How Do Firms Adjust When Trade Stops?*

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Abstract

We investigate how firms adjust to the introduction of sudden, unanticipated, and eventually long-lasting economic sanctions. In 2014, Russia introduced sanctions on imports from Europe, which caused an abrupt negative shock to the food production sector in Lithuania. We find that part-time employment is used as the first shock absorber, followed by full-time employment. Investment reacts immediately but also additionally in the later periods if part-time employment adjustments that proxy for the firm's exposure to the permanence of the shock are large. At the same time, firms dampen shock effects by expanding to other export markets. To rationalize this firm behavior, we provide a theoretical mechanism where forward-looking firms face non-convexities in the labor market along with heterogeneous variable trade costs.

JEL classification: D22, D25, F14, F16, F51

Keywords: economic sanctions, firm adjustment margins, part-time employment, new export markets

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1 Introduction

In the current times of deglobalization and trade wars, governments are increasingly using economic sanctions and company boycotts to influence each others' actions. Some of these sanctions directly target particular foreign firms or economic sectors, which consequently experience unanticipated drops in demand for their products and thus have to adjust how they organize their activities.

When faced with economic sanctions, firms are likely to adjust on a number of dimensions. Such adjustments might interact with each other and involve a substantial degree of heterogeneity as firms are subject to non-uniform adjustment costs and expectations of demand shock severity and permanence. In addition, understanding how firms adjust to economic sanctions and boycotts helps to determine the external validity of the findings of trade liberalization, i.e., by shedding light on whether the trade liberalization-driven adjustments are symmetrically undone when the trade stops.

We look at a unique event in which a major sector of a small open economy lost its main export market for political reasons unrelated to trade or other economic conditions. Following the political tensions in 2014, Russia banned agricultural and food product imports from a number of countries, including those from the European Union (EU). As a consequence, Lithuania's food sector which was highly exposed to the Russian market suffered an unexpected loss in demand. We use a rich firm-level dataset that covers all firms in Lithuania and enables us to comprehensively quantify the adjustment margins.

Our empirical analysis is based on the reduced-form triple-differences estimates for the food manufacturing sector in the Lithuanian economy over 2011-2017. We consider affected firms to be those that had exports of banned products to Russia in 2013. We then compare firm-level responses for the firms affected by Russia's export ban and the control firms in the period after the ban (2014-2017) as compared to the period before the ban (2011-2013). We pick control firms to be from the same sector, of a similar size, and also engaging in exports of their products to countries outside of Russia, thus unaffected directly by Russia's import ban. In this way, the procedure not only takes into account non-time-varying differences between firms but also controls for the general food sector-trends that might have varied across the firms of similar size. Our third difference compares whether the change in change was more pronounced for the affected firms that had a higher share of banned products to Russia as a fraction of their sales and thus were *more* exposed to Russia's import ban, as compared to the change in change in affected firms that were *less* exposed to the import ban.

We find that following the Russian trade ban, affected food manufacturers experienced an immediate drop in part-time employment, a downward adjustment of capital investment, and a delayed drop in full-time employment. An average exposed firm with 6.69% pre-ban share of banned export products in its sales reduced part-time employees by 67% over the pre-period sample mean of 14.5 part-time employees and full-time employees by 6.8% over the pre-shock period average of 378.5 full-time employees in treated firms in 2013. The affected firms also experienced a drop in investment and a rise in the exports to the rest of the world, destinations which can be seen as a proxy for revenue-increasing strategies exploited by manufacturers affected by the sanctions. Yet this did not lead to the complete recovery of the profits for the affected firms, at least over the horizon we analyze.

Motivated by these empirical findings, we set up a stylized theoretical framework on firm optimal adjustment that delivers further predictions. Firms produce output using capital and two different types of labor (full-time and part-time). We then suggest a cost minimization problem when firms face no adjustment costs for part-time labor, non-convex adjustment costs for full-time labor, and temporal rigidity when adjusting for capital.

Following a simplified version of Helpman et al. (2010), our firms export their products in addition to selling on a domestic market. We deviate from Helpman et al. (2010) by allowing firm-specific variable trade costs that reflect varying exporting efficiency, such as efficiency in transporting goods, accessing customs, and managing a distribution network. Furthermore, we consider two foreign markets, i.e., Russia and the rest of the world.

We show that firm choices are determined by their input adjustment frictions and heterogenous trade costs with foreign markets outside of Russia. Our stylized mechanism captures smooth capital decline if business prospects deteriorate and a jumpy reaction in labor when absorbing the unexpected sanctions. While part-time employment is generally the first shock absorber, depending on the magnitude of the shock, firms may start adjusting full-time employment, and if the shock is persistent and strong, also engage in more exports to the rest of the world.

We establish that the scope of other adjustments can be expressed in terms of the part-time employment margin, which serves as a proxy for the severity of the shock. In particular, capital investment is predicted to drop more, the larger the part-time employment adjustment. Similarly, the layoffs of full-time labor and the increase in the share of exports to the rest of the world are more likely if the shock is large and persistent and the part-time employment adjustment is sizable.

Our empirical findings are in line with the interpretation provided in our theory that part-time employment, as the most flexible margin, is adjusted first, and may precede further, costlier changes. More importantly, food manufacturers that in the short term reduced part-time employment relatively more, later reduced capital investment and laid off full-time employees. These results suggest that firm adjustment on the most flexible margin can capture its expected permanence of shock when such heterogeneity is not directly observable.

Taken together, these findings suggest that at times of global uncertainty, open economies need even more flexible labor regulations allowing for an array of different work contracts. Policymakers should also increase efforts to reduce reliance on a single trade partner. Some examples of potential policies are the provision of state subsidies for the search of and expansion of trade into new export markets, or the creation of export promotion agencies that would facilitate trade with less familiar destinations by reducing the information asymmetries for potential exporters; these measures would reduce the exporting costs for firms and would thus help to mitigate the negative shock effects.

Our paper contributes to several streams of literature. In broad terms, our paper belongs to the literature analyzing negative trade shocks and their economic consequences on different firms. With our empirical setting, we are able to overcome the identification challenge that many international trade barriers, which lead to substantial negative demand shocks, are likely to be correlated with the other more direct macroeconomic adjustments. For instance, they could be linked to changes in domestic worker wage expectations and labor supply. Technological shocks can also trigger alterations to trade agreements but are also likely to lead to demand changes directly or through the production function recompositions. In our case, rather than observing a trade shock stemming from a trade-agreement, tariff change or currency depreciation, we study a complete trade ban, i.e., limiting the exports of a range of products to a particular destination country, which is unlikely to be related to Lithuanian domestic economy or its other potential export markets. As we have detailed micro-level data on the affected firms, we can identify the magnitude of firm-level responses based on the variation of shock size across the firms.

We exploit the trade shock to provide the evidence on which adjustments firms adopt when they are faced with the drop in demand for their production. Contrary to a one-dimensional focus as in Hogan and Ragan (1995), Mouelhi (2007), Fabiani et al. (2015), Asquith et al. (2019), Tanaka et al. (2019), Caggese et al. (2019) and Baghai et al. (2021) who analyze labor margin adjustments, or Kee and Krishna (2008), Bernard et al. (2009), Morales et al. (2019), Eaton et al. (2022) who are interested in trade adjustments, we study multiple (competing) adjustment margins, somewhat similar to Bernard et al. (2006), Eslava et al. (2010), and Bertola et al. (2012). While Bernard et al. (2006) track manufacturing activity reallocation and product-mix changes, Eslava et al. (2010) and Casacuberta and Gandelman (2012) are looking at employment and capital adjustments, and Bertola et al. (2012) analyze price versus cost and wage versus employment adjustments, we analyze how firms change their full-time and part-time labour, investment, and new market selection choices after the trade shock.

Our paper is also related to a strand of literature discussing trade liberalization effects on the labor market (e.g., Dix-Carneiro and Kovak (2019), Dix-Carneiro (2014), Caliendo et al. (2019), Dix-Carneiro et al. (2023). Yet while these papers mostly look into general equilibrium effects and cross-industry or inter-regional adjustments of the labor market, we take a look at the adjustments within a firm and uncover part-time vs. full-time relationship, providing more granular evidence on the scope and the extent of the adjustments. With this, we abstract from general equilibrium implications in our model and only look into intra-firm adjustments. We also allow for other margins, in addition to labor, to play a role. Finally, a stark difference of our paper from the above-mentioned literature is the nature of the shock: trade liberalization is typically considered as a negative cost-push shock, provided that reduced tariffs result in higher international competition in the domestic market. In our case, the sanctions of international trade ban is a demand shock to the producers.

We also go a step further by trying to provide the mechanism responsible for these adjustments. Our approach is thus similar to Levchenko et al. (2010), who find compositional effects and the use of intermediate inputs being responsible for the largest trade drops, Matsuura et al. (2011) who find adjustments being dependent on firm's revenue volatility, Bricongne et al. (2012) who show the role of financial frictions and firm size, and Iacovone et al. (2013) who find that plant size affects its performance after shock. In our case, firm-specific labor and capital intensities, and the nature of labor and capital adjustment costs are the key drivers in firm responses to the trade shock.

Finally, we make a contribution to the literature on the topic of trade bans, or, more generally, severe trade restrictions. This literature has been expanding recently, reflecting the new era of geopolitical tensions across countries. Earlier work includes the meta-analysis of the sanction effects (Siddiquee and van Bergeijk 2012), the estimates of macroeconomic, political and firm-level effects of trade restrictions with Iran (Dizaji and van Bergeijk 2013, Haidar 2017), and effects on Danish firms in the aftermath of the Danish cartoon crisis (Hiller et al. 2014, Friedrich and Zator 2019). More recent research discusses the macroeconomic effects of China–US trade war (e.g., Fajgelbaum et al. (2019), Amiti et al. (2020a,b), Flaaen and Pierce (2020), He et al. (2021), Fajgelbaum et al. (2021), Fajgelbaum and Khandelwal (2022)), the Russian economic countersanctions in 2014 (e.g., Bělín and Hanousek (2021), Dong and Li (2018), Chowdhry et al. (2022)), and the sanctions on Russia that followed the invasion events of 2022 (e.g., Hausmann et al. (2022), Itskhoki and Mukhin (2022) and Mamonov and Pestova (2023)).

Despite this evidence on the macroeconomic responses, relatively few studies report firm-level responses to the trade bans and other sanction incidents, although the literature has been growing more recently (Crozet and Hinz (2020), Crozet et al. (2021), Deng et al. (2022), Ahn and Ludema (2020), Nigmatulina (2022), Huynh and Hoang (2022), Efing et al. (2023)). Typically, these studies abstract from uncovering the endogenous micro-level adjustment mechanisms within firms, which we aim to do in our paper.

2 Motivation

2.1 Trade Shock and Data

The negative trade shock that we analyze is Russia's import ban of agricultural and food products as well as certain raw materials from the EU, the United States (US) and some other countries in 2014.[1] The ban came as a result of the political tensions between Russia and the EU and was not related to economic reasons. In particular, in response to the Russia-Ukraine conflict, in February 2014, the EU, the US, and a few other Western countries introduced non-trade (primarily, financial) sanctions against certain Russian individuals and entities responsible for violating the sovereignty and territorial integrity of Ukraine.[2]

[1] The full list includes the countries of the EU, the US, Switzerland, Canada, Australia, Norway, Ukraine, Albania, Montenegro, Iceland, and Lichtenstein. More information about this decree is available at: https://ec.europa.eu/food/horizontal-topics/international-affairs/eu-russia-sps-issues/russian-import-ban-eu-products_en.

[2] Ahn and Ludema (2020) provide a detailed list of related EU Council and US White House decrees, that also list the sanctions against state-owned enterprises (Ahn and Ludema (2020); Nigmatulina (2022)) and banks (Mamonov et al. (2023)).

In August 2014, Russia responded by imposing import restrictions on a number of agricultural and food products from these countries. The range of products subject to Russian import restrictions mainly included meats, dairy products, fruits, and vegetables.[3] These import restrictions were initially introduced for one year but they have been extended annually since their adoption, and thus it is likely that at some point they started to be perceived as near-permanent.

This shock was particularly important to Lithuania, a small open economy, and a member of the EU, as Russia has been one of the most important trade partners for Lithuanian agricultural and food product exports. In 2013, 20% of Lithuanian exports were directed to Russia. Around 18% of them contained banned product exports. Since Lithuania is a small open economy and exports make 80% of its GDP, a shock to the exports to Russia was a significant event, especially for industries exporting a considerable amount of banned products. As shown in Table 1, in 2014, the year of the ban, exports of banned products to Russia shrunk by 38% (the ban was imposed in August) and by another 89% in 2015. Exports of all products to Russia decreased by 7% in 2014 and by another 27% in 2015, thus the ban affected a considerable proportion of the country's exports.[4]

We use a detailed firm-level dataset from Statistics Lithuania. The data consists of the whole population of food manufacturing firms in Lithuania[5] over 2011 to 2017. This time window provides us with enough power to study the adjustment margins and their dynamics over time for up to four years after the event while controlling for the trends prior to the event. The dataset covers firm balance sheet and income statement variables at a rather disaggregated level, as well as firm-level employment characteristics. Crucially, it

[3] The complete list of banned product codes is given in the Appendix A, Table A1.

[4] Across Lithuanian firms, the ten most affected products (based on 8-digit HS codes) were: Cheese and curd; Milk and cream, not concentrated, not containing added sugar; Milk and cream, concentrated or containing added sugar Meat of bovine animals, fresh or chilled; Prepared or preserved fish, caviar; Whey and products consisting of natural milk constituents; Apples, pears, and quinces; Citrus fruit; Fruit; Vegetables.

[5] Based on Eurostat data, Lithuanian firms compare similarly to the rest of the EU in terms of the margins we study in this paper. Average part-time and full-time employment is right at the median of EU-28 sample in 2013. In fact, an average Lithuanian food manufacturing firm (that includes exporters and non-exporters) in the food manufacturing sector has slightly more employees than the average firm in the EU.

Table 1: Firm exports and the exposure to the trade ban from Russia

	Total Economy	**Food Manufacturing**
Value added, m EUR, 2013	28,727	1,276
Total exports, m EUR, 2013	23,470	1,429
Total exports, % of GDP	81%	5%
Banned exports, m EUR, 2013	887	136
Banned exports, % of Total exports	4%	9%
Banned exports, m EUR, 2014	547	79
Banned exports, y-o-y % change	−38%	−41%
Banned exports, m EUR, 2015	61	5
Banned exports, y-o-y % change	−89%	−94%
Banned exports, m EUR, 2016	13	0
Banned exports, y-o-y % change	−79%	−99%

Source: National Accounts Statistics

also includes detailed data on firm-level trade, such as international trade values by 8-digit HS products and destination (source) country exports (imports), allowing us to track which specific firms have been affected by the trade ban.

2.2 Direct Outcomes for Affected Firms

In estimating each firm's direct exposure to this abrupt trade shock, for each Lithuanian firm we look at the pre-ban exports of the banned 8-digit level HS products to Russia. In particular, firm-level exposure to the trade shock is measured by the fraction of firm's sales that were composed of the banned product exports to Russia in 2013, the year before the ban was imposed. Figure 1 shows the dynamics of exports to Russia for the most exposed firms (with exports to Russia constituting over 10% of revenues), less exposed firms (with exports to Russia constituting between 2-10% of revenues), and non-exposed firms (with exports to Russia constituting less than 2% of revenues).[6]

The top left panel of Figure 1 depicts total exports of all products (that include banned

[6] In our further empirical estimations, we consider the continuous treatment with both *more* and *less* exposed firms considered as treated firms and non-exposed firms considered as the control firms.

and non-banned products) to Russia for these firms. We see a significant drop of exports for the firms exposed to the shock. The partial effect is already observed in 2014, when the ban was imposed in August, while the full change can be seen in 2015. Moreover, these drops in exports are reflected in the overall decrease in the affected firms' sales, suggesting that the demand shock for these firms was indeed considerable. As shown in the top right panel of Figure 1, affected food manufacturers experienced a sharp drop in the overall sales but later also showed some recovery. The drop in overall sales also suggests that the venting-in effect was limited, i.e., the drop in exports was not replaced by a respective increase in the domestic sales. We also confirm that in the bottom panel of Figure 1, which plots the dynamics of revenues from outside of Russia.

This observation of different exposure to the shock will be our key identifying variable in the empirical analysis and also one of the guiding inputs in building our theoretical framework.

3 Empirical Analysis

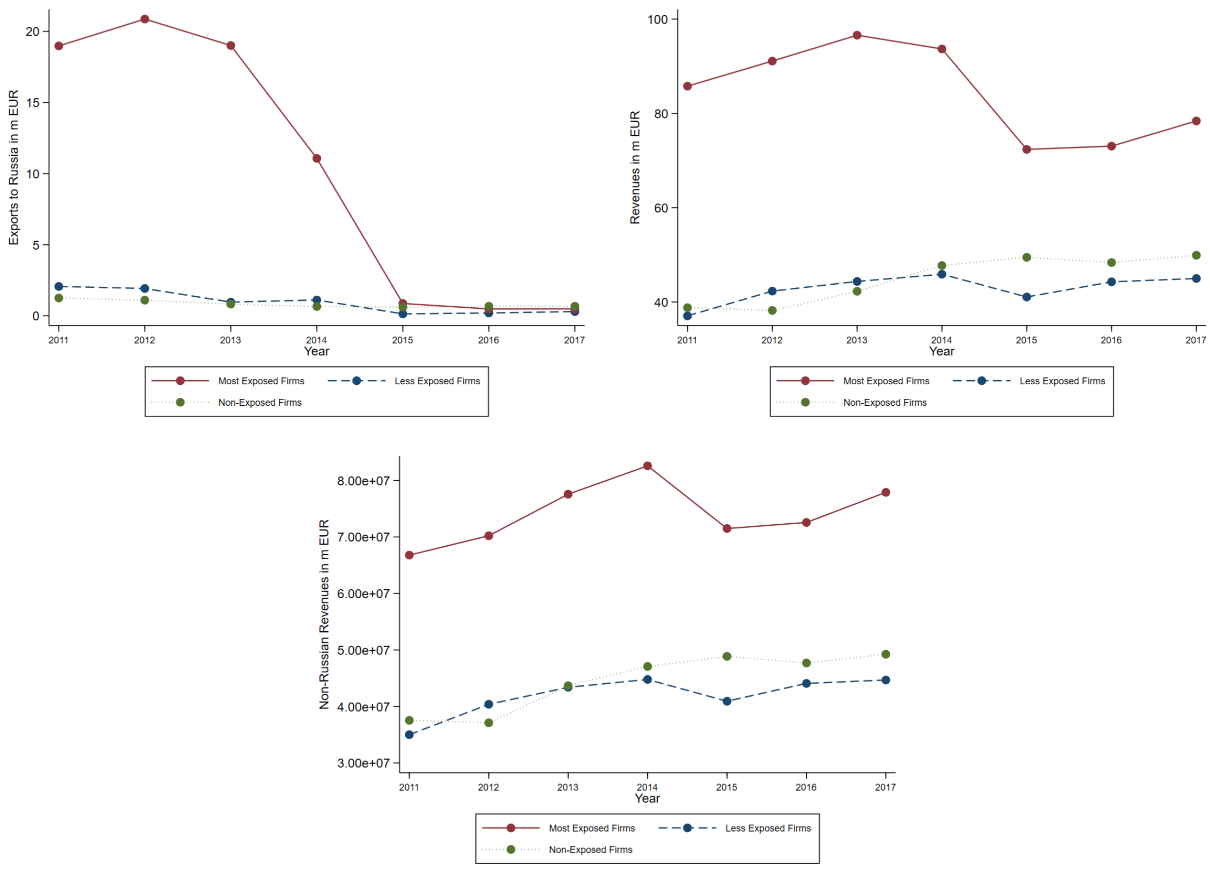
3.1 Reduced-form Identification

We start with the reduced-form analysis that provides causal evidence on the Russian ban's impact on Lithuanian food exporters. In particular, we match the export-level data to the balance sheet data and employ a reduced-form difference-in-differences identification strategy to identify the effect of how these firms have adjusted to the negative trade shock.

