated in a standard way, $\xi = 0.0025$, to induce steady-state determinacy. We use standard values for the elasticity of substitution between goods and the shape parameter of the Pareto distributions, i.e. $\theta = 3.8$,$\alpha = 3.4$, and $\sigma = 2$, while normalizing the lower bounds z_{min} and a_{min} to one.

For the parameters describing the labor market frictions, we closely follow Cacciatore and Fiori (2016) and set the elasticity of matches to unemployment equal to the bargaining power of workers: $\epsilon = \eta = 0.6$. The exogenous separation rate is $\lambda^x = 0.025$. The parameter values for work disutility $\nu = 0.243$, matching efficiency $\chi = 0.4544$, and firing cost $F = 0.275$ are chosen to hit the following steady-state targets: a job-finding rate of $q = 0.6$, an overall separation rate of $\lambda^{tot} = 0.036$, and an unemployment rate of $U = 0.09$. We set unemployment benefits to $b = 1.1$ in order to match a replacement rate of $b/\tilde{w} = 0.6$. Finally, the vacancy posting cost is set to $\kappa = 0.12$ to have a ratio of posting cost to average wage of roughly 6.5 percent in steady state.

The rest of the model's parameters follows standard trade models. A fixed exporting cost of $f_X = 0.0032$ leads to a share of exporting firms of 25 percent in the steady state. The iceberg transportation cost τ is set to 2.63 to have a trade-to-GDP ratio of 0.1. Following Cacciatore and Fiori (2016), entry cost f_E are equal to 5. In order to have a quarterly steady-state exit rate of 1 percent, fixed operational costs are set to $f_D = 0.0152$.

5 Counterfactual experiments

We are using the calibration of the model to study *i*) the role of labor market institutions and *ii*) the role of slackness. The former experiment accounts for the fact that the trade shock in Germany was accompanied by adjustments in labor market institutions. We are simulating a simultaneous change in both iceberg transportation costs and firing costs to see how the adjustment paths of different outcome variables depend on labor market institutions. The latter experiment is an assessment of the role of endogenous firm selection, which we added to the model of Cacciatore (2014). Iceberg transportation costs in our applications jump to the new level, which is 10 percent lower than the initial steady state level. The experiment is similar to the scenario studied by Cacciatore (2014) but their simulations allow for some slackness in the adjustments of iceberg transportation costs. The respective parameter is changing stepwise until the 10 percent reduction of iceberg transportation costs is reached after some periods. The authors compare this benchmark scenario to the results when iceberg transportation costs adjust without slackness, which is our benchmark scenario. The positive effect of trade on unemployment in their model become very small without slackness. Only a constant fraction of plants exit the market within each period, which mitigates the negative employment effects at the extensive margin.

This explains why there is only a rather modest effect of trade on unemployment without endogenous firm selection. Assuming slackness in the adjustment of iceberg transportation costs spreads the immediate effect of trade liberalization to more periods, which fosters the effects at the extensive margin resulting into a much more pronounced increase in unemployment in the short run. The overshooting of firm exit due to endogenous selection in our model magnifies these effects associated with much stronger effects on unemployment in the short-run. Thus, we don't need slackness to generate positive unemployment effects in the short-run. The simulation shows that slackness further magnifies these effects by postponing entry. More firm-exit with lower firm entry boosts unemployment in the short-run.