We define the period of 2011-2013, which precedes the export ban, to be *pre-period*, and the period of 2014-2017, which follows the export ban, to be *post-period*. Our treatment group consists of firms that had banned-product exports to Russia in 2013. We have 25 such treated food manufacturers in Lithuanian economy.[7] For each of these treated firms we

[7]While this number might appear small, it does correspond to the whole population of affected firms. If anything, low power sets us against establishing statistically significant effects.

Figure 1: Exports to Russia, Total Revenues, and Revenues from Outside of Russia



Notes: The top left figure plots the dynamics of all exports to Russia by food manufacturing firms. The top right figure plots the dynamics of overall revenues by food manufacturing firms. The bottom figure plots the dynamics of revenues from outside of Russia by food manufacturing firms. The solid red lines represent the firms with high pre-2013 exposure of exports to Russia (with exports to Russia constituting over 10% of revenues), the dashed blue lines represent the firms with low pre-2013 exposure of exports to Russia (with exports to Russia constituting between 2-10% of revenues), the dotted green lines represent the average for all food manufacturing firms in the economy (with exports to Russia constituting less than 2% of revenues). The ban of exports to Russia is effective as of August 2014, therefore the annual value of exports to Russia in 2014 features a considerable fall but not an immediate drop to zero. The exports to Russia go down to nearly zero in 2015 and beyond.

choose a control firm (with replacement) that satisfies the following criteria: (a) the control firm is also in the food manufacturing sector; (b) it is an exporter but does not have banned-product exports to Russia in 2013[8]; and (c) of all the candidate firms satisfying (a) and (b), it is the closest one in terms of size to the focal treated firm, as measured by total sales in

[8]Imposing an additional restriction that the control firms do not export to Russia in 2011 and 2012 does not change the matches between the firms.

2012.[9] By stable unit treatment value assumption (SUTVA), we consider that control firms are not affected by the treatment. That is, any spillover effects of, e.g., lower sales of control firms because treated firms now compete more aggressively in the domestic markets,[10] only contributes to underestimating the effects of our interest.

Given likely heterogeneity across firms, we impose these criteria to make sure that before the event, the treated and control firms are as similar as possible. As reported in Table 2, when we compare matched pairs in the pre-period of 2013, the treated firms appear smaller than control firms in terms of sales but larger in terms of the number of employees. Nevertheless, these differences are not statistically significant. We also compare the changes in these variables from 2012 to 2013 and find no statistically significant differences between treated and control firms, thus suggesting no apparent differences in the pre-existing trends.

Table 2: Balance checks of matched pairs

	Treated	**Control**	**Difference**	**Pairs**
Sales, m EUR, 2013	55.5	60.8	−5.3	25
Δ Sales, m EUR, 2013-2012	3.5	4.9	−1.4	25
Full-time employees, 2013	378.7	282.8	106.6	25
Δ Full-time employees, 2013-2012	10.5	26.2	15.8	25
Part-time employees, 2013	14.5	3.8	10.7	25
Δ Part-time employees, 2013-2012	−9.2	0.7	−9.9	25
Fixed assets, m EUR, 2013	9.6	15.1	−5.5	25
Δ Fixed assets, m EUR, 2013-2012	−0.6	3.4	−4.0	25
Total exports, m EUR, 2013	25.9	29.8	3.9	25
Δ Exports to Russia, m EUR, 2013-2012	0.9	1.6	−0.7	25
Exports to Russia, m EUR, 2013	6.4	0.9	5.5***	25
Δ Exports to Russia, m EUR, 2013-2012	−0.9	−0.4	0.5	25

This table shows the mean values of firm characteristics for the two groups of firms in 2013. ***, **, and * refer to the statistical significance at 1%, 5%, and 10%, respectively.

As firms are likely to vary in terms of their exposure to the sanctions, we rely on *Banned*

[9]We apply the matching technique with replacement and the number of distinct control firms is 19. We perform robustness tests and also provide results for matching without replacement.

[10]As per Figure 1, such venting-in was, however, limited. Another concern could be the change in the inter-firm trade between treated and control firms. While we do not have access to the detailed inter-firm trade data, we do not see that the control firms differentially increase domestic sales that include inter-firm trade between treated and control firms. We also do not find that the control firms raise more financial loans or equity capital that could explain the differences in the growth trajectories.

export share to identify the exposure to Russia's ban. *Banned export share* is defined as the fraction of the firm's revenue from exports of the banned products to Russia in 2013 to the total revenues of the firm in 2013. We then study whether the food production firms that had a larger fraction of their sales exported to Russia in 2013 experienced changes across different adjustment margins in 2014-2017 as compared to 2011-2013, and whether such changes had larger magnitudes than those experienced by the corresponding firms with a smaller fraction of their sales exported to Russia in 2013.

We investigate the following adjustment margins: the number of part-time employees,[11] the number of full-time employees, the dollar value of investment, measured as a change in fixed assets, and the change in exports to the rest of the world. We set up the specification at the firm-match × year level. That is, we take differences between treated firm values and control firm values, and investigate whether these differences become larger after the Russian ban.[12] The identifying parallel trends assumption is that in the absence of the Russia's ban the differential in the outcomes of firms that exported to Russia and firms that did not export to Russia prior to 2013 would have trended similarly after 2013 (Olden and Møen 2022). Given the continuous treatment we adopt in the paper, we rely on an even stronger assumption that high $Banned\,export\,share_i$ firms would have trended the same as low $Banned\,export\,share_i$ firms in the absence of the Russia's sanctions (Callaway et al. 2021), i.e., that other differences between high $Banned\,export\,share_i$ firms relative to low $Banned\,export\,share_i$ do not explain the differences in reaction. We then estimate a reduced form triple-differences specification:

$$\Delta Y_{i,t} = \beta_1 \times Banned\,export\,share_i \times Post2014_t + \gamma_i + \tau_t + \epsilon_{i,t}. \quad (1)$$

[11]The standard full-time employment contract in Lithuania is 40 hours per week; and thus part-time employees are defined as those who have fewer than 40 weekly hours defined in their labor contract. The Structure of Earnings Survey for Lithuania reveals that in October, 2014, part-time employees on average worked 17 hours a week while full-time employees worked 40 hours a week.

[12]Alternatively, we could set up an equivalent panel structure at the firm × year level, and identify the effects via the triple interaction *Treated* × $Banned\,export\,share_i$ × *Post*. For the ease of interpretation, we prefer the specification (1) at the firm-match × year level that only requires us to have $Banned\,export\,share_i$ × *Post*. That lets us avoid quadruple interactions when we further explore the heterogeneity of our effects.

In this specification, $\Delta Y_{i,t}$ refers to the difference in the adjustment margin $Y_{i,t}$, where the difference is taken between the values of a treated firm i and its matched control firm in a particular year t. $Banned\,export\,share_i$ refers to the fraction of firm i's sales of the banned products that it exported to Russia in 2013 over the total sales of firm i in 2013. $Post2014_t$ refers to the dummy equal to 1 in the years 2014-2017 and equal to 0 in years 2011-2013. γ_i and τ_t denote the match- and year-fixed effects. The identification thus relies on the variation in $Banned\,export\,share_i$ across treated firms in 2013.

In other words, we study whether the food producers that had a larger $Banned\,export\,share_i$ experienced changes in adjustment margins $Y_{i,t}$ in 2014-2017 (a) as compared to their average $Y_{i,t}$ over 2011-2013, (b) as compared to the respective changes in $Y_{i,t}$ in control firms, and (c) as compared to the respective changes in changes in corresponding firms with a smaller $Banned\,export\,share_i$. This estimation thus not only controls for non-time-varying differences between firms but also controls for general sectoral-trends that might have varied across the firms of similar size.

As some adjustments might be delayed due to the uncertainty about the permanence and the scope of the sanctions, in our analysis we also estimate a specification that studies dynamic adjustments, where we add another dummy in the middle of our post period (i.e., after 2016):

$$\begin{aligned}\Delta Y_{i,t} = & \beta_1 \times Banned\,export\,share_i \times Post2014_t + \\ & \beta_2 \times Banned\,export\,share_i \times Post2016_t + \gamma_i + \tau_t + \epsilon_{i,t}.\end{aligned} \tag{2}$$

Compared to the specification (1), here we separately estimate the additional adjustment that happened in years 2016-2017, over the general adjustment in 2014-2017. That is, $Post2016_t$ refers to the dummy equal to 1 in the years 2016-2017 and equal to 0 in years 2011-2015, while as before, $Post2014_t$ refers to the dummy equal to 1 in the years 2014-2017 and equal to 0 in years 2011-2013. All other variables are defined as in specification (1).

3.2 Findings

In this section we report the results from the empirical analysis. We separately discuss the results on labor market, investment, and revenue-increasing strategies.

3.2.1 Labor Market

We start with the number of employees and report results in Table 3. We report the results separately for part-time and full-time employees, and also split our treatment effect into the overall effect after year 2014 and the additional effect after 2016.

Table 3: Number of employees

	(1)	(2)	(3)	(4)
	Part-time employees		Full-time employees	
Banned export share x Post 2014	-146.909***	-125.123**	-384.578**	-128.022
	(50.223)	(48.105)	(177.502)	(159.867)
Banned export share x Post 2016		-56.133		-661.058**
		(52.725)		(314.478)
Constant	24.411***	24.378***	141.696***	141.306***
	(4.478)	(4.474)	(16.923)	(17.150)
R^2	0.755	0.757	0.953	0.956
N	151	151	151	151

Notes: This table shows the effect of the Russian ban on the number of employees in Lithuanian food manufacturing firms over 2011-2017. For each *treated* firm that exported any banned products to Russia in 2013, we assign one *control* firm that is a food exporter, and is closest in size (as measured by total sales). The dependent variable is then the difference in the number of either part-time employees (Columns 1-2) or full-time employees (Columns 3-4) between the treated and control firms. ***, **, and * refer to the statistical significance at 1%, 5%, and 10%, respectively.

We see the statistically significant adjustment for both part-time and full-time employees. We see that for the part-time employees, the effect is immediate, i.e., there is no statistically significant effect after 2016. For an average exposed food manufacturing firm with 6.69% of revenues coming from the banned product exports to Russia in 2013, the number of part-time employees dropped by an average of 9.76 (compared to the change in control firms), which constituted a 67% drop over the sample mean of 14.48 part-time employees in treated food manufacturing firms in 2013. Such an economically large depletion in the number of employees suggests that the shock perceived by the firms was substantial as they had significantly depleted their most flexible margin.

When we look at the full-time employees, we see that the adjustment is delayed. That is, the effect is not immediate but rather appears in years 2016-2017. In terms of the economic effect for an average exposed firm with 6.69% of revenues coming from the banned product exports to Russia in 2013, the number of employees dropped by an average of 25.9, constituting a 6.8% drop over the sample mean of 378.5 employees in treated firms in 2013. Taken together with our findings on the adjustment of part-time employees, these results suggest that firms lay off part-time employees first and then when they realize the actual magnitude of the shock, its permanence, or the lack of adjustment in terms of revenue-increasing strategies, they consequently reduce the number of full-time employees.

Note that while the number of treated firms, and thus the number of observations over which we estimate the effects, could appear small, the effects are estimated over the whole population of the directly affected food manufacturers in the Lithuanian economy. Further, the fact that we are able to get statistically significant results with limited power ascertains the precision of the effect.

3.2.2 Robustness

We perform several robustness tests. First, in Appendix Table B1, we show that the results are consistent if we consider hours worked rather than the number of employees.

Second, instead of a continuous variable as in Table 3, we consider a binary treatment $High\,banned\,export\,share$, based on the median value of $Banned\,export\,share$, which is 3%.[13] We report the results in Appendix Table B2 and find stronger results in terms of statistical significance. The binary treatment addresses some of the concerns about the strong assumptions behind difference-in-differences estimates with a continuous treatment raised in, e.g., Callaway et al. (2021).

[13] Assigning different thresholds such as 4%, 5%, and 6% does not affect our results.

Third, we provide robustness for our matching procedure of treated and control groups. We perform four robustness checks. First, in Appendix Table B3 we consider four closest controls to our treated firms (Abadie and Imbens (2011)) based on their sales rather than one in our baseline estimates. Second, in Appendix Table B4 we follow entropy balancing approach (see, e.g., Hainmueller (2012)) by re-weighing our sample where the first two moments of distributions of firm sales are balanced across the treated and control group in 2012. Third, in Appendix Table B5 we provide a propensity score matching estimator based on sales, export share and profitability. Fourth, while in the baseline matching procedure we match with replacement, in Appendix Table B6 we also perform matching without replacement.

Fourth, we go further with providing robustness to our matching procedures. In our baseline estimates, we consider all three types of firms as our controls: (a) those that export to Russia but export non-banned products, (b) those that export the same products as banned firms but do so to other countries than Russia, and (c) those that export outside of Russia and export non-banned products. One concern could be that Russian economy has been experiencing a demand shock that is not related to sanctions and our control group that includes the firms that export to Russia but export non-banned products could reduce their exports as well and thus we might be underestimating the effect of sanctions. As shown in Appendix Tables B7, B8, and B9, respectively, the effects are very similar if we consider each of these control groups separately and in particular if we limit the control group to those that export to Russia but export non-banned products and thus should be also facing demand shocks unrelated to sanctions. In Appendix C we further analyze this concern and investigate a similar export sector that did not face sanctions: beverage manufacturers. In Appendix Tables C1 and C2, we do not see the corresponding adjustment for beverage manufacturers as we see for food producers.

Fifth, in the main analysis we do not condition on the firms surviving until 2017. In

Appendix Table B10, we exclude two firms that do not survive until 2017.[14]

Sixth, we leave out one firm at a time to investigate outlier effects but we do not find that excluding any single firm changes the statistical significance of the earlier effect on part-time employees and delayed effect on full-time employees (these results are available at request).

3.2.3 Investment

While part-time and full-time employees represent the adjustments of the labor input, we also look at the adjustment of capital. We proxy the adjustment of capital by the change in investment, which we define as the annual change in the fixed assets, adjusted for depreciation. As shown in Table 4, we see a drop in investment; the effect is immediate and does not reverse in the longer term.[15]

The economic effect for an average exposed firm with 6.69% of revenues coming from the banned product exports to Russia in 2013 is the drop in fixed assets of 1.63 m EUR, constituting approximately a 17% drop over the sample mean of 9.6 m EUR in treated firms in 2013.

3.2.4 Revenue-Increasing Strategies

Finally, we study revenue-increasing strategies. In particular, we look at whether the affected firms increased their sales from exports to countries outside of Russia. We report results in Table 5, where we see a rise in the dollar value of exports. While we document an immediate positive effect, the effect is only statistically significant with a longer lag, suggesting that when we split the effect into two periods, the later period effect dominates. These results could be interpreted as suggesting that reaching new export markets requires a longer time and larger trade costs.[16]

[14] These two firms have slightly higher $Banned\,export\,share_i$ than the surviving firms, although differences are not statistically significant.

[15] Here and also in Section 3.2.4, we perform similar robustness checks as those reported for part-time and full-time employees in Appendix Tables B2-B10, and we find consistent results.

[16] Note that not only the Lithuanian food manufacturers but also the manufacturers from other EU countries were affected, and so such excess supply at the EU level might have contributed to larger search costs

Table 4: Investment

	(1)	(2)
Banned export share x Post 2014	-24.459**	-26.798*
	(11.235)	(13.657)
Banned export share x Post 2016		6.103
		(14.727)
Constant	-0.926	-1.274
	(1.609)	(1.772)
R^2	0.596	0.597
N	126	126

Notes: This table shows the effect of the Russian ban on the investment in fixed assets in Lithuanian food manufacturing firms over 2011-2017. For each *treated* firm that has exported any banned products to Russia in 2013, we assign one *control* firm that is a food exporter, and is closest in size (as measured by total sales). The dependent variable is the difference in the investment between the treated and control firms (in 1 million euros). ***, **, and * refer to the statistical significance at 1%, 5%, and 10%, respectively.

The economic effect for an average exposed firm with 6.69% of revenues coming from the banned product exports to Russia in 2013 is the increase in exports outside of Russia of 3.1m EUR, constituting approximately a 16% increase over the sample mean of 19.5 m EUR in treated firms in 2013.

Table 5: Exports outside of Russia

	(1)	(2)
Banned export share x Post 2014	46.042**	19.626
	(20.687)	(24.308)
Banned export share x Post 2016		54.657*
		(30.436)
Constant	-9.581***	-9.566***
	(1.799)	(1.807)
R^2	0.889	0.892
N	165	165

Notes: This table shows the effect of the Russian ban on dollar value of exports outside Russia in Lithuanian food manufacturing firms over 2011-2017. For each *treated* firm that has exported any banned products to Russia in 2013, we assign one *control* firm that is a food exporter, and is closest in size (as measured by total sales). The dependent variable is then the difference in the dollar value of exports, excluding Russia. ***, **, and * refer to the statistical significance at 1%, 5%, and 10%, respectively.

than those that would have otherwise materialized after the single-country-targeted sanctions.

4 Conceptual Mechanisms

In developing the theoretical mechanisms to rationalize our empirical findings, we conceptualize Russia's trade ban as an exogenous shock to the variable trade costs and analyze its effects on various adjustment margins. Notice that an alternative way to model sanctions is via a decrease in Russian demand. However, since demand shifters enter multiplicatively, the two ways are isomorphic, and we stick to a more standard approach. The hit of sanctions varies across firms due to the different exposure to the banned production.

We use a stylized framework with a firm as the ultimate decision maker.[17] We show that even without delving into a fully-fledged general equilibrium – due to very targeted sanctions — we can rationalize the empirical findings by highlighting the main role played by the part-time employment, a flexible shock absorption tier.[18] We refer an interested reader to the Appendix E, where we describe our economic environment, and Appendix F, where we provide detailed derivations. In this Section, we sketch key open economy relationships and then discuss the resulting implications.

4.1 Primitives

We employ a simplified version of the economic environment similar to Helpman et al. (2010).[19] We allow for J varieties overall, and index a particular one by j. As is usual, we use the constant elasticity of substitution (CES) preferences structure, where parameter σ governs the elasticity of substitution between varieties.

A firm takes consumers' choices as given and solves its profit maximization problem, also

[17] As in our dataset we do not observe the agents in other markets (e.g., employees, job searchers, suppliers), we limit the analysis to the firms' choices.

[18] We consider that part-time workers have lower firing costs. In Lithuania, statutory severance pay differs between permanent and fixed-term contracts. According to the Eurostat's Structure of Earnings Survey in Lithuania, in 2014 part-time employees were three times more likely to hold the fixed-term contract as compared to the full-time employees.

[19] However, we abstract from the demand and fixed costs heterogeneity, unlike Roberts et al. (2018), who, in addition to prices and destination patterns, also exploit data on quantity, which we do not observe. Roberts et al. (2018) find that demand shifters and marginal costs are key drivers of observed variation in the revenue share and the intensive margin of trade, which also constitute our focus.

taking the technology into account. The production function for a variety j is given by:

$$q_t(j) = \left(K_t^{\psi}(j)\left(L_t^F(j)\right)^{1-\psi}\right)^{\phi}\left(L_t^P(j)\right)^{1-\phi}, \tag{3}$$

where the produced and demanded quantity $q_t(j)$ coincides in equilibrium. The functional form is assumed to be identical across all firms producing varieties $j \in J$; ϕ, ψ denote distribution (share) parameters. As is standard, $q_t(j)$ denotes quantity, $K_t(j)$ capital, $L_t^F(j)$ full-time employment and $L_t^P(j)$ part-time employment. A simplifying assumption of the unitary elasticity of substitution across inputs helps us clarify key channels and arrive at the closed-form solutions.[20] We abstract away from interactions between full-time and part-time labor markets, assuming that they are separate. Before turning to key mechanisms, we first clarify how trade impacts firm production.

4.2 Trade

In addition to selling to the domestic market, a firm exports a fraction of its good after covering a fixed cost of exporting, $f_x > 0$. Additionally, in order for one unit to arrive in the foreign market, a firm faces an iceberg variable trade cost, $\tau(j) > 1$, denominated in units of a variety. Again, variable trade costs are firm-specific, showing, for example, efficiency in transporting goods, accessing customs, or managing a distribution network. The total production is then split between the domestic market: $q_t^d(j)$ and the export market $q_t^x(j)$, so that the firm's marginal revenues are equated in the two markets. Note that unlike Helpman et al. (2010), where production shares for export and domestic markets within firms are identical, in our setting trade cost heterogeneity generates varying (firm-specific)

[20] Please see Appendix F.3 for a more general case with the two-part production function, $q_t(j) = \left(\psi K_t^{\gamma}(j) + (1-\psi)\left(L_t^F(j)\right)^{\gamma}\right)^{\frac{\phi}{\gamma}}\left(L_t^P(j)\right)^{1-\phi}$, $0 < \phi < 1$, $0 < \psi < 1$, $\gamma \leq 1$ (see, for instance, Goldin and Katz (1998), Krusell et al. (2000)). In such a case, the elasticity of substitution between full-time employment and capital is $\epsilon_{K,L^F} = \frac{1}{1-\gamma}$ but it is unitary between the part-time employment and the other two inputs, i.e., $\epsilon_{K,L^P} = \epsilon_{L^F,L^P} = 1$. Since the additional parameter, γ, capturing imperfect substitutability between part-time labor and the mix of full-time labor and capital, cannot be reliably inferred from our data and also some solutions would require approximations, we stick to the Cobb-Douglas specification to demonstrate the key mechanism for our baseline analysis.

proportions of export production.

We denote the firm's market access variable by $\Upsilon_t(j)$ or, more precisely, by $\Upsilon_t(j) - 1$. $\Upsilon_t(j) - 1$ captures the share of exports over domestic revenue:

$$\Upsilon_t(j) \equiv 1 + \tau_{RU,t}^{1-\sigma}(j) \left(\frac{A_{RU,t}^{\star}}{A_t} \right)^{\sigma} + s_{RW,t}^{x}(j)\, \tau_{RW,t}^{1-\sigma}(j) \left(\frac{A_{RW,t}^{\star}}{A_t} \right)^{\sigma} \geq 1, \tag{4}$$

where trade partners are allowed to be Russia (RU) and the rest of the world (RW), and thus $A_{RU,t}$ and $A_{RW,t}$ correspond to the respective demand shifters. As we consider only those firms that are exporters to Russia (i.e., firms *conditional* on exporting to Russia), we model the rest of the world using the share function, $s_{RW,t}^{x}(j)$, which captures the coverage of all remaining world markets under a trade costs symmetry assumption and provides a close and transparent connection to the data (see Appendix E for details).

4.3 Optimal Choices and Constraints

Since factor installment, legal environment, and contractual obligations entail time rigidities, a firm engages in a dynamic planning and optimizes by taking into account a constant discount rate ρ. A firm decides on the optimal level of full-time labor next period $L_{t+1}^{F}(j)$ (and thus a change in full-time employment stock this period, $H_t^F(j)$), part-time labor $L_t^P(j)$, capital stock next period $K_{t+1}(j)$ (and thus investment this period, $I_t(j)$), and the sales to other markets but Russia, $s_{RW,t}^{x}(j)$.

A firm faces full-time labor adjustment costs, embedded in the function $\Phi^L\left(L_t^F(j), H_t^F(j)\right)$. Reflecting the institutional setup, we assume that hiring and firing costs per each full-time employee, h and f, respectively, are constant across all firms. Hence, $\Phi^L\left(L_t^F(j), H_t^F(j)\right) = hH_t^F(j)\,\mathbb{I}_{\triangle L_t^F(j)>0} - fH_t^F(j)\,\mathbb{I}_{\triangle L_t^F(j)<0}$, where an indicator function $\mathbb{I}$ turns to one when the respective subscript condition is true (i.e., when a firm hires or fires full-time labor) and assumes value zero otherwise. As described earlier, part-time labor is cheaper to adjust for Lithuanian firms, and we simplify analysis by assuming costless adjustment. Regarding capital adjustment, we assume that capital takes time to be installed and become productive. It depreciates at a rate δ, i.e., it follows the standard law of motion, $I_t(j) = K_{t+1}(j) - (1-\delta)\, K_t(j)$.[21]

We denote the shadow value of full-time labor by $\mu_t(j)$. It embodies an inter-temporal optimization where a current value of full-time employment is equal to the discounted value of the marginal value of full-time employment,[22] discounted wage, and future value of full-time employment. Since a decision today realizes only next period due to the lengthy search for employees, discounting affects the current value (and thus the optimal action). As full-time labor can be hired or fired with a lag due to search and other frictions, the net variation in full-time employment, $H_t^F(j)$, can be positive, negative or zero, and result in the new labor stock $L_{t+1}^F(j)$ next period. This adjustment mechanism introduces non-convexities and thus intervals of optimal inaction, as covered in Bentolila and Bertola (1990). The part-time employment can be adjusted more quickly and costlessly, equating wage w_t^P with the marginal (revenue) product of part-time labor.

Lastly, since we analyze only those firms that exported to Russia before the shock, we obtain the optimal intensive margin of trade with the rest of the world, $s_{RW,t}^x(j)$, which also links the firm's openness and quantity. We can therefore get an expression for the share of the rest of the world's market using the openness variable, $\Upsilon_t(j)$:

$$s_{RW,t}^{x}(j) = \frac{q_t(j)}{\tau_{RW,t}^{1-\sigma}(j)\left(\frac{A_{RW,t}^{\star}}{A_t}\right)^{\sigma} \frac{\tau_{RW,t}(j)^{\sigma} A_t^{\sigma}\left(A_{RW,t}^{\star}\right)^{\frac{\sigma}{1-\sigma}\sigma}}{\sigma^{\frac{\sigma}{1-\sigma}} f_x^{\frac{\sigma}{1-\sigma}}}} \\ -\tau_{RW,t}^{\sigma-1}(j)\left(\frac{A_{RW,t}^{\star}}{A_t}\right)^{-\sigma} - \left(\frac{\tau_{RU,t}(j)}{\tau_{RW,t}(j)}\right)^{1-\sigma}\left(\frac{A_{RU,t}^{\star}}{A_{RW,t}^{\star}}\right)^{\sigma}.$$

Based on the first-order condition for the flexible adjustment margin, namely part-time employment, we can express output as:

$$q_t(j) = \left[(1-\phi)\left(\tfrac{\sigma-1}{\sigma}\right)\right]^{\frac{\sigma}{1-\sigma}} \Upsilon_t^{\frac{1}{1-\sigma}}(j) A_t^{\frac{\sigma}{1-\sigma}} \left(w_t^P L_t^P(j)\right)^{\frac{\sigma}{\sigma-1}}.$$

[21] Otherwise, we abstract from the adjustment costs of investment, thus marginal (revenue) product of capital refers to marginal product of capital and additional revenue, both evaluated next period and discounted, as well as depreciation rate.

[22] Marginal product tells how much output gets reduced by marginally reducing employment and then multiplying it by the price of (the last unit of) production.

Finally, combining the above expressions, the trade share can be written in an explicit form as:

$$\begin{aligned} s^{x}_{RW,t}(j) = (\sigma-1)^{\frac{\sigma}{1-\sigma}} \left(\frac{w^{P}L^{P}_{t}(j)}{1-\phi}\right)^{\frac{\sigma}{\sigma-1}} f_{x}^{\frac{\sigma}{1-\sigma}} \tau^{-1}_{RW,t}(j) \left(\frac{A_{t}}{A^{\star}_{RW,t}}\right)^{\frac{\sigma}{1-\sigma}} \Upsilon_{t}^{\frac{1}{1-\sigma}}(j) \\ -\tau^{\sigma-1}_{RW,t}(j)\left(\frac{A^{\star}_{RW,t}}{A_{t}}\right)^{-\sigma} - \left(\frac{\tau_{RU,t}(j)}{\tau_{RW,t}(j)}\right)^{1-\sigma}\left(\frac{A^{\star}_{RU,t}}{A^{\star}_{RW,t}}\right)^{\sigma}. \end{aligned} \tag{5}$$

The trade with the rest of the world thus depends on the choice variable, part-time labor, and openness, which is determined by firm-specific variable trade costs. In what follows, we show that even though part-time employment is endogenous, a change can be linked to exogenous factors and a change in trade costs. As long as the change in trade costs is exogenous, so will be the adjustment in part-time labor.

5 Testable Implications

We first discuss what happens with the intensive margin of trade and then turn to implications for the firms experiencing a large trade shock.

5.1 Flexible Adjustment Margin

Using the optimal trade share choice in combination with the optimal part-time employment, we can express the intensive margin of trade as:

$$\Upsilon_{t}(j) = \left(\frac{w^{P}L^{P}_{t}(j)}{1-\phi}\right)(\sigma-1)^{-1}\,\tau^{1-\sigma}_{RW,t}(j)\left(\frac{A^{\star}_{RW,t}}{A_{t}}\right)^{\sigma} f_{x}^{-1}.$$

Therefore, $\Upsilon_t(j)$ is determined by the part-time labor, which acts as a choice variable in the face of an exogenous shock to trade with Russia. In other words, a change in an intensive margin of trade acts through a direct effect of trade costs and an indirect channel through the flexible adjustment margin, part-time labor. We can therefore conclude that:

$$\frac{\frac{\partial \Upsilon_{t}(j)}{\partial \tau_{RU,t}(j)}}{\frac{\partial \Upsilon_{t}(j)}{\partial L^{P}_{t}(j)}} = \frac{\partial L^{P}_{t}(j)}{\partial \tau_{RU,t}(j)} = \frac{(\sigma-1)(1-\sigma)\,\tau^{-\sigma}_{RU,t}(j)\,f_{x}}{\left(\frac{w^{P}}{1-\phi}\right)\tau^{1-\sigma}_{RW,t}(j)}\left(\frac{A^{\star}_{RU,t}}{A^{\star}_{RW,t}}\right)^{\sigma} < 0, \tag{6}$$

leading to the following result:

Proposition 1. *An exogenous increase in trade costs with Russia induces layoffs of part-time employees. Conditional on exporting to Russia prior to the ban, this effect is larger for larger fixed exporting costs*[23] *and for lower variable exporting costs to Russia before a shock (in other words, the larger f_x and thus the larger export basket and/or the lower $\tau_{RU,t}(j)$ or the larger the revenue share of exports to Russia, $\mathcal{S}_t^{RU}(j) \equiv \frac{\left(\tau_{RU,t}(j)\right)^{1-\sigma}\left(\frac{A^\star_{RU,t}}{A_t}\right)^{\sigma}}{\Upsilon_t(j)}$, for a given level of intensive margin $\Upsilon_t(j)$).*

Proof. Follows from the equation (6), which is in detail derived in Appendix F.4.1. □

Our empirical strategy is thus based on the approximation:

$$\triangle L_t^P(j) \approx \frac{(\sigma-1)(1-\sigma) f_x}{\left(\frac{w^P}{1-\phi}\right)} \left(\frac{A^\star_{RU,t}}{A^\star_{RW,t}}\right)^{\sigma} \underbrace{\left(\frac{\tau_{RU,t}(j)}{\tau_{RW,t}(j)}\right)^{1-\sigma}}_{\text{Rel.trade costs: RU/RW;}} \underbrace{\frac{\triangle\tau_{RU,t}(j)}{\tau_{RU,t}(j)}}_{\text{Rel.change in trade costs w RU}} \tag{7}$$

A change in part-time labor is solely driven by a change in trade costs, adjusted by the forces exogenous from the firm's perspective. What matters is not only the relative magnitude of a trade costs shock ($\triangle\tau_{RU,t}(j)/\tau_{RU,t}(j)$), but also how large trading costs with Russia are vis-a-vis the rest of the world ($\tau_{RU,t}(j)/\tau_{RW,t}(j)$). As a result, we should not only look at the change in trade costs but also at its prior relationship with respect to the entire firm's portfolio, i.e., how small or large exports to Russia have been compared to other countries. In other words, the firm-specific part-time labor adjusts due to a change in firm-specific trade with Russia costs but the effect also varies across firms due to trade costs with the rest of the world.

5.2 Trade Adjustment

Since the openness measure $\Upsilon_t(j)$ in equation (4) may be less intuitive than the immediately observable revenue share of openness, $\mathcal{S}_t^{RW}(j)$, we move on to analyze the key drivers in its

[23] We are conditioning on the firms that are exporters to Russia, therefore higher fixed exporting costs must be associated with larger pre-shock export share to Russia.

adjustment to the Russian trade shock. The response in the revenue share is given by:

$$\begin{aligned} \frac{\partial \mathcal{S}_t^{RW}(j)}{\partial \tau_{RU,t}(j)} &= \frac{1}{(\Upsilon_t(j))^2}\frac{\partial \Upsilon_t(j)}{\partial \tau_{RU,t}(j)} \\ \times &\left[1-(1-\sigma)\,\tau_{RU,t}^{-\sigma}(j)\,\Upsilon_t(j)\left(\frac{A_{RU,t}^{\star}}{A_t}\right)^{\sigma}\left(\frac{\partial \Upsilon_t(j)}{\partial \tau_{RU,t}(j)}\right)^{-1}+\tau_{RU,t}^{1-\sigma}(j)\left(\frac{A_{RU,t}^{\star}}{A_t}\right)^{\sigma}\right] \\ &= -\frac{\tau_{RU,t}(j)}{\Upsilon_t(j)}\frac{\partial \Upsilon_t(j)}{\partial \tau_{RU,t}(j)}\frac{\mathcal{S}_t^{RW}(j)}{\tau_{RU,t}(j)} > 0, \end{aligned} \tag{8}$$

where the last inequality follows since $\frac{\partial \Upsilon_t(j)}{\partial \tau_{RU,t}(j)} < 0$. We show in Appendix E.2 that the export revenue share collapses to $\mathcal{S}_t(j) = \frac{\Upsilon_t(j)-1}{\Upsilon_t(j)}$ in a two-country world.

Therefore, notice that a two-country case only has a direct effect, which is negative, $\frac{1}{(\Upsilon_t(j))^2}\frac{\partial \Upsilon_t(j)}{\partial \tau_{RU,t}(j)} < 0$. As shown in equation (8), in a multi-country case, however, the sign switches to a positive one. All else equal, trade reallocation to the rest of the world is larger if a firm's openness sensitivity to trade costs was larger (i.e., a relative trade shock, $\triangle\tau_{RU,t}(j)/\tau_{RU,t}(j)$, induced a larger adjustment in relative openness, $\triangle\Upsilon_t/\Upsilon_t$,[24] trade costs to export to Russia were smaller (lower $\tau_{RU,t}(j)$), and the firm had a larger revenue share of the rest of the world, $\mathcal{S}_t^{RW}$, to start with.

Proposition 2. *Elasticity of the revenue share of the rest of the world, after an increase in variable trade costs with Russia, is given by:*

$$\frac{\partial \mathcal{S}_t^{RW}(j)}{\partial \tau_{RU,t}(j)}\frac{\tau_{RU,t}(j)}{\mathcal{S}_t^{RW}(j)} = -\frac{\partial \Upsilon_t(j)}{\partial \tau_{RU,t}(j)}\frac{\tau_{RU,t}(j)}{\Upsilon_t(j)} > 0.$$

For each level of openness, the larger the relative trade shock, the larger the adjustment in the revenue share of the rest of the world.

Proof. Follows from the equation (8), which is derived in detail in Appendix F.4.2. □

As summarized in Table 5, the dollar value of exports in fact increases after a shock to trade costs with Russia, suggesting a rise in revenue share of the rest of the world. Note that the full effect is a combination of a mechanical effect of lower or no trade with Russia and also export reorientation towards other markets. Table 5 reports only the latter effect

[24] Recall that $\frac{\triangle\Upsilon_t(j)}{\triangle\tau_{RU,t}(j)} \approx (1-\sigma)\,\tau_{RU,t}^{-\sigma}(j)\left(\frac{A_{RU,t}^{\star}}{A_t}\right)^{\sigma}$. Hence, a change in openness is also caused by exogenous factors as long as a change in trade costs can be argued to be exogenous.

as it looks at the pre-shock export revenue to non-Russian destinations.

5.3 Large Shock

We are now equipped with the required tools to analyze costly adjustment margins. Since a small and temporary shock could have been fully absorbed by the flexible adjustment margin and shifting exports to other destinations but Russia, we introduce a concept of a *large shock*, which necessitates costly adjustment margins by a firm. We start with clarifying the concept of a large shock.

According to the full-time labor adjustment cost function $\Phi^L\left(L_t^F(j), H_t^F(j)\right)$, the full-time labor shadow value varies in the interval $h \geq \mu_t(j) \geq -f$, with the equality constraint binding when hiring or firing occurs. To illustrate the mechanism and find a closed-form solution, we consider a state space reduction into two discrete states – good and bad. In the former case, a firm hires new full-time staff whereas in the latter – it lays off current full-time employees. Our definition of a large shock considers only those shocks that surpass the thresholds of hiring and firing. That is, due to non-convexities, if a shock is small and does not surpass a required threshold of hiring and firing, the optimal strategy in terms of full-time labor is inaction.

Let the transition probability of moving between good and bad states be p, whereas with probability $1-p$ the state remains the same in the next period. For instance, a degenerate probability of no change implies $1-p=1$, and thus a firm is permanently stuck in the current state. Note that we do not explicitly model the probability parameter as a stochastic process or endogenize it, which can reflect firm's capabilities in forecasting future events, past experience or severity of a shock.[25]

Using the first-order conditions for the full-time labor, describing marginal revenue and marginal costs, and summarized by the shadow values $\mu_t(j)$, we can find an implicit ex-

[25] The persistence of the state can be explicitly modeled by an autoregressive process and richer state space but we merely treat it as one of the reasons behind an increase in the probability of a bad state remaining bad in the next period.

pression for the optimal full-time labor stock next period. In essence, we can exploit the two states since a shadow value in a bad state will be related to a shadow value in a good state and the other way round. Finally, using the production function and the relationship between part-time labor and openness variable, we end up with:

$$\left(L_{t+1}^{F-}(j)\right)^{(1-\psi)\phi\frac{\sigma-1}{\sigma}-1} = \Psi_{t+1}\tau_{RW,t+1}^{\frac{\sigma-1}{\sigma}}(j)K_{t+1}(j)^{-\psi\phi\frac{\sigma-1}{\sigma}}\left(L_{t+1}^{P}(j)\right)^{-(1-\phi)\frac{\sigma-1}{\sigma}-\frac{1}{\sigma}}, \tag{9}$$

where L_{t+1}^{F-} stands for the optimal full-time labor under a negative shock (firing) and Ψ_{t+1} is a time-varying term, exogenous from the perspective of a firm.[26] Three channels make full-time labor adjust: a direct one (trade conditions with the rest of the world next period), capital adjustment (which, in turn, depends on part-time labor), and part-time labor change itself.

Before learning how full-time employment adjusts in a closed-form expression, we first solve for the capital choice. From the first-order conditions,[27] we get:

$$K_{t+1}(j) = \left(\frac{w^P}{1-\phi}\right)(\sigma-1)^{-1} f_x^{-1}\frac{\rho f_x\phi\psi(\sigma-1)}{1-\rho+\delta\rho}L_{t+1}^{P}(j), \tag{10}$$

thereby yielding:

$$I_t(j) = \left(\frac{w^P}{1-\phi}\right)\frac{\rho}{1-\rho}\phi\psi\triangle L_{t+1}^{P}(j) \tag{11}$$

where, for exposition purposes, we assume depreciation to be equal to zero, $\delta = 0$.