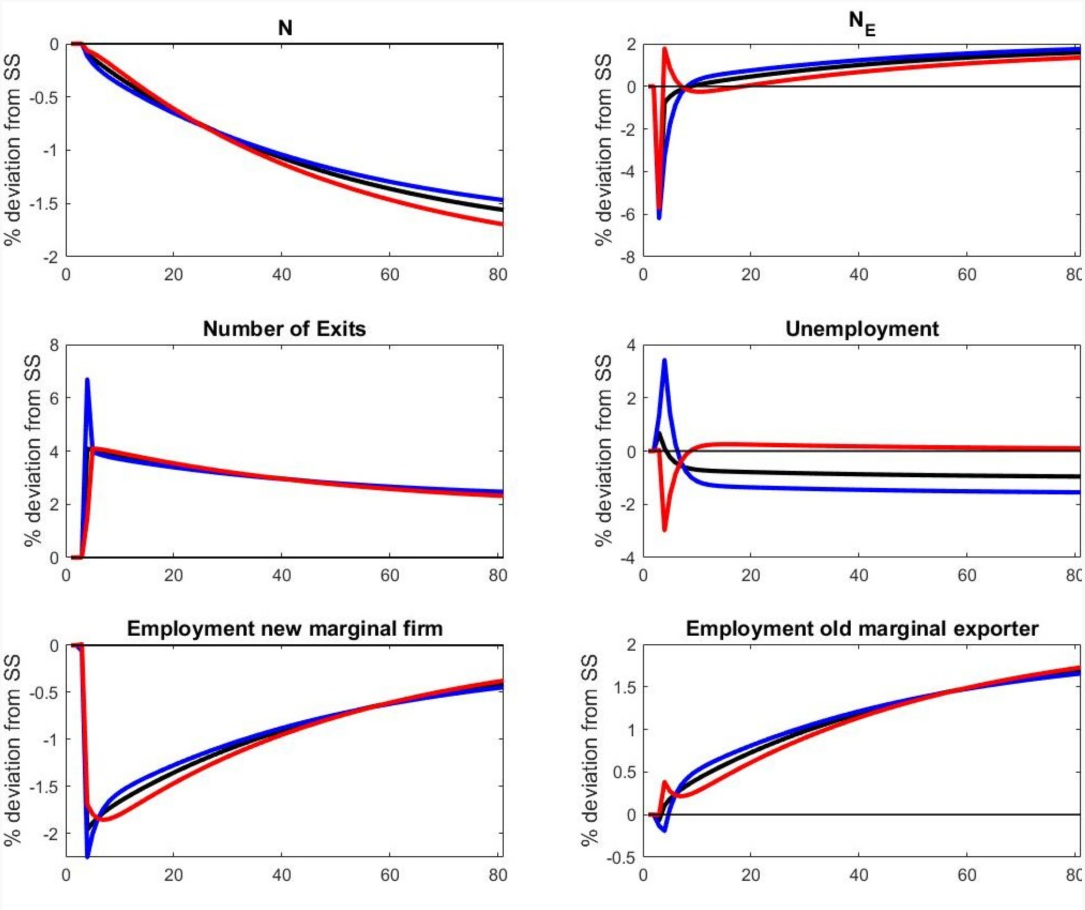
5.1 Simulation I: Interaction between trade liberalization and labor market institutions

At the extensive margin, trade liberalization reduces the number of firms in the market by 1.5 percent in 20 years. Lower firing costs attenuates firm selection in the long run as depicted by the blue line. However, firm selection due to trade liberalization is also stronger in the short run, which can be explained by stronger competition. More productive firms adjust much faster by hiring even more workers at the extensive margin, which erases expected future profits by less productive firms much faster than compared to the benchmark trade liberalization scenario. Lower firing costs accelerate the plants' adjustment speed to trade liberalization at both the extensive and intensive margin.

Moreover, lower firing costs also attenuate firm entry. With lower firing costs, less firms enter the market right after the shock but there is a recovery in the medium-run. After about one year, the blue entry curve intersects the benchmark entry curve. Both curves are approaching comparable steady state levels in the long run. Exits are overshooting in the short-run before bouncing back to a level that is almost similar to the benchmark.

Most interestingly, the rate of unemployment is overshooting in the very short-run by almost 4 percent with lower firing costs. It takes about one year before the positive effects of trade on unemployment start reducing unemployment. The long-run unemployment rate is even below the benchmark unemployment rate due to the lower firing costs. The remaining two plots show the adjustments at the intensive margin of the two marginal

Figure 8: Trade liberalization and the role of firing costs



This graph depicts the evolution of the main outcome variables for different firing costs. All simulations start at similar steady state levels. The black line represents the benchmark scenario that simulates a 10 percentage points reduction in iceberg transportation costs without adjustments in firing costs. The blue line simulates the same reduction in iceberg transportation costs but with additional decrease in firing costs by 10 percent. The red line simulates the benchmark trade liberalization scenario with simultaneous 10 percent increase in firing costs.

firms. The least productive firm that survives the shocks reduces employment much more than the least productive plant in the benchmark scenario does. Surprisingly, the marginal exporter does the same, which is again due to more competition from highly productive firms.