Proposition 3. *A forward-looking firm reduces investment proportionally to a forthcoming drop in part-time employment.*

Proof. Follows from the investment equation (11), which is derived in Appendix F.4.4. See also equation (6) where the relationship between trade costs and part-time employment is established. □

[26] See Appendix E.4 for the description and Appendix F.4.3 for the precise expression and derivation. To simplify expressions, we normalized hiring costs to $h = 0$.

[27] See equation (E15) in the Appendix F.3.

Table 4 provides empirical support for the Proposition 3: when prospects deteriorate, firms cut investment early on with no significant effect in later periods. A change in the part-time employment acts a measure of the shock severity. Since expansion to the new export markets is lengthy and costly, whereas full time labor and capital are costlier adjustment margins, an anticipated change in part-time labor becomes an indicator of investment plans.

Finally, taking into account capital adjustment in equation (10), we can re-express labor adjustment equation (9) in terms of the flexible adjustment margin, part-time employment, and exogenous (from the perspective of a firm) variables:

$$\left(L_{t+1}^{F-}(j)\right)^{(1-\psi)\phi\left(\frac{\sigma-1}{\sigma}\right)-1} = \widetilde{\Psi}_t \tau_{RW,t+1}^{\frac{\sigma-1}{\sigma}}(j) \left(L_{t+1}^{P}(j)\right)^{-\frac{1}{\sigma}([1-\phi+\psi\phi](\sigma-1)+1)}, \tag{12}$$

where $\widetilde{\Psi}_t$ is a mix of aggregate and exogenous terms (see Appendix F.4.5). A new (lower) level of full-time employees is driven by variable trade costs with other countries except for Russia and part-time employees present with a firm at the time of full-time employment adjustment. As in Bertola (2004), under a strictly diminishing marginal productivity of inputs, an interior solution would require that firms have a higher full-time labor stock in a good state. The larger are the firing and hiring costs, the larger are the opportunity costs and thus the wedge between marginal values, making a strategy of hoarding labor more likely. We summarize this finding as follows:

Proposition 4. *Contingent on the decision to fire full-time employees, the layoffs are more likely to be larger (i.e., there is a decrease in $L_{t+1}^{F-}(j)$ or an increase in $\left(L_{t+1}^{F-}(j)\right)^{(1-\psi)\phi\frac{\sigma-1}{\sigma}-1}$ since $(1-\psi)\,\phi\frac{\sigma-1}{\sigma} < 1$), the higher the firm's variable costs to trade with the rest of the world, the smaller the stock of part-time employment, and a bad state is more likely to persist (higher $1-p$).*

Proof. Follows from the equation (12), which is derived in Appendix F.4.3. As for the first claim, higher $\tau_{RW,t+1}$ leads to a larger full-time labor adjustment. To establish the second claim, notice that $(1-\psi)\,\phi\frac{\sigma-1}{\sigma} < 1$ as ψ, ϕ, and $\frac{\sigma-1}{\sigma}$ are all strictly between zero and one.

The power of part-time employment is negative, i.e., $-\frac{1}{\sigma}\left(\left[1-\phi+\psi\phi\right](\sigma-1)+1\right)<0$ since $\left[1-\phi+\psi\phi\right](\sigma-1)+1>0$ or $(1-\psi)\,\phi<\frac{\sigma}{\sigma-1}$, which is always the case since ψ, ϕ are between zero and one, whereas $\sigma>1$, hence, $\frac{\sigma}{\sigma-1}>1$. As for the last claim, Ψ_{t+1} is an increasing function of $1-p$. □

Recall that, even though a level of part-time employment is an endogenous firm's choice, a change, for a given level of part-time workers, is driven by exogenous factors (e.g., an unexpected change in trade costs due to political reasons), as summarized in equation (7). This insight underlies our ensuing empirical strategy.

6 Discussion and Additional Empirical Results

6.1 Implications of Key Mechanisms

Before moving to the additional empirical evidence, we take stock of the main theoretical implications. First, as Proposition 1 indicates, an exogenous increase in trade costs with Russia induces layoffs of part-time employees. This effect is larger, the larger the revenue share of exports to Russia had been before a shock. An implication is that if a shock is large relative to the flexible labor margin (part-time employment) and/or considered to be persistent (i.e., lost access to the Russian market in the future periods), it triggers other adjustments: further inputs reductions and export re-direction to other markets.

Due to the concave production function, a reduction in part-time employment increases its shadow value. To equalize marginal returns across productive inputs, firms are forced to make further adjustments. Yet, not all adjustments are alike: temporal rigidity makes investment react smoothly and early on, whereas full-time labor moves if the shock happens to be persistent and sufficiently severe. More precisely, Propositions 3 and 4 suggest that investment drops by more if the predicted part-time employment adjustment is large, whereas the layoffs of full-time labor are more likely both if the shock was large and persistent and if the part-time employment adjustment was large.

Starting by adjusting on the margin with no adjustment costs, i.e., part-time labor, larger shocks trigger forward-looking firms to pursue other adjustments, i.e., investment, when they expect the shock to continue. When the shocks turn out to be indeed large and persistent, firms also adjust the margin with non-convex adjustment costs, i.e., full-time labor. There are two types of firms that engage in costly adjustments. First, conditional on other actions such as new markets search, firms hit by a large shock engage in front-loading of future adjustments costs. Second, some firms engage in costly adjustments later since the original shock turns out be more persistent than expected, thereby necessitating changes in capital and full-time labor.

The non-action in the first period following the shock can be optimal from the perspective of a temporary shock, which could have been sufficiently small to be absorbed by a flexible input in the first period, but could force a firm to recalculate its response in case of the unforeseen persistence of the bad shock. In fact, under such circumstances a firm faces more depleted part-time staff (with a higher shadow value) and is thus more likely to change its full-time labor and capital.

Beyond cost reductions, firms can engage in export re-orientation to the rest of the world, i.e., an increase in the trade share with the rest of the world, is larger for a larger trade shock. In other words, a larger exposure to the Russian market makes producers search for alternative routes, other factors being held constant (see Proposition 2).

6.2 Further Empirical Evidence

Our conceptual framework suggests that the adjustments on other margins depend on such parameters as heterogeneity in the variable exporting costs to Russia and to the rest of the world.[28] Thus, while our theoretical framework demonstrates that the firm's response to the unanticipated shocks is likely to be heterogeneous depending on these parameters, such heterogeneity might be challenging to capture empirically for the econometrician with

[28]In principle, though not in the model, time preferences, expected probability of the shock persistence, and various adjustment costs may also vary across firms.

limited data.

At the same time, as the model implies, such heterogeneity can be expressed by how strongly the firm adjusts on its most flexible adjustment margin, the part-time labor. Thus, one way to test the theory is to track changes in part-time employment caused by an exogenous change in trade costs with Russia and see whether they can be a relevant statistic of subsequent adjustments within a firm.

Hence, we now present empirical results on whether the same firms that adjust part-time labor also follow other adjustments. In other words, with this test, we aim to evaluate whether the adjustment of the most flexible margin, which in our case is $\Delta Part\, time\, change_i$, provides an additional information signal about firms' *perceived* exposure to the shock on top of the *directly measurable* exposure to the shock, which in our case is $Banned\, export\, share_i$. Such differences in the perceived and directly observed exposure can come from the heterogeneity in expected permanence of the shock or the expectations of internal adjustment.

In particular, we add an additional term capturing the change in part-time employees over 2013-2015 to our dynamic specification (2) and we test whether the change in full-time employees was related to the initial adjustment to part-time employees:

$$\begin{aligned}\Delta Y_{i,t} =& \beta_1 \times Banned\, export\, share_i \times Post2014_t + \\ & \beta_2 \times Banned\, export\, share_i \times Post2016_t + \\ & \beta_3 \times Banned\, export\, share_i \times \Delta Part\, time\, change_i \times Post2016_t + \gamma_i + \tau_t + \epsilon_{i,t}\end{aligned} \tag{13}$$

In this specification, $\Delta Part\, time\, change_i$ refers to the difference in the change of part-time employees between 2013 and 2015, where the difference is taken between the values of a treated firm i and its matched control firm. All other variables are defined as in specifications (1) and (2).

We report the results in Table 6, where the dependent variable is the number of full-time employees. In Column 1, we report the estimates, where we separately include $Banned\, export\, share_i \times Post\, 2016$ and $\Delta Parttimechange_i \times Post\, 2016$. We find that $\Delta Parttimechange_i$ is an independently strong predictor for the delayed change in full-time employment. That is consistent with our interpretation that $\Delta Parttimechange_i$ can act as a proxy for how firms perceived the permanence and persistence of the shock.

In terms of economic effects, based on the average banned export share of 6.69% that resulted in the 9.76 part-time employee drop (as per Table 3), the information proxied by part-time employee drop was related to 24.21 fewer full-time employee in 2016-2017 while the direct exposure effect explains the decrease in 32.28 employees. That compares to an unconditional decrease in 42.41 full-time employees in 2016-2017 as per Table 3, Column 3.

One concern, however, is that there might be adjustments to part-time employees (or any flexible adjustment margin) that are unrelated to the introduction of the sanctions. We then move to Column 2 in which we report the specification that also includes the triple interaction term $Banned\, export\, share_i \times \Delta Part\, time\, change_i \times Post2016_t$. We see that the adjustment in full-time employees over 2016-2017 was larger for firms that had a larger cut in part-time employees between 2013-2015, as compared to the respective change in the control firms. That is, firms that experienced larger trade shock and consequently laid off more part-time employees, as captured by the triple interaction term, also engaged in larger layoffs of full-time labor.[29]

These findings suggest that the firms were facing heterogeneity in terms of their adjustment margins. They also bring a broader takeaway from our paper: that when the expected permanence of the shock and the adjustment margins are not fully observable, one proxy that could capture the full extent of the shock exposure of the firm with perfect foresight is its adjustment on the most flexible margin. While *Banned export share* captures the observable part of the effect, the heterogeneity of the adjustments might differ across firms due to firm differences in their perceived permanence and persistence of the shock. Firm adjustments on

[29] We also see a similar delayed reaction for investment, conditional on the change in part-time employees. Investment is arguably a costly adjustment margin. For example, if the shock turns out to be more persistent than expected and that would necessitate additional changes in full-time labor, it might have to be accompanied by the additional change in investment. As we do not have an explicit prediction on the delayed reaction in investment in our theoretical framework, we relegate these results on interaction effects on investment to Appendix D.

Table 6: Interaction with the change in part-time employees

	(1)	(2)
	Full-time employees	
Banned export share x Post 2014	-128.022	-128.022
	(152.047)	(154.568)
$\Delta PartTime(2013-2014)$ x Post 2016	2.481***	-0.896
	(0.768)	(1.379)
Banned export share x Post 2016	-482.558*	-484.914*
	(270.067)	(271.284)
Banned export share x $\Delta PartTime(2013-2014)$ x Post 2016		22.104***
		(7.738)
Constant	142.925***	142.967***
	(16.183)	(15.420)
R^2	0.961	0.963
N	149	149

Notes: This table shows the effect of the Russian ban on the number of employees in Lithuanian food manufacturing firms over 2011-2017. For each *treated* firm that has exported any banned products to Russia in 2013, we assign one *control* firm that is a food exporter, and is closest in size (as measured by total sales). The dependent variables are the difference in the number of full-time employees between the treated and control firms. ***, **, and * refer to the statistical significance at 1%, 5%, and 10%, respectively.

the most flexible margin thus reveal their expectations of their own exposure to the shock.

This insight brings us to the policy implications. To prevent costly layoffs of full-time labor, firms could face lower shadow costs of keeping employees on the payroll if a government subsidized wage costs. Part-time labor acts as an important shock absorber but that requires smooth and fast reallocation across fired labor, effective and accessible training policies, and labor market regulation admitting different types of work contracts.

Finally, we conduct the same analysis as above but instead condition on the openness margin, as discussed in Section 5.1 and Proposition 2. In the spirit of the specification (13), we add an additional interaction term of the change in dollar value of exports outside of Russia between 2013 and 2015 to our dynamic specification. In line with our predictions in Section 4, in Appendix D we find that the adjustment in full-time employees over 2016-2017 was smaller for firms that had a larger increase in exports outside of Russia between 2013 and 2015, as compared to the respective change in the control firms. When the shock turns out to be severe in terms of its persistence and expected cumulative effect, firms lay off full-time labor. However, those firms that managed to increase the reach of export markets outside of Russia reduced full-time employment less. This suggests another policy implication: trade deregulation and setting up the infrastructure to direct exports to more diverse foreign markets can help absorb trade shocks.

7 Conclusions

We investigate how firms in a small open economy adjust to a sudden, unanticipated, and permanent negative demand shock coming from the economic sanctions. We explore a unique event when, due to political reasons, unrelated to trade, the exporters lost access to a major export market. In particular, we look at an abrupt negative trade shock to the food production sector in Lithuania in 2014 after the Russian sanctions on imports from Europe, the US, and some other countries. We use a rich firm-level dataset, which covers all exporters in the country and which allows us to comprehensively quantify the adjustment margins.

We look at the sample of all Lithuanian firms over 2011-2017, and first show that indeed the exports to Russia and consequently the total revenues dropped after 2013 for those food manufacturers that had substantial exports to Russia prior to the trade ban. We then estimate reduced form difference-in-differences estimation, comparing the adjustments of the affected versus unaffected food exporters. We find that part-time employment drops first and we see further adjustments in full-time employment, capital investment, and the expansion to markets outside of Russia. This suggests that if flexible adjustment margins are limited, food manufacturers might embark on finding new markets.

Based on these observations, we sketch a theoretical framework which explicitly considers an important adjustment margin, the employment of part-time workers. We show that part-time employment, as the most flexible margin, adjusts first. The further adjustments depend on the size of the shock and the expectations of persistence. In case of a larger shock, the full-time employment and capital also adjust. Moreover, if the shock is large enough that flexible adjustment margins are exhausted, the firms might revert to revenue-increasing strategies.

This conceptual set-up suggests additional theoretical predictions that we confirm in the data. Indeed, we see that food manufacturing firms which were quick to reduce part-time employees first, also reduced their full-time employees later on and dropped investment. These results suggest that firm adjustment on the most flexible margin can capture its expected permanence of shock when such heterogeneity is not directly observable.

Understanding the full scale of adjustments that are implemented in response to cleanly identified exposure to the economic sanctions can guide economic policy makers in deciding which alterations to policy making should be done on their behalf. This is particularly important because any adjustment is likely to result in aggregate economic effects and might even generate feedback loops with further uncertainty.

Our results thus contribute to the literature on the most effective ways to react to such shocks, which may have implications for labor and trade market reforms. For instance, at times of global uncertainty, more flexible work contracts could help absorb unexpected demand shocks. Such contracts could also allow firms to be more confident in their ex ante hiring decisions. Ensuring access to wide exports markets could also mitigate the risks that result from the unexpected loss of a large trade partner.

One could be concerned about the external validity of our findings given a unique composition of Lithuanian economy and its institutional environment. Indeed, every sanctions' package might be different[30] and thus our paper contributes with the empirical evidence on how the firms respond to one particular set of sanctions in an environment with flexible labor policies. While this particular episode might be unique, one way to build a broader picture how firms react to external trade shocks would be to study a wide range situations and with this paper we provide one piece to this puzzle.

[30] See, e.g., estimates of macroeconomic and political effects of trade restrictions with Iran (Dizaji and van Bergeijk 2013), the effects on Danish firms in the aftermath of the Danish cartoon crisis (Hiller et al. 2014, Friedrich and Zator 2019), or the effects of Russia's sanctions on firms in Western European countries (Crozet and Hinz 2020, Klomp 2020, Crozet et al. 2021).

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A Appendix: Data description

Table A1: Banned products

HS code	Description
0201	Meat of bovine animals, fresh or chilled
0202	Meat of bovine animals, frozen
0203	Meat of swine, fresh, chilled or frozen
0207	Meat and edible offal of fowls of the species Gallus domesticus, ducks, geese, turkeys and guinea fowls, fresh, chilled or frozen
0210	Meat and edible offal, salted, in brine, dried or smoked; edible flours and meals of meat or meat offal
03	Fish and crustaceans, molluscs and other aquatic invertebrates
0401	Milk and cream, not concentrated nor containing added sugar or other sweetening matter
0402	Milk and cream, concentrated or containing added sugar or other sweetening matter
0403	Buttermilk, curdled milk and cream, yogurt, kephir and other fermented or acidified milk and cream, whether or not concentrated or flavoured or containing added sugar or other sweetening matter, fruit, nuts or cocoa, and yogurt may additionally contain chocolate, spices, coffee, plants or cereals
0404	Whey, whether or not concentrated or containing added sugar or other sweetening matter; products consisting of natural milk constituents, whether or not containing added sugar or other sweetening matter, n.e.s.
0405	Butter, incl. dehydrated butter and ghee, and other fats and oils derived from milk; dairy spreads
0406	Cheese and curd
07	Edible vegetables and certain roots and tubers
08	Edible fruit and nuts; peel of citrus fruit or melons, except for 0812
1601	Sausages and similar products, of meat, meat offal, blood or insects; food preparations based on these products
19019011	Malt extract with a dry extract content of >= 90%
19019091	Food preparations of flour, groats, meal, starch or malt extract (...)
21069092	Food preparations, n.e.s., not containing milkfats, sucrose, isoglucose starch or glucose
21069098	Food preparations, n.e.s.

Notes: The table provides a list of agricultural products, raw materials and foodstuffs originating from the United States, European Union countries, Canada, Australia and, Norway, and that were banned for imports to the Russian Federation on August 6, 2014.

Table A2: List of variables

Variable	Description
Sales	The value of firm's sales over the year
Full-time employees	The average number of full-time employees in a firm over the year, where full-time employees are those that work 40 hours per week
Part-time employees	The average number of part-time employees in a firm over the year, where part-time employees are those that work less than 40 hours per week
Number of full-time hours	The number of hours by full-time employees worked per year
Number of part-time hours	The number of hours by part-time employees worked per year
Fixed assets	The value of firm's fixed assets
Investment	The change of firm's fixed assets over the year
Total exports	The value of firm's exports of goods to all countries
Banned exports	The value of firm's exports of goods under Russia's counter-sanctions; the complete list of products is provided in Table A1
Banned export share	The value of firm's exports of goods as a ratio to firm's total sales
Russian export share	The value of firm's exports of goods as a ratio to firm's total sales

B Appendix: Robustness Tests

Table B1: Number of hours

	(1)	(2)	(3)	(4)
	Part-time hours		Full-time hours	
Banned export share x Post 2014	-112.657***	-81.330**	-760.604**	-364.107
	(42.458)	(39.657)	(332.419)	(308.019)
Banned export share x Post 2016		-80.719		-1021.639*
		(56.313)		(560.785)
Constant	18.992***	18.944***	210.729***	210.126***
	(3.793)	(3.784)	(29.558)	(29.733)
R^2	0.674	0.681	0.949	0.952
N	151	151	151	151

Notes: This table shows the effect of the Russian ban on the hours worked by employees in Lithuanian food manufacturing firms over 2011-2017. For each *treated* firm that exported any banned products to Russia in 2013, we assign one *control* firm that is a food exporter, and is closest in size (as measured by total sales). The dependent variable is then the difference in the number of either part-time hours (Columns 1-2) or full-time hours (Columns 3-4) between the treated and control firms. All specifications include match- and year-fixed effects. ***, **, and * refer to the statistical significance at 1%, 5%, and 10%, respectively.

Table B2: Dummy treatment

	(1)	(2)	(3)	(4)
	Part-time employees		Full-time employees	
High banned export share x Post 2014	-19.415***	-17.423***	-58.332**	-10.816
	(6.726)	(6.261)	(27.378)	(23.298)
High banned export share x Post 2016		-5.756		-137.309**
		(8.490)		(54.037)
Constant	24.327***	24.311***	141.528***	141.149***
	(4.643)	(4.645)	(16.963)	(17.083)
R^2	0.742	0.743	0.952	0.957
N	151	151	151	151

Notes: This table shows the effect of the Russian ban on the number of employees in Lithuanian food manufacturing firms over 2011-2017. For each *treated* firm that exported any banned products to Russia in 2013, we assign one *control* firm that is a food exporter, and is closest in size (as measured by total sales). The dependent variable is then the difference in the number of either part-time employees (Columns 1-2) or full-time employees (Columns 3-4) between the treated and control firms. Instead of a continuous variable as in Table 3, *High banned export share* is defined as a dummy equal to one if the *Banned export share* is larger than 3%. All specifications include match- and year-fixed effects. ***, **, and * refer to the statistical significance at 1%, 5%, and 10%, respectively.