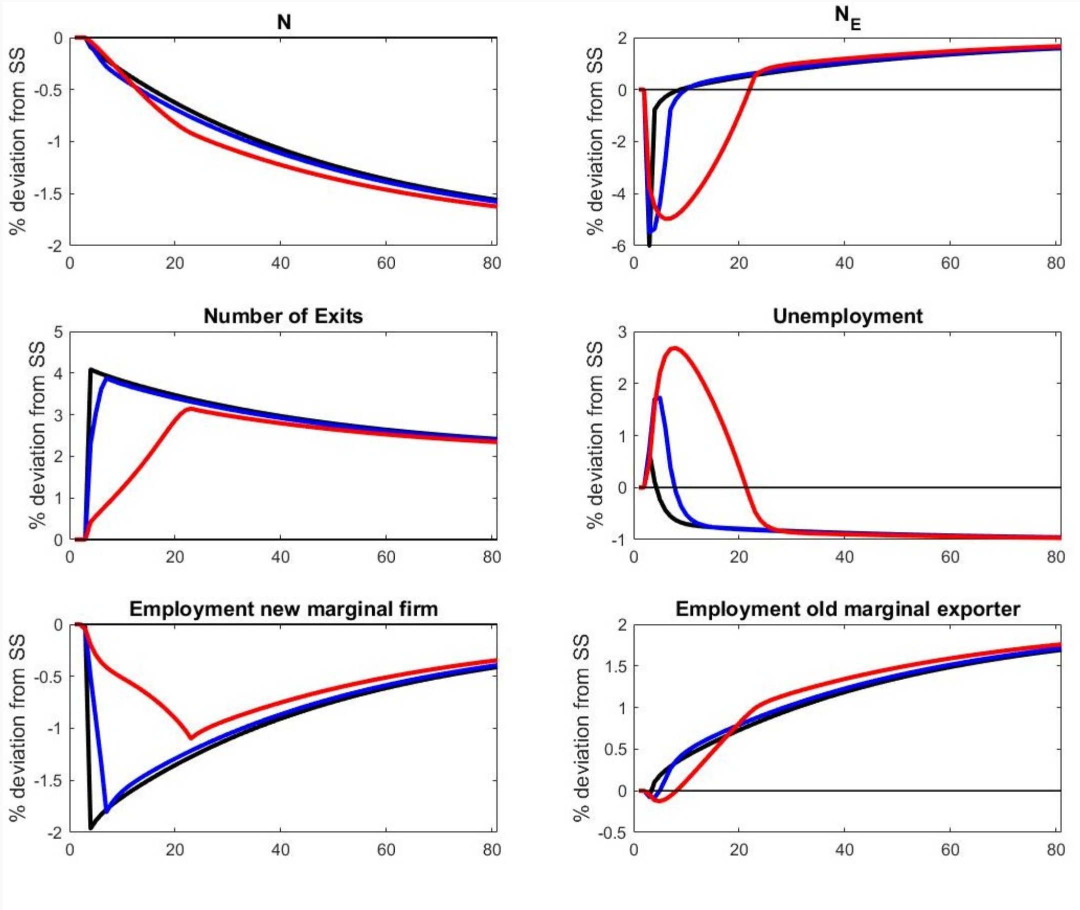
The red line depicts the counter-factual scenario of trade liberalization with higher firing costs. Starting from our benchmark calibration, we reduce iceberg transportation costs by 10 percent and increase firing costs by 10 percent. The higher firing costs slow down the adjustments in the short-run but firm selection in the long run becomes stronger. There is also less entry in the short-run but the dip is comparable to all other scenarios. Surprising is the result for the number of exits. There are less exits with higher firing costs compared to the scenario with lower firing costs. This result can be explained by the evolution at the intensive margin. Higher firing-costs prevents layoffs at the intensive margin. The competition effect is mitigated by higher firing costs and even the marginal exporting firm is hiring more workers instead of less. Thus, the rate of unemployment is falling in the short-run, which is an unexpected result. However, these immediate responses are offset by the adjustments in the medium- or long run. Additional firm entry increases competition, the less productive firms exit the market and unemployment moves back to its steady state value. The higher firing costs erode the positive trade liberalization effects on unemployment.