Table B3: Four control firms for each treated firm

	(1)	(2)	(3)	(4)
	Part-time employees		Full-time employees	
Banned export share x Post 2014	-147.486***	-114.990**	-396.773**	-81.593
	(49.980)	(49.311)	(175.955)	(167.078)
Banned export share x Post 2016		-78.096		-757.459***
		(50.818)		(281.392)
Constant	21.910***	21.854***	70.794***	70.244***
	(4.347)	(4.346)	(15.613)	(15.642)
R^2	0.739	0.744	0.939	0.944
N	157	157	157	157

Notes: This table shows the effect of the Russian ban on the number of employees in Lithuanian food manufacturing firms over 2011-2017. For each *treated* firm that exported any banned products to Russia in 2013, we assign four *control* firms that are food exporter and are closest in size (as measured by total sales). The dependent variable is then the difference in the number of either part-time employees (Columns 1-2) or full-time employees (Columns 3-4) between the treated and control firms. All specifications include match- and year-fixed effects. ***, **, and * refer to the statistical significance at 1%, 5%, and 10%, respectively.

Table B4: Entropy balancing

	(1)	(2)	(3)	(4)
	Part-time employees		Full-time employees	
Banned export share x Post 2014	-146.909***	-125.123**	-384.578**	-128.022
	(50.223)	(48.105)	(177.502)	(159.867)
Banned export share x Post 2016		-56.133		-661.058**
		(52.725)		(314.478)
Constant	24.411***	24.378***	141.696***	141.306***
	(4.478)	(4.474)	(16.923)	(17.150)
R^2	0.755	0.757	0.953	0.956
N	151	151	151	151

Notes: This table shows the effect of the Russian ban on the number of employees in Lithuanian food manufacturing firms over 2011-2017. For each *treated* firm that exported any banned products to Russia in 2013, we assign one *control* firm that is a food exporter and is closest in size (as measured by total sales). The dependent variable is then the difference in the number of either part-time employees (Columns 1-2) or full-time employees (Columns 3-4) between the treated and control firms. The first-differences observations are reweighted by balancing the first two moments of distributions of firm sales across the treated and control group in 2012. All specifications include match- and year-fixed effects. ***, **, and * refer to the statistical significance at 1%, 5%, and 10%, respectively.

Table B5: Propensity score matching

	(1)	(2)	(3)	(4)
	Part-time employees		Full-time employees	
Banned export share x Post 2014	-97.367**	-80.392*	53.687	352.928
	(41.103)	(40.822)	(259.022)	(249.252)
Banned export share x Post 2016		-107.457		-1894.211***
		(75.836)		(497.288)
Constant	21.534***	21.488***	123.219***	122.405***
	(4.213)	(4.251)	(24.427)	(23.876)
R^2	0.759	0.762	0.959	0.964
N	136	136	136	136

Notes: This table shows the effect of the Russian ban on the number of employees in Lithuanian food manufacturing firms over 2011-2017. For each *treated* firm that exported any banned products to Russia in 2013, we assign one *control* firm that is a food exporter and is closest in terms of propensity score, estimated based on sales in 2013, gross profit margin in 2013, and total exports in 2013. The dependent variable is then the difference in the number of either part-time employees (Columns 1-2) or full-time employees (Columns 3-4) between the treated and control firms. All specifications include match- and year-fixed effects. ***, **, and * refer to the statistical significance at 1%, 5%, and 10%, respectively.

Table B6: Matching without replacement

	(1)	(2)	(3)	(4)
	Part-time employees		Full-time employees	
Banned export share x Post 2014	-131.739***	-106.893**	-784.731***	-374.865**
	(48.875)	(47.099)	(206.920)	(183.002)
Banned export share x Post 2016		-63.698		-1050.801***
		(54.748)		(314.289)
Constant	20.920***	20.882***	71.740***	71.105***
	(4.143)	(4.141)	(22.863)	(22.689)
R^2	0.822	0.824	0.955	0.960
N	150	150	150	150

Notes: This table shows the effect of the Russian ban on the number of employees in Lithuanian food manufacturing firms over 2011-2017. For each *treated* firm that exported any banned products to Russia in 2013, we assign one *control* firm that is a food exporter and is closest in terms of in size (as measured by total sales). We match without replacement, picking the closest size matches as a priority. The dependent variable is then the difference in the number of either part-time employees (Columns 1-2) or full-time employees (Columns 3-4) between the treated and control firms. All specifications include match- and year-fixed effects. ***, **, and * refer to the statistical significance at 1%, 5%, and 10%, respectively.

Table B7: Control group only exporters to Russia but only non-banned products

	(1)	(2)	(3)	(4)
	Part-time employees		Full-time employees	
Banned export share x Post 2014	-141.070***	-119.876**	-453.575**	-209.698
	(50.460)	(48.461)	(184.888)	(167.125)
Banned export share x Post 2016		-57.096		-657.001**
		(52.446)		(323.490)
Constant	25.290***	25.251***	189.319***	188.877***
	(4.445)	(4.451)	(17.615)	(17.802)
R^2	0.760	0.763	0.941	0.944
N	147	147	147	147

Notes: This table shows the effect of the Russian ban on the number of employees in Lithuanian food manufacturing firms over 2011-2017. For each *treated* firm that exported any banned products to Russia in 2013, we assign one *control* firm that is a food exporter and is closest in terms of in size (as measured by total sales). We only consider control firm candidates among firms that export to Russia but export only those products that were not banned by Russian sanctions. The dependent variable is then the difference in the number of either part-time employees (Columns 1-2) or full-time employees (Columns 3-4) between the treated and control firms. All specifications include match- and year-fixed effects. ***, **, and * refer to the statistical significance at 1%, 5%, and 10%, respectively.

Table B8: Control group only exporters outside of Russia but banned products

	(1)	(2)	(3)	(4)
	Part-time employees		Full-time employees	
Banned export share x Post 2014	-127.845**	-103.264**	-729.323***	-392.096*
	(49.986)	(48.931)	(238.171)	(224.804)
Banned export share x Post 2016		-59.143		-811.389**
		(51.133)		(352.099)
Constant	18.920***	18.880***	17.958	17.404
	(4.600)	(4.603)	(24.741)	(24.995)
R^2	0.761	0.763	0.935	0.939
N	153	153	153	153

Notes: This table shows the effect of the Russian ban on the number of employees in Lithuanian food manufacturing firms over 2011-2017. For each *treated* firm that exported any banned products to Russia in 2013, we assign one *control* firm that is a food exporter and is closest in terms of in size (as measured by total sales). We only consider control firm candidates among firms that export to outside Russia but export those products that were banned by Russian sanctions. The dependent variable is then the difference in the number of either part-time employees (Columns 1-2) or full-time employees (Columns 3-4) between the treated and control firms. All specifications include match- and year-fixed effects. ***, **, and * refer to the statistical significance at 1%, 5%, and 10%, respectively.

Table B9: Control group only exporters outside of Russia and non-banned products

	(1)	(2)	(3)	(4)
	Part-time employees		Full-time employees	
Banned export share x Post 2014	-116.780**	-84.619*	-285.004**	-71.600
	(47.555)	(44.564)	(136.023)	(104.392)
Banned export share x Post 2016		-85.914*		-570.085**
		(50.317)		(253.234)
Constant	25.501***	25.439***	110.078***	109.663***
	(4.273)	(4.256)	(12.528)	(12.662)
R^2	0.784	0.789	0.975	0.977
N	153	153	153	153

Notes: This table shows the effect of the Russian ban on the number of employees in Lithuanian food manufacturing firms over 2011-2017. For each *treated* firm that exported any banned products to Russia in 2013, we assign one *control* firm that is a food exporter and is closest in terms of in size (as measured by total sales). We only consider control firm candidates among firms that export to outside Russia and export only those products that were not banned by Russian sanctions. The dependent variable is then the difference in the number of either part-time employees (Columns 1-2) or full-time employees (Columns 3-4) between the treated and control firms. All specifications include match- and year-fixed effects. ***, **, and * refer to the statistical significance at 1%, 5%, and 10%, respectively.

Table B10: Surviving firms

	(1)	(2)	(3)	(4)
	Part-time employees		Full-time employees	
Banned export share x Post 2014	-152.426***	-131.323***	-386.130**	-117.405
	(50.846)	(48.748)	(182.749)	(165.680)
Banned export share x Post 2016		-52.413		-667.427**
		(52.868)		(315.623)
Constant	23.841***	23.816***	149.633***	149.312***
	(4.766)	(4.773)	(18.222)	(18.454)
R^2	0.756	0.758	0.953	0.956
N	141	141	141	141

Notes: This table shows the effect of the Russian ban on the number of employees in Lithuanian food manufacturing firms over 2011-2017. For each *treated* firm that exported any banned products to Russia in 2013, we assign one *control* firm that is a food exporter, and is closest in size (as measured by total sales). The dependent variable is then the difference in the number of either part-time employees (Columns 1-2) or full-time employees (Columns 3-4) between the treated and control firms. In this analysis, we condition on the firm surviving until 2017. All specifications include match- and year-fixed effects. ***, **, and * refer to the statistical significance at 1%, 5%, and 10%, respectively.

C Appendix: Falsification Test

One concern with our tests is that we might be misestimating the effect of sanctions as Russian economy might have been facing lower general demand due to, e.g., lower world oil prices in 2014 or general economic recession. From Appendix Table B7, we see that when we compare food manufacturers that export banned products and non-banned products to Russia, it is particularly those that export banned products that changed their employment and adjusted on other margins.

We also go further and investigate another Lithuanian sector that had significant exports to Russia prior to 2013: beverage manufacturers. Arguably, any non-sanction related demand shock that affects food imports to Russia should have also affected beverage imports. However, a key distinction is that beverage manufacturers did not face Russian sanctions of their products.[31] We define treated group of beverage manufacturers in a similar fashion as we do for our baseline tests, i.e., based on the fraction exports to Russia out of their total sales, and control group to be the beverage manufacturers that are closest in terms of sales but did not export to Russia.[32]

As reported in Appendix Tables C1 and C2, we find no change in full-time employment, investment, and expansion to other foreign markets for beverage manufacturers that exported in Russia as compared those that did not. We do observe a delayed effect on part-time employment, presumably as the 2013 sanctions started appearing more permanent and some started anticipated sanctions on other products.

[31] We reconfirm that by investigating the actual products that Lithuanian beverage manufacturers export.

[32] We do not impose the condition that they should be exporters as that results in just 9 candidate control firms.

Table C1: Beverage manufacturers: Employment

	(1)	(2)	(3)	(4)
	Part-time employees		Full-time employees	
Russian export share x Post 2014	0.370	7.790	-21.607	-2.339
	(7.226)	(6.406)	(23.774)	(14.155)
Russian export share x Post 2016		-15.727**		-40.839
		(6.263)		(43.807)
Constant	-2.476	-2.497	1.316	1.261
	(2.495)	(2.521)	(5.762)	(5.811)
R^2	0.510	0.513	0.905	0.906
N	89	89	89	89

Notes: This table shows the effect of the Russian ban on the number of employees in Lithuanian beverage manufacturing firms over 2011-2017. For each *treated* firm that exported any products to Russia in 2013, we assign one *control* firm that is closest beverage manufacturer in size (as measured by total sales) but that did not export to Russia in 2013. The dependent variable is then the difference in the number of either part-time employees (Columns 1-2) or full-time employees (Columns 3-4) between the treated and control firms. All specifications include match- and year-fixed effects. ***, **, and * refer to the statistical significance at 1%, 5%, and 10%, respectively.

Table C2: Beverage manufacturers: Investment and revenue-increasing strategies

	(1)	(2)	(3)	(4)
	Investment		Exports outside of Russia	
Russian export share x Post 2014	-0.657	-1.179	1.862	1.266
	(1.489)	(1.694)	(1.534)	(1.533)
Russian export share x Post 2016		1.108		1.192
		(1.717)		(1.844)
Constant	-0.167	-0.251	1.091	1.091
	(0.424)	(0.473)	(0.695)	(0.700)
R^2	0.716	0.717	0.785	0.786
N	71	71	104	104

Notes: Notes: This table shows the effect of the Russian ban on the investment and export expansion of Lithuanian beverage manufacturing firms over 2011-2017. For each *treated* firm that exported any products to Russia in 2013, we assign one *control* firm that is closest beverage manufacturer in size (as measured by total sales) but that did not export to Russia in 2013. The dependent variable is then the difference in the number of either investment (Columns 1-2) or the dollar value of exports, excluding Russia (Columns 3-4) between the treated and control firms. All specifications include match- and year-fixed effects. ***, **, and * refer to the statistical significance at 1%, 5%, and 10%, respectively.

D Appendix: Further Empirical Evidence

D.1 Access to new export markets

In addition to the main channel discuss in the main text, another policy-relevant dimension is firms' ability to adjust towards finding new export markets. In the spirit of the specification (13), we add an additional interaction of the change in dollar value of exports outside of Russia between 2013 and 2015 to our dynamic specification:

$$\begin{aligned}\Delta Y_{i,t} =& \beta_1 \times Banned\, export\, share_i \times Post2014_t + \\ & \beta_2 \times Banned\, export\, share_i \times Post2016_t + \\ & \beta_2 \times Banned\, export\, share_i \times \Delta NonRu\, export\, change_i \times Post2016_t + \gamma_i + \tau_t + \epsilon_{i,t}.\end{aligned} \tag{D1}$$

In this specification, $\Delta NonRu\, export\, change_i$ refers to the difference in the change of exports outside of Russia between 2013 and 2015, where the difference is taken between the values of a treated firm i and its matched control firm. All other variables are defined as in specifications (1) and (2).

We report the results in Table D1, where we show that the adjustment in full-time employees over 2016-2017 was smaller for firms that had a larger increase in exports outside of Russia between 2013 and 2015, as compared to the respective change in the control firms. See the main text for the discussion of the main policy implications from this finding.

D.2 Investment

We also replicate the results reported in Table 6 and discussed in Section 6.2, where we estimate the triple interaction of banned export share and the change in part-time employees in 2013-2015 on investment as the dependent variable.

We argue that investment is a costly adjustment margin. For example, if the shock turns

Table D1: Interaction with the change in exports outside of Russia

	(1) Full-time employees
Banned export share x Post 2014	-128.022
	(163.557)
Banned export share x Post 2016	-546.798**
	(261.905)
Banned export share x Δ Non-Ru Exports (2013-2015) x Post 2016	25.454*
	(13.311)
Δ Non-Ru Exports (2013-2015) x Post 2016	-0.951
	(1.053)
Constant	142.975***
	(16.655)
R^2	0.958
N	149

Notes: This table shows the effect of the Russian ban on the number of employees in Lithuanian food manufacturing firms over 2011-2017. For each *treated* firm that has exported any banned products to Russia in 2013, we assign one *control* firm that is a food exporter, and is closest in size (as measured by total sales). The dependent variable is the difference in the number of full-time employees between the treated and control firms. All specifications include match- and year-fixed effects. ***, **, and * refer to the statistical significance at 1%, 5%, and 10%, respectively.

out to be more persistent than expected and that would necessitate additional changes in full-time labor, it might have to be accompanied by the additional change in investment. We thus estimate the specification (13) with investment as an outcome variable, i.e., we test whether the change in full-time employees was related to the initial adjustment to part-time employees:

$$\begin{aligned}\Delta Y_{i,t} = &\beta_1 \times Banned\,export\,share_i \times Post2014_t + \\ &\beta_2 \times Banned\,export\,share_i \times Post2016_t + \\ &\beta_3 \times Banned\,export\,share_i \times \Delta Part\,time\,change_i \times Post2016_t + \gamma_i + \tau_t + \epsilon_{i,t}\end{aligned}$$

In this specification, $\Delta Part\,time\,change_i$ refers to the difference in the change of part-time employees between 2013 and 2015, where the difference in investment is taken between the values of a treated firm i and its matched control firm. All other variables are defined as in specifications (1) and (2).

We report the results in Table D2, where we show that the adjustment in investment over 2016-2017 was indeed larger for firms that reduced part-time employees more between 2013 and 2015, as compared to the respective change in the control firms.

Table D2: Interaction of investment with the change in the part-time employees

	(1)
	Investment
Banned export share x Post 2014	-26.798*
	(13.679)
Banned export share x Post 2016	7.230
	(15.670)
$\Delta PartTime(2013-2014)$ x Post 2016	-0.097
	(0.077)
Banned export share x $\Delta PartTime(2013-2014)$ x Post 2016	0.744*
	(0.408)
Constant	-1.056
	(1.839)
R^2	0.603
N	125

Notes: This table shows the effect of the Russian ban on investment of Lithuanian food manufacturing firms over 2011-2017. For each *treated* firm that has exported any banned products to Russia in 2013, we assign one *control* firm that is a food exporter, and is closest in size (as measured by total sales). The dependent variable is the difference in invesment between the treated and control firms. All specifications include match- and year-fixed effects. ***, **, and * refer to the statistical significance at 1%, 5%, and 10%, respectively.

E Appendix: Conceptual Framework

The objective of this section is to set out a theoretical framework at a more conceptual level, leaving more technical details for the Appendix F. The theory helps us interpret empirical results as well as elucidate assumptions, channels, and implications consistent with the empirical findings.

E.1 Preferences and Technology

The real consumption index (Q_t) is defined as follows:

$$Q_t = \left[\int_{j \in J} q_t(j)^{\frac{\sigma-1}{\sigma}} \, dj \right]^{\frac{\sigma}{\sigma-1}}, \qquad \sigma > 1, \tag{D1}$$

where j indexes varieties; J is the set of all varieties; $q_t(j)$ denotes consumption of variety j; and σ governs the elasticity of substitution between varieties. The dual price index for the differentiated sector (P_t) is given by:

$$P_t = \left[\int_{j \in J} p_t(j)^{1-\sigma} \, dj \right]^{\frac{1}{1-\sigma}}. \tag{D2}$$

Then it follows that the domestic demand for variety j is:

$$q_t(j) = \left(\frac{p_t(j)}{P_t} \right)^{-\sigma} Q_t = \left(\frac{A_t}{p_t(j)} \right)^{\sigma}, \tag{D3}$$

where $A_t \equiv Q_t^{\frac{1}{\sigma}} P_t$ is a demand-shifter, similarly to Helpman et al. (2010). Refer below to the Appendix F.1 for a more detailed derivation.

A firm takes consumers' choices as given. Given the specification of the demand, the equilibrium revenues of a firm are:

$$r_t(j) \equiv p_t(j)\, q_t(j) = A_t q_t(j)^{\frac{\sigma-1}{\sigma}} = p_t(j)^{1-\sigma} A_t^{\sigma}. \tag{D4}$$

The production function is given by:

$$q_t(j) = \left(K_t^{\psi}(j) \left(L_t^F(j) \right)^{1-\psi} \right)^{\phi} \left(L_t^P(j) \right)^{1-\phi}, \tag{D5}$$

where the functional form is assumed to be identical across all firms producing varieties $j \in J$; ϕ, ψ denote distribution (share) parameters. As is standard, $q_t(j)$ denotes quantity, $K_t(j)$ capital, $L_t^F(j)$ full-time employment and $L_t^P(j)$ part-time employment. A simplifying assumption of the unitary elasticity of substitution across inputs helps us clarify key channels and arrive at the closed-form solutions.

E.2 Openness

Building on the above economic structure of preferences and technology, we move to the firm's choice to trade. Based on equation (D3), the domestic quantity satisfies $q_t(j) = \left(\frac{A_t}{p_t(j)}\right)^{\sigma}$ and it follows that a foreign consumer faces a price $\tau(j)\, p_t(j)$, whereas a domestic producer has to produce $\tau(j) > 1$ units for $\left(\frac{A_t^{\star}}{\tau(j) p_t(j)}\right)^{\sigma}$ quantity to arrive to the foreign market:

$$q_t^x(j) = \tau(j) \left(\frac{A_t^{\star}}{\tau(j)\, p_t(j)}\right)^{\sigma},$$

where $A_t^{\star}$ is the foreign demand shifter, $A_t^{\star} \equiv Q_t^{\star\frac{1}{\sigma}} P_t^{\star}$.

This expression yields $\left(\frac{q_t^x(j)}{q_t^d(j)}\right)^{\frac{1}{\sigma}} = \tau_t^{\frac{1-\sigma}{\sigma}}(j) \left(\frac{A_t^{\star}}{A_t}\right)$. And, lastly, we can express total quantity as:

$$\begin{aligned} q_t(j) &\equiv q_t^d(j) + \mathbb{I}_t^x(j)\, q_t^x(j) = q_t^d(j) + \mathbb{I}_t^x(j) \left[\tau_t^{\frac{1-\sigma}{\sigma}}(j) \left(\frac{A_t^{\star}}{A_t}\right)\right]^{\sigma} q_t^d(j) \\ &= \left[1 + \mathbb{I}_t^x(j) \left(\tau_t^{\frac{1-\sigma}{\sigma}}(j) \left(\frac{A_t^{\star}}{A_t}\right)\right)^{\sigma}\right] \left(\frac{A_t}{p_t(j)}\right)^{\sigma} = \Upsilon_t(j) \left(\frac{A_t}{p_t(j)}\right)^{\sigma}, \end{aligned}$$

and the total revenues of a firm as follows:

$$\begin{aligned} r_t(j) &\equiv p_t(j)\, q_t(j) \\ &= \left[1 + \mathbb{I}_t^x(j)\, \tau_t^{1-\sigma}(j) \left(\frac{A_t^{\star}}{A_t}\right)^{\sigma}\right]^{\frac{1}{\sigma}} A_t q_t^{\frac{\sigma-1}{\sigma}}(j) = \Upsilon_t^{\frac{1}{\sigma}}(j)\, A_t q_t^{\frac{\sigma-1}{\sigma}}(j). \end{aligned} \tag{D6}$$

The variable $\Upsilon_t(j) - 1$ denotes the market access by a firm, and captures the share of exports over domestic revenue:

$$\Upsilon_t(j) \equiv 1 + \mathbb{I}_t^x(j)\, \tau_t^{1-\sigma}(j) \left(\frac{A_t^{\star}}{A_t}\right)^{\sigma} \geq 1, \tag{D7}$$

where $\mathbb{I}_t^x(j)$ is an indicator variable equal to one (zero) if firm j chooses to serve a foreign market. It is straightforward to extend this setting to more than two foreign countries[33] but it suffices to consider two trade partners.

In our case, we refer to them as Russia (RU) and the rest of the world (RW):

$$\Upsilon_t(j) \equiv 1 + \tau_{RU,t}^{1-\sigma}(j)\left(\frac{A_{RU,t}^{\star}}{A_t}\right)^{\sigma} + s_{RW,t}^{x}(j)\,\tau_{RW,t}^{1-\sigma}(j)\left(\frac{A_{RW,t}^{\star}}{A_t}\right)^{\sigma} \geq 1. \qquad \text{(D8)}$$

We consider only those firms that are exporters to Russia, so there is no indicator function (in other words, we consider firms *conditional* on exporting to Russia). The rest of the world is captured by the share function, $s_{RW,t}^{x}(j)$, an extensive margin of trade. Unlike a binary choice ($\mathbb{I}_t^x(j)$), and to provide as close and transparent connection as possible to the data, $s_{RW,t}^{x}(j)$ captures the coverage of all remaining world markets under a trade costs symmetry assumption.[34] We denote a share of export revenues (an intensive margin) as:

$$\mathcal{S}_t^{RU}(j) = \frac{\Upsilon_t(j)-1}{\Upsilon_t(j)} - \frac{s_{RW,t}^{x}(j)\tau_{RW,t}^{1-\sigma}(j)\left(\frac{A_{RW,t}^{\star}}{A_t}\right)^{\sigma}}{\Upsilon_t(j)}$$

and

$$\mathcal{S}_t^{RW}(j) = \frac{r_t^{RW}(j)}{r_t^{d}(j)+r_t^{RU}(j)+r_t^{RW}(j)} = \frac{\Upsilon_t(j)-1}{\Upsilon_t(j)} - \frac{\tau_{RU,t}^{1-\sigma}(j)\left(\frac{A_{RU,t}^{\star}}{A_t}\right)^{\sigma}}{\Upsilon_t(j)}. \qquad \text{(D9)}$$

In a standard two-country setting, export revenue share collapses to $\mathcal{S}_t(j) = \frac{\Upsilon_t(j)-1}{\Upsilon_t(j)}$. For full details regarding the derivation of quantity, prices and revenues in this three-country setting, please refer to the Appendix F.2 below.

E.3 Optimal Choices

Given the structure outlined above, we summarize firm's optimal choices. Recall that since the focus of our empirical analysis is on the exporters to Russia, we only consider those firms

[33] If each firm reaches a set of foreign markets, we can generalize: $\Upsilon_t(j) \equiv 1+\sum_{\ell}\mathbb{I}_{\ell t}^{x}(j)\,\tau_{\ell t}^{1-\sigma}(j)\left(\frac{A_{\ell t}^{\star}}{A_t}\right)^{\sigma} \geq 1$, where $\ell = 1,\ldots,\mathcal{L}$.

[34] One can think of the (normalized) sum as: $\sum_{\ell=1}^{\mathcal{L}}\mathbb{I}_{\ell,t}^{x}(j)\,\tau_{RW,t}^{1-\sigma}(j)\left(\frac{A_{RW,t}^{\star}}{A_t}\right)^{\sigma} = \tau_{RW,t}^{1-\sigma}(j)\left(\frac{A_{RW,t}^{\star}}{A_t}\right)^{\sigma}\sum_{\ell}\mathbb{I}_{\ell,t}^{x}(j)$, where symmetry across foreign markets was assumed. In such a case, $\mathcal{L}\times s_{RW,t}^{x}(j) = \sum_{\ell}\mathbb{I}_{\ell,t}^{x}(j)$, and we can thus normalize $\mathcal{L}=1$.

that have been trading with Russia. As in the data, these firms have a choice to increase exporting to the rest of the world. The per-period profit of a firm is then:

$$\pi_t(j) = \Bigg\{ \left[1 + \tau_{RU,t}^{1-\sigma}(j) \left(\frac{A_{RU,t}^{\star}}{A_t}\right)^{\sigma} + s_{RW,t}^{x}(j)\, \tau_{RW,t}^{1-\sigma}(j) \left(\frac{A_{RW,t}^{\star}}{A_t}\right)^{\sigma}\right]^{\frac{1}{\sigma}} \times$$

$$A_t \left(\left(\psi K_t^{\gamma}(j) + (1-\psi)\left(L_t^F(j)\right)^{\gamma}\right)^{\frac{\phi}{\gamma}} \left(L_t^P(j)\right)^{1-\phi} \right)^{\frac{\sigma-1}{\sigma}} \tag{D10}$$

$$- w_t^F L_t^F(j) - w_t^P L_t^P(j) - I_t(j) - \Phi^L\left(L_t^F(j), H_t^F(j)\right) - s_{RW,t}^{x}(j)\, f_x \Bigg\},$$

where Φ^L stands for a full-time labor adjustment costs function. The other notation is standard: $I_t(j)$ stands for the firm j investment, $H_t^F(j)$ denotes a change in full-time labor stock, and $\Phi^L\left(L_t^F(j), H_t^F(j)\right)$ takes full-time labor adjustment costs into account. We will assume that hiring and firing costs per each full-time employee, h and f, respectively, are constant across all firms.

A firm engages in a dynamic planning and optimizes by taking into account a constant discount rate ρ:

$$\max_{\substack{L_{t+1}^F(j),\, H_t^F(j),\, L_t^P(j),\\ K_{t+1}(j),\, I_t(j),\, s_{RW,t}^{x}(j)}} \mathbb{E}_t \sum_{s=t}^{+\infty} \rho^s \pi_s(j) =$$

$$\max_{\substack{L_{t+1}^F(j),\, H_t^F(j),\, L_t^P(j),\\ K_{t+1}(j),\, I_t(j),\, s_{RW,t}^{x}(j)}} \mathbb{E}_t \sum_{s=t}^{+\infty} \rho^s \Bigg\{ \left[1 + \tau_{RU,s}^{1-\sigma}(j) \left(\frac{A_{RU,s}^{\star}}{A_s}\right)^{\sigma} + s_{RW,s}^{x}(j)\, \tau_{RW,s}^{1-\sigma}(j) \left(\frac{A_{RW,s}^{\star}}{A_s}\right)^{\sigma}\right]^{\frac{1}{\sigma}}$$

$$\times A_s \left(\left(\psi K_s^{\gamma}(j) + (1-\psi)\left(L_s^F(j)\right)^{\gamma}\right)^{\frac{\phi}{\gamma}} \left(L_s^P(j)\right)^{1-\phi} \right)^{\frac{\sigma-1}{\sigma}} \tag{D11}$$

$$- w_s^F L_s^F(j) - w_s^P L_s^P(j) - I_s(j)$$

$$- \Phi^L\left(L_s^F(j), H_s^F(j)\right) - s_{RW,s}^{x}(j)\, f_x \Bigg\},$$

subject to the following constraints:

$$I_t(j) = K_{t+1}(j) - (1-\delta)\,K_t(j), \tag{D12}$$

$$L^F_{t+1}(j) = L^F_t(j) + H^F_t(j), \tag{D13}$$

$$\Phi^L\left(L^F_t(j), H^F_t(j)\right) = hH^F_t(j)\,\mathbb{I}_{\triangle L^F_t(j)>0} - fH^F_t(j)\,\mathbb{I}_{\triangle L^F_t(j)<0}. \tag{D14}$$

The firm's optimal choices, ignoring variety-specific notation, can be summarized as follows:

$$\begin{aligned}
\mu_t &= \rho\left(\Upsilon^{\frac{1}{\sigma}}_{t+1}A_{t+1}\left(\tfrac{\sigma-1}{\sigma}\right)q_{t+1}^{\frac{\sigma-1}{\sigma}}(1-\psi)\,\phi\left(L^F_{t+1}\right)^{\gamma-1}\left(\Phi^{\gamma}_{t+1}\right)^{-1} - w^F_{t+1} + \mu_{t+1}\right),\\
\mu_t &= h\mathbb{I}_{H^F_t>0} - f\mathbb{I}_{H^F_t<0},\\
w^P_t &= \Upsilon^{\frac{1}{\sigma}}_t A_t\left(\tfrac{\sigma-1}{\sigma}\right)q_t^{-\frac{1}{\sigma}}\tfrac{\partial q_t}{\partial L^P_t},\\
\tfrac{1-\rho+\delta\rho}{\rho} &= \Upsilon^{\frac{1}{\sigma}}_{t+1}A_{t+1}\left(\tfrac{\sigma-1}{\sigma}\right)q_{t+1}^{-\frac{1}{\sigma}}\tfrac{\partial q_{t+1}}{\partial K_{t+1}},\\
q_t^{\frac{1}{\sigma}} &= \frac{\tau_{RW,t}A_t\left(A^{\star}_{RW,t}\right)^{\frac{\sigma}{1-\sigma}}}{\sigma^{\frac{1}{1-\sigma}}f_x^{\frac{1}{1-\sigma}}}\Upsilon^{\frac{1}{\sigma}}_t\left(s^x_{RW,t};\tau_{RU,t},\tau_{RW,t}\right).
\end{aligned} \tag{D15}$$

As usual, capital takes time to be installed and become productive and depreciates at a rate δ (see equation (D12)). Otherwise, we abstract from the adjustment costs of investment, thus marginal (revenue) product of capital refers to marginal product of capital and additional revenue, both evaluated next period and discounted, as well as depreciation rate.

E.4 Full-time Labor Adjustment

As covered in the main text, we introduce a concept of a large shock, which necessitates costly adjustment margins by a firm. Recall that we consider a state space reduction into two discrete states – good and bad. Let the transition probability of moving between good and bad states be p, whereas with probability $1-p$ that the state remains the same in the next period. In the good state change case, a firm hires new full-time staff whereas in the case when a bad state happens – it lays off current full-time employees. Given the full-time labor adjustment cost function in the equation (D14), the full-time labor shadow value varies in the interval $h \geq \mu_t(j) \geq -f$, with the equality constraint binding when hiring or firing occurs. Whenever a firm hits an action interval, then $\mu_t(j)$ is equal to $-f$ under the adverse shock and h under a favorable shock.

Using the first-order conditions for the full-time labor, summarized by the first two equations of the shadow value $\mu_t(j)$ in Section E.3, we get:

$$-f = \rho \left(\Upsilon_{t+1}^{\frac{1}{\sigma}}(j) A_{t+1} \left(\frac{\sigma - 1}{\sigma} \right) \underline{q}_{t+1}^{-\frac{1}{\sigma}}(j) \frac{\partial \underline{q}_{t+1}(j)}{\partial L_{t+1}^{F}(j)} - w_{t+1}^{F} - (1-p) f + ph \right), \tag{D16}$$

where $\underline{q}_{t+1}(j) \equiv q\left(L_{t+1}^{F-}(j), L_{t+1}^{P}(j)\right)$ denotes *reduced* employment levels (thereby implying a negative $H_t^F(j)$). This means that firing is optimal rather than waiting. That coincides with our definition of a large shock, i.e., a situation when the trade disruption is so large that paying firing costs is preferred.[35] In a good state:

$$h = \rho \left(\Upsilon_{t+1}^{\frac{1}{\sigma}}(j) A_{t+1} \left(\frac{\sigma - 1}{\sigma} \right) \bar{q}_{t+1}^{-\frac{1}{\sigma}}(j) \frac{\partial \bar{q}_{t+1}(j)}{\partial L_{t+1}^{F}(j)} - w_{t+1}^{F} - pf + (1-p) h \right), \tag{D17}$$

where $\bar{q}_{t+1}(j) \equiv q\left(L_{t+1}^{F+}(j), L_{t+1}^{P}(j)\right)$ denotes *increased* employment levels (implying positive $H_t^F(j)$). Manipulating these two expressions and simplifying by the normalization of hiring costs to $h = 0$, we end up with:

$$\left(L_{t+1}^{F-}(j)\right)^{(1-\psi)\phi\frac{\sigma-1}{\sigma}-1} = \Psi_{t+1} \tau_{RW,t+1}^{\frac{\sigma-1}{\sigma}}(j) K_{t+1}(j)^{-\psi\phi\frac{\sigma-1}{\sigma}} \left(L_{t+1}^{P}(j)\right)^{-(1-\phi)\frac{\sigma-1}{\sigma}-\frac{1}{\sigma}}, \tag{D18}$$

where Ψ_{t+1} is a time-varying term, exogenous from the perspective of a firm (see Appendix F.4.3 below for the precise expression and derivation).[36]

[35] Technically, when μ_t drops below $-f$, an optimizing firm must fire full-time workers and do so until $\mu_t \geq -f$ is restored. That is why we only consider marginal values with equality.

[36] The term is given by $\Psi_{t+1} \equiv \frac{\left(-\frac{1}{\rho}f + (1-p(j))f + w_{t+1}^{F}\right)(\sigma-1)^{\frac{1}{\sigma}} f_x^{\frac{1}{\sigma}}}{A_{RW,t+1}^{\star}\left(\frac{\sigma-1}{\sigma}\right)\left(\frac{w^P}{1-\phi}\right)^{\frac{1}{\sigma}}(1-\psi)\phi}$.

F Appendix: Detailed Derivations

F.1 Demand Derivation

$$\max \left[\int_{j \in J} q_t(j)^{\frac{\sigma-1}{\sigma}} dj \right]^{\frac{\sigma}{\sigma-1}}, s.t. \int_{j \in J} p_t(j) q_t(j) = E_t = P_t Q_t.$$

The first order conditions (FOCs), after setting a Lagrangian, are

$$\frac{\sigma}{\sigma-1} \left[\int_{j \in J} q_t(j)^{\frac{\sigma-1}{\sigma}} dj \right]^{\frac{\sigma}{\sigma-1}-1} \frac{\sigma-1}{\sigma} q_t(j)^{\frac{\sigma-1}{\sigma}-1} - \lambda p_t(j) = 0$$
$$Q_t^{\frac{1}{\sigma}} q_t(j)^{-\frac{1}{\sigma}} - \lambda p_t(j) = 0$$
$$Q_t^{\frac{1}{\sigma}} q_t(j')^{-\frac{1}{\sigma}} - \lambda p_t(j') = 0$$

So, $\begin{matrix} Q_t^{\frac{1}{\sigma}} q_t(j)^{-\frac{1}{\sigma}} = \lambda p_t(j) \\ Q_t^{\frac{1}{\sigma}} q_t(j')^{-\frac{1}{\sigma}} = \lambda p_t(j') \end{matrix}$ or $q_t(j)^{-\frac{1}{\sigma}} = \frac{p_t(j)}{p_t(j')} q_t(j')^{-\frac{1}{\sigma}}$. It follows that

$$\int_{j \in J} q_t(j)^{-\frac{1}{\sigma}} p_t(j') q_t(j')^{\frac{1}{\sigma}} q_t(j) dj = p_t(j') q_t(j')^{\frac{1}{\sigma}} \int_{j \in J} q_t(j)^{\frac{\sigma-1}{\sigma}} dj$$
$$= p_t(j') q_t(j')^{\frac{1}{\sigma}} Q_t^{\frac{\sigma-1}{\sigma}} = P_t Q_t$$

and $q_t(j)^{\frac{1}{\sigma}} = p_t(j)^{-1} P_t Q_t^{\frac{1}{\sigma}}$ or $q_t(j) = p_t(j)^{-\sigma} P_t^{\sigma} Q_t$. An inverse demand function follows immediately:

$$p_t(j) = A_t (q_t(j))^{-\frac{1}{\sigma}}.$$

F.2 Extension to Multiple Countries

For the two foreign countries, the additivity is useful when it comes to expressing a total quantity for an exporter as:

$$q_t(j) \equiv q_t^d(j) + q_t^{RU}(j) + q_t^{RW}(j)$$
$$= (p_t(j))^{-\sigma} A_t^{\sigma} \left[1 + \left(\frac{A^{\star}_{RU,t}}{A_t} \right)^{\sigma} \tau_{RU,t}^{1-\sigma}(j) + s^x_{RW,t}(j) \left(\frac{A^{\star}_{RW,t}}{A_t} \right)^{\sigma} \tau_{RW,t}^{1-\sigma}(j) \right]$$

and inverse demand

$$p_t(j) = (q_t(j))^{-\frac{1}{\sigma}} A_t \left(1 + \left(\frac{A^{\star}_{RU,t}}{A_t} \right)^{\sigma} \tau_{RU,t}^{1-\sigma}(j) + s^x_{RW,t}(j) \left(\frac{A^{\star}_{RW,t}}{A_t} \right)^{\sigma} \tau_{RW,t}^{1-\sigma}(j) \right)^{\frac{1}{\sigma}}$$
$$= (q_t(j))^{-\frac{1}{\sigma}} A_t \Upsilon_t(j)^{\frac{1}{\sigma}},$$

thereby yielding

$$
\begin{aligned}
r_t(j) &\equiv p_t(j)\, q_t^d(j) + p_t(j)\, q_t^{RU}(j) + p_t(j)\, q_t^{RW}(j) = p_t(j)\, q_t^d(j) \left[1 + \frac{q_t^{RU}(j)}{q_t^d(j)} + \frac{q_t^{RW}(j)}{q_t^d(j)}\right] \\
&= (p_t(j))^{1-\sigma} A_t^\sigma \left[1 + \left(\frac{A^\star_{RU,t}}{A_t}\right)^\sigma \tau^{1-\sigma}_{RU,t}(j) + s^x_{RW,t}(j) \left(\frac{A^\star_{RW,t}}{A_t}\right)^\sigma \tau^{1-\sigma}_{RW,t}(j)\right] \\
&= (q_t(j))^{\frac{\sigma-1}{\sigma}} A_t \left[1 + \left(\frac{A^\star_{RU,t}}{A_t}\right)^\sigma \tau^{1-\sigma}_{RU,t}(j) + s^x_{RW,t}(j) \left(\frac{A^\star_{RW,t}}{A_t}\right)^\sigma \tau^{1-\sigma}_{RW,t}(j)\right]^{\frac{1}{\sigma}}.
\end{aligned}
$$