5.2 Simulation II: The role of endogenous firm selection

The second counterfactual experiment is an assessment of the role of slackness in trade liberalization. Trade liberalization may take some time, which is irrelevant for the long run impacts as steady state levels are independent of adjustment speeds. However, the short-run effects may differ. In particular adjustments in unemployment react differently depending on the assumptions imposed in the model. Cacciatore (2014) assumes some slackness in the adjustments of iceberg transportation costs.[20] Instead of reducing the respective parameter at once, iceberg transportation costs are falling by constant fractions from period to period. The ten percent reduction in iceberg trade costs is reached after some periods. It is possible to show that more sluggish adjustments of iceberg transportation costs magnify the positive unemployment effects in the short-run. Extending the model to endogenous exit is an important source for the positive unemployment effects. Without slackness in trade liberalization, our benchmark calibration already generates a positive unemployment effect in the short run, which becomes much stronger when lowering the adjustment speed to four periods (blue line) or 20 periods (red line). The employment effects at the extensive and intensive margin become less extreme but more persistent. The peak of the exit rate becomes smaller and the countervailing effects through firm entry are

[20] Cacciatore (2014) simulate a gradual 20 percent reduction in iceberg transportation costs over 25 years.

Figure 9: Stepwise trade liberalization



This graph depicts the evolution of the main outcome variables for three different scenarios. Notice that one year consists of four periods. The black line represents the benchmark scenario: Iceberg transportation costs decrease by 10 percent within one period. The blue line is associated with the simulation of a stepwise trade liberalization over 4 periods through 2.5 percentage points decreases in iceberg transportation costs per period. The red line simulates a rather slow trade liberalization scenario of 0.5 percentage points reduction in iceberg transportation costs over 4× 5 periods.

postponed to later periods. Thus, the negative effects through firm selection and firings are more pronounced due to the prevented/postponed entry. This is why the marginal effect of trade liberalization on unemployment changes from positive to negative when entry rates are recovering after some periods.

Due to our extension, the negative effects on employment are much stronger in the short-run due to the over-shooting of endogenous exits right after the shock. Exits are exogenous in Cacciatore (2014). Hence, this effect does not occur in Cacciatore (2014).

However, the authors also observe an immediate increase in unemployment followed by a permanent reduction in their paper. But this effect is due to the sluggishness of the shock and the resulting postponed firm entries in combination with a constant death rate. Without the slackness, they would not observe this result as their firm exit rate does not change. Instead, in our extension, firm exits do matter and trigger negative employment effects of trade liberalization in the short-run.

6 Conclusion

We present first evidence on the counter acting effects of imports and exports 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.

Moreover, the intensive employment margin is analyzed taking into consideration the Heckman selection problem. We find significant effects of imports from China at the extensive but no effect at the intensive plant margin. There is no evidence that plants systematically adjust their size as reaction to the import shock. However, we find evidence on positive reactions to soaring exports. The export shock works through both the extensive and intensive margin when the Heckman selection problem is accounted for.

A sample-split analysis uncovers non-linear effects of imports on employment decisions of firms. Firms systematically expand and contract employment as response to trade liberalization.

We explain these findings using an extended DSGE framework with endogenous firm selection. The effects of import competition on the intensive employment margin are ambiguous, which explains the insignificant effects in our reduced form analysis. Firms may expand or contract.

Our simulations also shed light on the role of labor market institutions and the adjustment speed of trade liberalization. Lower firing costs magnify the positive effects on unemployment. Less jobs are protected associated with stronger unemployment effects. However, firms expand in the long-run and lower employment protection magnifies the firms' willingness to hire new workers. Thus, decreases in unemployment in the long run are stronger compared to the benchmark scenario. The opposite is true for higher employment protection. More jobs are protected in the short-run but the reduction of unemployment in the short-run is offset by the effects of higher employment protection in the long run. Firms hesitate hiring new workers associated with almost zero effects on unemployment.

Introducing slackness in adjustments of iceberg transport costs brings the simulations closer to the model by Cacciatore (2014). Slackness is needed for obtaining short-run increases in unemployment in response to trade liberalization. We get substantial increases in unemployment without slackness and the effects become much bigger when assuming slackness akin the Cacciatore (2014). The only difference in both simulations is the endogenous firm selection. We conclude that the stronger adjustments at the extensive margin matter for the positive unemployment effects in the short-run.