We will denote a share of export revenues (an intensive margin) as

$$
\begin{aligned}
\mathcal{S}_t^{RU}(j) &= \frac{r_t^{RU}(j)}{r_t^d(j)+r_t^{RU}(j)+r_t^{RW}(j)} = \frac{\tau_{RU,t}(j)\left(\frac{A^\star_{RU,t}}{\tau_{RU,t}(j)}\right)^\sigma p_t^{1-\sigma}(j)}{(q_t(j))^{\frac{\sigma-1}{\sigma}} A_t \left[1+\left(\frac{A^\star_{RU,t}}{A_t}\right)^\sigma \tau^{1-\sigma}_{RU,t}(j)+s^x_{RW,t}(j)\left(\frac{A^\star_{RW,t}}{A_t}\right)^\sigma \tau^{1-\sigma}_{RW,t}(j)\right]^{\frac{1}{\sigma}}} \\
&= \frac{\tau_{RU,t}(j)\left(\frac{A^\star_{RU,t}}{\tau_{RU,t}(j)}\right)^\sigma (q_t(j))^{-\frac{1-\sigma}{\sigma}} A_t^{1-\sigma} \Upsilon_t(j)^{\frac{1-\sigma}{\sigma}}}{(q_t(j))^{\frac{\sigma-1}{\sigma}} A_t \Upsilon_t(j)^{\frac{1}{\sigma}}} = \frac{\tau_{RU,t}(j)\left(\frac{A^\star_{RU,t}}{\tau_{RU,t}(j)}\right)^\sigma A_t^{-\sigma}}{\Upsilon_t(j)} \\
&= \frac{\Upsilon_t(j)-1-s^x_{RW,t}(j)\tau^{1-\sigma}_{RW,t}(j)\left(\frac{A^\star_{RW,t}}{A_t}\right)^\sigma}{\Upsilon_t(j)} = \frac{\Upsilon_t(j)-1}{\Upsilon_t(j)} - \frac{s^x_{RW,t}(j)\tau^{1-\sigma}_{RW,t}(j)\left(\frac{A^\star_{RW,t}}{A_t}\right)^\sigma}{\Upsilon_t(j)}
\end{aligned}
$$

and

$$
\begin{aligned}
\mathcal{S}_t^{RW}(j) &= \frac{r_t^{RW}(j)}{r_t^d(j)+r_t^{RU}(j)+r_t^{RW}(j)} = \frac{s^x_{RW,t}(j)\tau_{RW,t}(j)\left(\frac{A^\star_{RW,t}}{\tau_{RW,t}(j)}\right)^\sigma p_t^{1-\sigma}(j)}{(q_t(j))^{\frac{\sigma-1}{\sigma}} A_t \left[1+\left(\frac{A^\star_{RU,t}}{A_t}\right)^\sigma \tau^{1-\sigma}_{RU,t}(j)+s^x_{RW,t}(j)\left(\frac{A^\star_{RW,t}}{A_t}\right)^\sigma \tau^{1-\sigma}_{RW,t}(j)\right]^{\frac{1}{\sigma}}} \\
&= \frac{s^x_{RW,t}(j)\tau_{RW,t}(j)\left(\frac{A^\star_{RW,t}}{\tau_{RW,t}(j)}\right)^\sigma (q_t(j))^{-\frac{1-\sigma}{\sigma}} A_t^{1-\sigma} \Upsilon_t(j)^{\frac{1-\sigma}{\sigma}}}{(q_t(j))^{\frac{\sigma-1}{\sigma}} A_t \Upsilon_t(j)^{\frac{1}{\sigma}}} = \frac{s^x_{RW,t}(j)\tau_{RW,t}(j)\left(\frac{A^\star_{RW,t}}{\tau_{RW,t}(j)}\right)^\sigma A_t^{-\sigma}}{\Upsilon_t(j)} \\
&= \frac{\Upsilon_t(j)-1-\tau^{1-\sigma}_{RU,t}(j)\left(\frac{A^\star_{RU,t}}{A_t}\right)^\sigma}{\Upsilon_t(j)} = \frac{\Upsilon_t(j)-1}{\Upsilon_t(j)} - \frac{\tau^{1-\sigma}_{RU,t}(j)\left(\frac{A^\star_{RU,t}}{A_t}\right)^\sigma}{\Upsilon_t(j)}.
\end{aligned}
$$

It is clear that when $\tau_{RU,t}(j) \to \infty$, $\mathcal{S}_t^{RU}(j) \to 0$ and $\mathcal{S}_t^{RW}(j) \to \frac{\Upsilon_t(j)-1}{\Upsilon_t(j)}$, thereby replicating a two-country world, as in Helpman et al. (2010) (see their footnote 15).

F.3 Optimal Choices

Setting up a Lagrangian in a perfect foresight environment with firm symmetry (to save on notation for each firm j, we abstract from variety/firm-specific notation from now on) yields:

$$\mathcal{L} = \sum_{s=t}^{+\infty} \rho^s \Bigg\{ \left[1 + \tau_{RU,s}^{1-\sigma} \left(\tfrac{A^\star_{RU,s}}{A_s} \right)^\sigma + s^x_{RW,s} \tau_{RW,s}^{1-\sigma} \left(\tfrac{A^\star_{RW,s}}{A_s} \right)^\sigma \right]^{\frac{1}{\sigma}} \times$$

$$A_s \left(\left(\psi K_s^\gamma + (1-\psi) \left(L_s^F \right)^\gamma \right)^{\frac{\phi}{\gamma}} \left(L_s^P \right)^{1-\phi} \right)^{\frac{\sigma-1}{\sigma}}$$

$$-w_s^F L_s^F - w_s^P L_s^P - I_s - h H_s^F \mathbb{I}_{\triangle L_s^F > 0}$$

$$+ f H_s^F \mathbb{I}_{\triangle L_s^F < 0} - s^x_{RW,s} f_x$$

$$+ \mathsf{q}_s \left(I_s + (1-\delta) K_s - K_{s+1} \right)$$

$$+ \mu_s \left(H_s^F + L_s^F - L_{s+1}^F \right) \Bigg\}.$$

The optimality conditions read as follows:

$$\frac{\partial \mathcal{L}}{\partial L_{t+1}^F} = 0 \Rightarrow -\rho^{t+1} w_{t+1}^F - \rho^t \mu_t + \rho^{t+1} \mu_{t+1} + \rho^{t+1} \Upsilon_{t+1}^{\frac{1}{\sigma}} A_{t+1} \left(\frac{\sigma - 1}{\sigma} \right) q_{t+1}^{-\frac{1}{\sigma}} \frac{\partial q_{t+1}}{\partial L_{t+1}^F}$$

$$\mu_t = \rho \left(\Upsilon_{t+1}^{\frac{1}{\sigma}} A_{t+1} \left(\frac{\sigma - 1}{\sigma} \right) q_{t+1}^{-\frac{1}{\sigma}} \frac{\partial q_{t+1}}{\partial L_{t+1}^F} - w_{t+1}^F + \mu_{t+1} \right) \tag{E1}$$

$$\mu_t = \rho \left(\Upsilon_{t+1}^{\frac{1}{\sigma}} A_{t+1} \left(\frac{\sigma - 1}{\sigma} \right) q_{t+1}^{\frac{\sigma-1}{\sigma}} (1-\psi) \phi \left(L_{t+1}^F \right)^{\gamma - 1} \left(\psi K_{t+1}^\gamma + (1-\psi) \left(L_{t+1}^F \right)^\gamma \right)^{-1} \right. \tag{E2}$$

$$\left. - w_{t+1}^F + \mu_{t+1} \right) \tag{E3}$$

$$\mu_t = \rho \left(\Upsilon_{t+1}^{\frac{1}{\sigma}} A_{t+1} \left(\frac{\sigma - 1}{\sigma} \right) q_{t+1}^{\frac{\sigma-1}{\sigma}} (1-\psi) \phi \left(L_{t+1}^F \right)^{\gamma - 1} \left(\Phi_{t+1}^\gamma \right)^{-1} - w_{t+1}^F + \mu_{t+1} \right) \tag{E4}$$

$$\frac{\partial \mathcal{L}}{\partial H_t^F} = 0 \Rightarrow h \mathbb{I}_{H_t^F > 0} - f \mathbb{I}_{H_t^F < 0} = \mu_t, \tag{E5}$$

$$\frac{\partial \mathcal{L}}{\partial L_{it}^P} = 0 \Rightarrow w_t^P = \Upsilon_t^{\frac{1}{\sigma}} A_t \left(\frac{\sigma - 1}{\sigma} \right) q_t^{-\frac{1}{\sigma}} \frac{\partial q_t}{\partial L_t^P}, \tag{E6}$$

$$\frac{\partial \mathcal{L}}{\partial K_{t+1}} = 0 \Rightarrow \mathsf{q}_{t+1}(1-\delta)\rho^{t+1} - \rho^t \mathsf{q}_t \tag{E7}$$

$$+ \rho^{t+1}\Upsilon_{t+1}^{\frac{1}{\sigma}} A_{t+1}\left(\frac{\sigma-1}{\sigma}\right) q_{t+1}^{-\frac{1}{\sigma}} \frac{\partial q_{t+1}}{\partial K_{t+1}} = 0,$$

$$\frac{1}{\rho}\mathsf{q}_t = \Upsilon_{t+1}^{\frac{1}{\sigma}} A_{t+1}\left(\frac{\sigma-1}{\sigma}\right) q_{t+1}^{-\frac{1}{\sigma}} \frac{\partial q_{t+1}}{\partial K_{t+1}} + \mathsf{q}_{t+1}(1-\delta), \tag{E8}$$

$$\frac{\partial \mathcal{L}}{\partial s_{RW,t}^x} = 0 \Rightarrow \frac{1}{\sigma}\left[1 + \tau_{RU,t}^{1-\sigma}\left(\frac{A_{RU,t}^\star}{A_t}\right)^\sigma + s_{RW,t}^x \tau_{RW,t}^{1-\sigma}\left(\frac{A_{RW,t}^\star}{A_t}\right)^\sigma\right]^{\frac{1-\sigma}{\sigma}} \tau_{RW,t}^{1-\sigma}\left(\frac{A_{RW,t}^\star}{A_t}\right)^\sigma A_t q_t^{\frac{\sigma-1}{\sigma}} = f_x, \tag{E9}$$

$$\sigma^{-\frac{1}{\sigma-1}} \Upsilon_t^{-\frac{1}{\sigma}}\left(s_{RW,t}^x; \tau_{RU,t}, \tau_{RW,t}\right) \tau_{RW,t}^{-1}\left(\frac{A_{RW,t}^\star}{A_t}\right)^{\frac{\sigma}{\sigma-1}} A_t^{\frac{1}{\sigma-1}} q_t^{\frac{1}{\sigma}} = f_x^{\frac{1}{\sigma-1}} \tag{E10}$$

$$q_t^{\frac{1}{\sigma}} = \frac{\tau_{RW,t} A_t \left(A_{RW,t}^\star\right)^{\frac{\sigma}{1-\sigma}}}{\sigma^{\frac{1}{1-\sigma}} f_x^{\frac{1}{1-\sigma}}} \Upsilon_t^{\frac{1}{\sigma}}\left(s_{RW,t}^x; \tau_{RU,t}, \tau_{RW,t}\right), \tag{E11}$$

$$\frac{\partial \mathcal{L}}{\partial I_t} = 0 \Rightarrow \mathsf{q}_t = 1, \tag{E12}$$

$$\frac{1-\rho+\delta\rho}{\rho} = \Upsilon_{t+1}^{\frac{1}{\sigma}} A_{t+1}\left(\frac{\sigma-1}{\sigma}\right) q_{t+1}^{-\frac{1}{\sigma}} \frac{\partial q_{t+1}}{\partial K_{t+1}} \tag{E13}$$

$$= \Upsilon_{t+1}^{\frac{1}{\sigma}} A_{t+1}\left(\frac{\sigma-1}{\sigma}\right) q_{t+1}^{\frac{\sigma-1}{\sigma}} \phi\psi K_{t+1}^{\gamma-1}\left(\psi K_{t+1}^\gamma + (1-\psi)\left(L_{t+1}^F\right)^\gamma\right)^{-1} \tag{E14}$$

$$= \Upsilon_{t+1}(\sigma-1)\tau_{RW,t+1}^{\sigma-1}\left(\frac{A_{t+1}}{A_{RW,t+1}^\star}\right)^\sigma f_x \phi\psi K_{t+1}^{\gamma-1}\left(\Phi_{t+1}^\gamma\right)^{-1} = \frac{1-\rho+\delta\rho}{\rho}. \tag{E15}$$

Notice that output can be split into flexible and non-flexible parts, $q_t = \Phi_t^\phi \left(L_t^P\right)^{1-\phi}$, where the non-flexible part of production is summarized by $\Phi_t^\gamma \equiv \left(\psi K_t^\gamma + (1-\psi)\left(L_t^F\right)^\gamma\right)$. In the main text, we consider a special case when γ approaches zero, the elasticity of substitution becomes unitary, and the production function becomes (D5).

Note that next period's capital requires adjusting investment in the current period, whereas full-time labor entails hiring and firing costs on top of temporal rigidities (a firm cannot hire or fire full-time employees contemporaneously).

F.4 Implications

F.4.1 Intensive Margin of Trade

We can use the trade share choice (E11) in combination with the part-time employment expression (E6) to pin down the relationship between openness and firm adjustment in the face of a shock. From (E11) , we have:

$$q_t = \frac{\tau_{RW,t}^{\sigma} A_t^{\sigma} \left(A_{RW,t}^{\star}\right)^{\frac{\sigma}{1-\sigma}\sigma}}{\sigma^{\frac{\sigma}{1-\sigma}} f_x^{\frac{\sigma}{1-\sigma}}} \Upsilon_t,$$

and equating to (E6), we obtain

$$\Upsilon_t^{\frac{1}{1-\sigma}\frac{\sigma-1}{\sigma}} A_t^{\frac{\sigma}{1-\sigma}\frac{\sigma-1}{\sigma}} \left(\frac{\sigma-1}{\sigma}\right)^{\frac{\sigma}{1-\sigma}\frac{\sigma-1}{\sigma}} \left(\frac{w^P L_t^P}{1-\phi}\right)^{\frac{\sigma}{\sigma-1}\frac{\sigma-1}{\sigma}} = \frac{\tau_{RW,t}^{\sigma\frac{\sigma-1}{\sigma}} A_t^{\sigma\frac{\sigma-1}{\sigma}} \left(A_{RW,t}^{\star}\right)^{\frac{\sigma}{1-\sigma}\sigma\frac{\sigma-1}{\sigma}}}{\sigma^{\frac{\sigma}{1-\sigma}\frac{\sigma-1}{\sigma}} f_x^{\frac{\sigma}{1-\sigma}\frac{\sigma-1}{\sigma}}} \Upsilon_t^{\frac{\sigma-1}{\sigma}}.$$

We can therefore express intensive margin as:

$$\Upsilon_t = \left(\frac{w^P L_t^P}{1-\phi}\right) (\sigma-1)^{-1} \tau_{RW,t}^{1-\sigma} \left(\frac{A_{RW,t}^{\star}}{A_t}\right)^{\sigma} f_x^{-1}.$$

It is clearly determined by the part-time labor, which acts as a choice variable in the face of an exogenous shock to trade to Russia. To see the full effect, notice that

$$\frac{\partial \Upsilon_t}{\partial L_t^P} = \left(\frac{w^P}{1-\phi}\right) (\sigma-1)^{-1} \tau_{RW,t}^{1-\sigma} \left(\frac{A_{RW,t}^{\star}}{A_t}\right)^{\sigma} f_x^{-1}$$

and

$$\frac{\partial \Upsilon_t}{\partial \tau_{RU,t}} = (1-\sigma)\, \tau_{RU,t}^{-\sigma} \left(\frac{A_{RU,t}^{\star}}{A_t}\right)^{\sigma} < 0,$$

thereby yielding

$$\frac{\frac{\partial \Upsilon_t}{\partial \tau_{RU,t}}}{\frac{\partial \Upsilon_t}{\partial L_t^P}} = \frac{\partial L_t^P}{\partial \tau_{RU,t}} = \frac{(\sigma-1)(1-\sigma)\, \tau_{RU,t}^{-\sigma} f_x}{\left(\frac{w^P}{1-\phi}\right) \tau_{RW,t}^{1-\sigma}} \left(\frac{A_{RU,t}^{\star}}{A_{RW,t}^{\star}}\right)^{\sigma} < 0,$$

as reported in the main text.

F.4.2 Revenue Share

Making use of the revenue share function, we get:

$$\mathcal{S}_t^{RW} = \frac{r_t^{RW}}{r_t^d + r_t^{RU} + r_t^{RW}} = \frac{\Upsilon_t - 1}{\Upsilon_t} - \frac{\tau_{RU,t}^{1-\sigma}\left(\frac{A_{RU,t}^{\star}}{A_t}\right)^{\sigma}}{\Upsilon_t}.$$

It then follows that

$$\begin{aligned}
\frac{\partial \mathcal{S}_t^{RW}}{\partial \tau_{RU,t}} &= \frac{\frac{\partial \Upsilon_t}{\partial \tau_{RU,t}}\Upsilon_t - \frac{\partial \Upsilon_t}{\partial \tau_{RU,t}}(\Upsilon_t - 1)}{(\Upsilon_t)^2} - \left[\frac{(1-\sigma)\tau_{RU,t}^{-\sigma}\left(\frac{A_{RU,t}^{\star}}{A_t}\right)^{\sigma}\Upsilon_t - \frac{\partial \Upsilon_t}{\partial \tau_{RU,t}}\tau_{RU,t}^{1-\sigma}\left(\frac{A_{RU,t}^{\star}}{A_t}\right)^{\sigma}}{(\Upsilon_t)^2}\right] \\
&= \frac{\frac{\partial \Upsilon_t}{\partial \tau_{RU,t}}}{(\Upsilon_t)^2} - \left[\frac{(1-\sigma)\tau_{RU,t}^{-\sigma}\Upsilon_t - \frac{\partial \Upsilon_t}{\partial \tau_{RU,t}}\tau_{RU,t}^{1-\sigma}}{(\Upsilon_t)^2}\right]\left(\frac{A_{RU,t}^{\star}}{A_t}\right)^{\sigma} \\
&= \frac{1}{(\Upsilon_t)^2}\left[\frac{\partial \Upsilon_t}{\partial \tau_{RU,t}} - (1-\sigma)\,\tau_{RU,t}^{-\sigma}\Upsilon_t\left(\frac{A_{RU,t}^{\star}}{A_t}\right)^{\sigma} + \frac{\partial \Upsilon_t}{\partial \tau_{RU,t}}\tau_{RU,t}^{1-\sigma}\left(\frac{A_{RU,t}^{\star}}{A_t}\right)^{\sigma}\right] \\
&= \frac{1}{(\Upsilon_t)^2}\frac{\partial \Upsilon_t}{\partial \tau_{RU,t}}\left[1 - (1-\sigma)\,\tau_{RU,t}^{-\sigma}\Upsilon_t\left(\frac{A_{RU,t}^{\star}}{A_t}\right)^{\sigma}\left(\frac{\partial \Upsilon_t}{\partial \tau_{RU,t}}\right)^{-1} + \tau_{RU,t}^{1-\sigma}\left(\frac{A_{RU,t}^{\star}}{A_t}\right)^{\sigma}\right].
\end{aligned}$$

Recall that

$$\frac{\partial \Upsilon_t}{\partial \tau_{RU,t}} = (1-\sigma)\,\tau_{RU,t}^{-\sigma}\left(\frac{A_{RU,t}^{\star}}{A_t}\right)^{\sigma},$$

therefore,

$$\frac{\partial \mathcal{S}_t^{RW}}{\partial \tau_{RU,t}} = \frac{1}{(\Upsilon_t)^2}\frac{\partial \Upsilon_t}{\partial \tau_{RU,t}}\left[1 - \Upsilon_t + \tau_{RU,t}^{1-\sigma}\left(\frac{A_{RU,t}^{\star}}{A_t}\right)^{\sigma}\right].$$

From the definition of the revenue share:

$$-\mathcal{S}_t^{RW}\Upsilon_t = 1 - \Upsilon_t + \tau_{RU,t}^{1-\sigma}\left(\frac{A_{RU,t}^{\star}}{A_t}\right)^{\sigma},$$

we obtain

$$\frac{\partial \mathcal{S}_t^{RW}}{\partial \tau_{RU,t}} = -\frac{\mathcal{S}_t^{RW}}{\Upsilon_t}\frac{\partial \Upsilon_t}{\partial \tau_{RU,t}}$$

or

$$\frac{\partial \mathcal{S}_t^{RW}}{\partial \tau_{RU,t}}\frac{\tau_{RU,t}}{\mathcal{S}_t^{RW}} = -\frac{\partial \Upsilon_t}{\partial \tau_{RU,t}}\frac{\tau_{RU,t}}{\Upsilon_t},$$

just as stated in Proposition 2.