References

Andolfatto, D. (1996): "Business cycles and labor-market search," *The american economic review*, 112–132.

Autor, D. H., D. Dorn, and G. H. Hanson (2013): "The China Syndrome: Local Labor Market Effects of Import Competition in the United States," *American Economic Review*, 103(6), 2121–2168.

Bernard, A. B., J. B. Jensen, and P. K. Schott (2006): "Survival of the best fit: Exposure to low-wage countries and the (uneven) growth of U.S. manufacturing plants," *Journal of International Economics*, 68(1), 219–237.

Bloom, N., M. Draca, and J. V. Reenen (2016): "Trade Induced Technical Change? The Impact of Chinese Imports on Innovation, IT and Productivity," *Review of Economic Studies*, 83(1), 87–117.

Cacciatore, M. (2014): "International trade and macroeconomic dynamics with labor market frictions," *Journal of International Economics*, 93(1), 17–30.

Cacciatore, M. and G. Fiori (2016): "The macroeconomic effects of goods and labor markets deregulation," *Review of Economic Dynamics*, 20, 1–24.

Cacciatore, M., G. Fiori, and F. Ghironi (2015): "The domestic and international effects of euro area market reforms," *Research in Economics*, 69(4), 555–581.

Dauth, W., S. Findeisen, and J. Suedekum (2014): "The Rise Of The East And The Far East: German Labor Markets And Trade Integration," *Journal of the European Economic Association*, 12(6), 1643–1675.

D'Haultfoeuilley, X., A. Maurelz, and Y. Zhang (2018): "Extremal quantile regressions for selection models and the black white wage gap ," *Journal of Econometrics*, 03(1), 129–142.

Fitzenberger, B., A. Osikominu, and R. Voelter (2005): "Imputation rules to improve the education variable in the IAB employment subsample," FDZ Methodenreport 200503en, Institute for Employment Research, Nuremberg, Germany.

Ghironi, F. and M. Melitz (2005): “International trade and macroeconomic dynamics with heterogeneous firms,” *The Quarterly Journal of Economics*, 120(3), 865–915.

Hauptmann, A. and H.-J. Schmerer (forthcoming): “The China shock and German plant closure,” *Applied Economics Letters*.

Helpman, E., O. Itskhoki, and S. Redding (2010): “Inequality and unemployment in a global economy,” *Econometrica*, 78(4), 1239–1283.

Hethey-Maier, T. and J. F. Schmieder (2013): “Does the Use of Worker Flows Improve the Analysis of Establishment Turnover? Evidence from German Administrative Data,” *Schmollers Jahrbuch*, 133(4), 477–510.

Inui, T., R. Kneller, T. Matsuura, and D. McGowan (2009): “Globalization, Productivity and Plant Exit - Evidence from Japan -,” Discussion paper 09048, RIETI.

Melitz, M. (2003): “The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity,” *Econometrica*, 71(6), 1695–1725.

Merz, M. (1995): “Search in the labor market and the real business cycle,” *Journal of monetary Economics*, 36(2), 269–300.

Reinecke, A. and H.-J. Schmerer (2019): “German Employment Legislation and its Impact on the Trade and Laboor Market Nexus,” *WTO Special issue "Making Globalization More Inclusive: Lessons from experience with adjustment policies"*, 87–110.

Rigby, D. L., T. Kemeny, and A. Cooke (2017): “Plant exit and U.S. imports from low-wage countries,” *International Economics*, 149(C), 27–40.

Rossi, L. (2019): “The overshooting of firms’ destruction, banks and productivity shocks,” *European Economic Review*, 113, 136–155.

Schmitt-Grohé, S. and M. Uribe (2003): “Closing small open economy models,” *Journal of International Economics*, 61(1), 163–185.

Schmucker, A., A. Ganzer, J. Stegmaier, and S. Wolter (2018): “Establishment History Panel 1975-2017,” Fdz-datenreport, 09/2018 (en).

Simoes, A. and C. Hidalgo (2011): "The Economic Complexity Observatory: An Analytical Tool for Understanding the Dynamics of Economic Development," .