For completeness, note that the openness margin can be expressed as:

$$\frac{\partial \Upsilon_t}{\partial \tau_{RU,t}} \frac{\tau_{RU,t}}{\Upsilon_t} = \frac{(1-\sigma)\tau_{RU,t}^{1-\sigma}\left(\frac{A^\star_{RU,t}}{A_t}\right)^\sigma}{\Upsilon_t} = \frac{(1-\sigma)\tau_{RU,t}^{1-\sigma}\left(\frac{A^\star_{RU,t}}{A_t}\right)^\sigma}{\left(\frac{w^P L_t^P}{1-\phi}\right)(\sigma-1)^{-1}\tau_{RW,t}^{1-\sigma}\left(\frac{A^\star_{RW,t}}{A_t}\right)^\sigma f_x^{-1}}$$

$$= -\frac{(\sigma-1)^2}{\left(\frac{w^P L_t^P}{1-\phi}\right)}\left(\frac{\tau_{RU,t}}{\tau_{RW,t}}\right)^{1-\sigma}\left(\frac{A^\star_{RU,t}}{A^\star_{RW,t}}\right)^\sigma f_x.$$

Making use of

$$\frac{\partial L_t^P}{\partial \tau_{RU,t}} \frac{\tau_{RU,t}}{L_t^P} = \frac{(\sigma-1)(1-\sigma)}{\left(\frac{w^P L_t^P}{1-\phi}\right)}\left(\frac{\tau_{RU,t}}{\tau_{RW,t}}\right)^{1-\sigma}\left(\frac{A^\star_{RU,t}}{A^\star_{RW,t}}\right)^\sigma f_x,$$

we obtain

$$\frac{\partial \Upsilon_t}{\partial \tau_{RU,t}} \frac{\tau_{RU,t}}{\Upsilon_t} = -\frac{(\sigma-1)^2}{\left(\frac{w^P L_t^P}{1-\phi}\right)}\left(\frac{\tau_{RU,t}}{\tau_{RW,t}}\right)^{1-\sigma}\left(\frac{A^\star_{RU,t}}{A^\star_{RW,t}}\right)^\sigma f_x = \frac{\partial L_t^P}{\partial \tau_{RU,t}} \frac{\tau_{RU,t}}{L_t^P}.$$

Therefore, this analysis justifies the use of part-time employment as a proxy for the trade shock hit by the firm.

F.4.3 Large Shock and Full-time Labor Adjustment

To shed light on key drivers of full-time labor layoffs, we focus on a closed-form solution for the production function (D5), as reported in the main text. The following expression for the next period's (lower) level of full-time labor emerges:

$$\left(L_{t+1}^{F-}\right)^{(1-\psi)\phi\frac{\sigma-1}{\sigma}-1} = \frac{\left(-\frac{1}{\rho}f + (1-p)\,f + w_{t+1}^F\right)(\sigma-1)^{\frac{1}{\sigma}} f_x^{\frac{1}{\sigma}} \tau_{RW,t+1}^{\frac{\sigma-1}{\sigma}}}{A^\star_{RW,t+1}\left(\frac{\sigma-1}{\sigma}\right)\left(L_{t+1}^P\right)^{(1-\phi)\frac{\sigma-1}{\sigma}+\frac{1}{\sigma}}\left(\frac{w^P}{1-\phi}\right)^{\frac{1}{\sigma}} K_{t+1}^{\psi\phi\frac{\sigma-1}{\sigma}}(1-\psi)\,\phi}.$$

To derive this result, we combine equations (E1) and (E5) and obtain:

$$-f = \rho\left(\Upsilon_{t+1}^{\frac{1}{\sigma}} A_{t+1}\left(\frac{\sigma-1}{\sigma}\right)\underline{q}_{t+1}^{-\frac{1}{\sigma}}\frac{\partial \underline{q}_{t+1}}{\partial L_{t+1}^F} - w_{t+1}^F - (1-p)\,f + ph\right), \tag{E16}$$

where $\underline{q}_{t+1} \equiv q\left(L_{t+1}^{F-}, L_{t+1}^P\right)$ denotes *reduced* employment levels (thereby implying a negative H_t^F). This means that firing is optimal rather than waiting. That coincides with our definition of a large shock, i.e., a situation when the trade disruption is so large that paying firing costs is preferred.[37] In a good state:

$$h = \rho \left(\Upsilon_{t+1}^{\frac{1}{\sigma}} A_{t+1} \left(\frac{\sigma - 1}{\sigma} \right) \bar{q}_{t+1}^{-\frac{1}{\sigma}} \frac{\partial \bar{q}_{t+1}}{\partial L_{t+1}^{F}} - w_{t+1}^{F} - pf + (1-p)\, h \right), \tag{E17}$$

where $\bar{q}_{t+1} \equiv q\left(L_{t+1}^{F+}, L_{t+1}^{P}\right)$ denotes *increased* employment levels (implying positive H_t^F). These two equations deliver the following result:

$$\begin{aligned}
-\tfrac{1}{\rho} f + (1-p)\, f + w_{t+1}^{F} - ph &= \Upsilon_{t+1}^{\frac{1}{\sigma}} A_{t+1} \left(\tfrac{\sigma-1}{\sigma}\right) \underline{q}_{t+1}^{-\frac{1}{\sigma}} \tfrac{\partial \underline{q}_{t+1}}{\partial L_{t+1}^{F}} \\
\tfrac{1}{\rho} h - (1-p)\, h + w_{t+1}^{F} + pf &= \Upsilon_{t+1}^{\frac{1}{\sigma}} A_{t+1} \left(\tfrac{\sigma-1}{\sigma}\right) \bar{q}_{t+1}^{-\frac{1}{\sigma}} \tfrac{\partial \bar{q}_{t+1}}{\partial L_{t+1}^{F}}.
\end{aligned}$$

Since we are dealing with a negative shock, we normalize $h = 0$ to simplify expressions (we are not concern with costly hiring decisions). We can summarize the new level of full-time employment under the large sanctions shock as follows:

$$\begin{aligned}
-\tfrac{1}{\rho} f + (1-p)\, f + w_{t+1}^{F} &= \Upsilon_{t+1}^{\frac{1}{\sigma}} A_{t+1} \left(\tfrac{\sigma-1}{\sigma}\right) \underline{q}_{t+1}^{\frac{\sigma-1}{\sigma}} (1-\psi)\, \phi \left(L_{t+1}^{F-}\right)^{\gamma-1} \Phi_{t+1}^{-\gamma} \\
w_{t+1}^{F} + pf &= \Upsilon_{t+1}^{\frac{1}{\sigma}} A_{t+1} \left(\tfrac{\sigma-1}{\sigma}\right) \bar{q}_{t+1}^{\frac{\sigma-1}{\sigma}} (1-\psi)\, \phi \left(L_{t+1}^{F+}\right)^{\gamma-1} \Phi_{t+1}^{\gamma}.
\end{aligned}$$

or

$$\begin{aligned}
-\tfrac{1}{\rho} f + (1-p)\, f + w_{t+1}^{F} &= \Upsilon_{t+1}^{\frac{1}{\sigma}} A_{t+1} \left(\tfrac{\sigma-1}{\sigma}\right) \Phi_{t+1}^{\phi\frac{\sigma-1}{\sigma}} \left(L_{t+1}^{P}\right)^{(1-\phi)\frac{\sigma-1}{\sigma}} (1-\psi)\, \phi \left(L_{t+1}^{F-}\right)^{\gamma-1} \Phi_{t+1}^{-\gamma} \\
w_{t+1}^{F} + pf &= \Upsilon_{t+1}^{\frac{1}{\sigma}} A_{t+1} \left(\tfrac{\sigma-1}{\sigma}\right) \bar{q}_{t+1}^{\frac{\sigma-1}{\sigma}} (1-\psi)\, \phi \left(L_{t+1}^{F+}\right)^{\gamma-1} \Phi_{t+1}^{\gamma}.
\end{aligned}$$

To follow the steps, we collect required elements:

$$\begin{aligned}
q_t &= \left(K_t^{\psi} \left(L_t^{F}\right)^{1-\psi}\right)^{\phi} \left(L_t^{P}\right)^{1-\phi} \\
\tfrac{\partial \underline{q}_{t+1}}{\partial L_{t+1}^{F}} &= (1-\psi)\, \phi K_{t+1}^{\psi\phi} \left(L_{t+1}^{F-}\right)^{(1-\psi)\phi-1} \left(L_{t+1}^{P}\right)^{1-\phi} \\
\underline{q}_{t+1}^{-\frac{1}{\sigma}} &= K_{t+1}^{-\frac{\phi}{\sigma}\psi} \left(L_{t+1}^{F-}\right)^{-\frac{\phi}{\sigma}(1-\psi)} \left(L_{t+1}^{P}\right)^{-\frac{(1-\phi)}{\sigma}}
\end{aligned}$$

Hence,

$$\begin{aligned}
&-\tfrac{1}{\rho} f + (1-p)\, f + w_{t+1}^{F} \\
&= (1-\psi)\, \phi \Upsilon_{t+1}^{\frac{1}{\sigma}} A_{t+1} \left(\tfrac{\sigma-1}{\sigma}\right) K_{t+1}^{\psi\phi - \frac{\phi}{\sigma}\psi} \left(L_{t+1}^{F-}\right)^{((1-\psi)\phi-1)-\frac{\phi}{\sigma}(1-\psi)} \left(L_{t+1}^{P}\right)^{(1-\phi)-\frac{(1-\phi)}{\sigma}} \\
&= (1-\psi)\, \phi \Upsilon_{t+1}^{\frac{1}{\sigma}} A_{t+1} \left(\tfrac{\sigma-1}{\sigma}\right) K_{t+1}^{\psi\phi\left(\frac{\sigma-1}{\sigma}\right)} \left(L_{t+1}^{F-}\right)^{(1-\psi)\phi\left(\frac{\sigma-1}{\sigma}\right)-1} \left(L_{t+1}^{P}\right)^{(1-\phi)\left(\frac{\sigma-1}{\sigma}\right)}
\end{aligned}$$

The above expression allows us re-expressing:

[37] Technically, when μ_t drops below $-f$, an optimizing firm must fire full-time workers and do so until $\mu_t \geq -f$ is restored. That is why we only consider marginal values with equality.

$$\left(L^{F-}_{t+1}\right)^{(1-\psi)\phi\left(\frac{\sigma-1}{\sigma}\right)-1} = \frac{-\frac{1}{\rho}f+(1-p)f+w^F_{t+1}}{(1-\psi)\phi\Upsilon^{\frac{1}{\sigma}}_{t+1}A_{t+1}\left(\frac{\sigma-1}{\sigma}\right)K^{\psi\phi\left(\frac{\sigma-1}{\sigma}\right)}_{t+1}\left(L^P_{t+1}\right)^{(1-\phi)\left(\frac{\sigma-1}{\sigma}\right)}}.$$

To get rid of the openness variable, we make use of

$$\Upsilon^{\frac{1}{\sigma}}_{t+1} = \left(\frac{w^P L^P_{t+1}}{1-\phi}\right)^{\frac{1}{\sigma}} (\sigma-1)^{-\frac{1}{\sigma}} \tau^{\frac{1-\sigma}{\sigma}}_{RW,t+1}\frac{A^\star_{RW,t+1}}{A_{t+1}} f_x^{-\frac{1}{\sigma}},$$

which leads to

$$\left(L^{F-}_{t+1}\right)^{(1-\psi)\phi\left(\frac{\sigma-1}{\sigma}\right)-1} = \frac{\left(-\frac{1}{\rho}f+(1-p)f+w^F_{t+1}\right)(\sigma-1)^{\frac{1}{\sigma}} f_x^{\frac{1}{\sigma}}}{(1-\psi)\phi\left(\frac{w^P}{1-\phi}\right)^{\frac{1}{\sigma}}\tau^{\frac{1-\sigma}{\sigma}}_{RW,t+1}A^\star_{RW,t+1}\left(\frac{\sigma-1}{\sigma}\right)K^{\psi\phi\left(\frac{\sigma-1}{\sigma}\right)}_{t+1}\left(L^P_{t+1}\right)^{(1-\phi)\left(\frac{\sigma-1}{\sigma}\right)+\frac{1}{\sigma}}}.$$

A closed-form solution for the production function (D5), therefore, follows:

$$\left(L^{F-}_{t+1}\right)^{(1-\psi)\phi\frac{\sigma-1}{\sigma}-1} = \Psi_{t+1}\tau^{\frac{\sigma-1}{\sigma}}_{RW,t+1}K^{-\psi\phi\frac{\sigma-1}{\sigma}}_{t+1}\left(L^P_{t+1}\right)^{-(1-\phi)\frac{\sigma-1}{\sigma}-\frac{1}{\sigma}}, \tag{E18}$$

where we used $q_t = \left(K^\psi_t\left(L^F_t\right)^{1-\psi}\right)^\phi\left(L^P_t\right)^{1-\phi}$, and denoted by $\Psi_{t+1} \equiv \frac{\left(-\frac{1}{\rho}f+(1-p)f+w^F_{t+1}\right)(\sigma-1)^{\frac{1}{\sigma}}f_x^{\frac{1}{\sigma}}}{A^\star_{RW,t+1}\left(\frac{\sigma-1}{\sigma}\right)\left(\frac{w^P}{1-\phi}\right)^{\frac{1}{\sigma}}(1-\psi)\phi}$ a time-varying term, exogenous from the perspective of a firm. This is an expression just as reported in the main text's equation (9).

Before learning how full-time employment adjusts, we have to first solve for the capital choice. From the first-order conditions, (E15), and under the production function (D5), we obtain:

$$K_{t+1} = \left(\frac{w^P}{1-\phi}\right)(\sigma-1)^{-1} f_x^{-1}\frac{\rho f_x\phi\psi(\sigma-1)}{1-\rho+\delta\rho}L^P_{t+1}, \tag{E19}$$

yielding

$$I_t = \left(\frac{w^P}{1-\phi}\right)\frac{\rho}{1-\rho}\phi\psi\triangle L^P_{t+1} \tag{E20}$$

where, for exposition purposes, we assume depreciation to be equal to zero. This result is what we report in the main text equations (10) and (11).

F.4.4 Investment

Our starting position is the capital equation

$$K_{t+1} = \Upsilon_{t+1}\tau_{RW,t+1}^{\sigma-1}\left(\frac{A_{t+1}}{A^{\star}_{RW,t+1}}\right)^{\sigma}\frac{\rho f_x\phi\psi\left(\sigma-1\right)}{1-\rho+\delta\rho}.$$

Making use of

$$\Upsilon_{t+1} = \left(\frac{w^P L^P_{t+1}}{1-\phi}\right)\left(\sigma-1\right)^{-1}\tau_{RW,t+1}^{1-\sigma}\left(\frac{A^{\star}_{RW,t+1}}{A_{t+1}}\right)^{\sigma} f_x^{-1} \ ,$$

we find that

$$K_{t+1} = \left(\frac{w^P}{1-\phi}\right)\left(\sigma-1\right)^{-1} f_x^{-1}\frac{\rho f_x\phi\psi(\sigma-1)}{1-\rho+\delta\rho}L^P_{t+1} \ .$$

It therefore follows that

$$\triangle K_{t+1} = I_t = \left(\frac{w^P}{1-\phi}\right)\frac{\rho}{1-\rho}\phi\psi\triangle L^P_{t+1} \ ,$$

when $\delta = 0$.

F.4.5 Full-time Labor and Capital

We can re-express labor adjustment (E18) in terms of the flexible adjustment margin, part-time employment, and exogenous (from the perspective of a firm) variables:

$$\left(L^{F-}_{t+1}\right)^{(1-\psi)\phi\left(\frac{\sigma-1}{\sigma}\right)-1} = \widetilde{\Psi}_t\tau_{RW,t+1}^{\frac{\sigma-1}{\sigma}}\left(L^P_{t+1}\right)^{-\frac{1}{\sigma}([1-\phi+\psi\phi](\sigma-1)+1)},$$

where $\widetilde{\Psi}_t$ is a mix of aggregate and exogenous terms. In fact, it is equal to:
$\widetilde{\Psi}_t \equiv \Psi_t\left(\left(\frac{w^P}{1-\phi}\right)\left(\sigma-1\right)^{-1} f_x^{-1}\frac{\rho f_x\phi\psi(\sigma-1)}{1-\rho+\delta\rho}\right)^{-\psi\phi\frac{\sigma-1}{\sigma}}$.

We combine an expression for $\left(L_{t+1}^{F-}\right)^{(1-\psi)\phi\left(\frac{\sigma-1}{\sigma}\right)-1}$ with K_{t+1} above:

$$\begin{aligned}\left(L_{t+1}^{F-}\right)^{(1-\psi)\phi\left(\frac{\sigma-1}{\sigma}\right)-1} &= \frac{\left(-\frac{1}{\rho}f+(1-p)f+w_{t+1}^{F}\right)(\sigma-1)^{\frac{1}{\sigma}}f_x^{\frac{1}{\sigma}}}{(1-\psi)\phi\left(\frac{w^P}{1-\phi}\right)^{\frac{1}{\sigma}}\tau_{RW,t+1}^{\frac{1-\sigma}{\sigma}}A_{RW,t+1}^{\star}\left(\frac{\sigma-1}{\sigma}\right)K_{t+1}^{\psi\phi\left(\frac{\sigma-1}{\sigma}\right)}\left(L_{t+1}^{P}\right)^{(1-\phi)\left(\frac{\sigma-1}{\sigma}\right)+\frac{1}{\sigma}}} \\ &= \Psi_{t+1}\tau_{RW,t+1}^{\frac{\sigma-1}{\sigma}}K_{t+1}^{-\psi\phi\frac{\sigma-1}{\sigma}}\left(L_{t+1}^{P}\right)^{-(1-\phi)\frac{\sigma-1}{\sigma}-\frac{1}{\sigma}} \\ &= \Psi_{t+1}\tau_{RW,t+1}^{\frac{\sigma-1}{\sigma}}\left(\left(\frac{w^P}{1-\phi}\right)(\sigma-1)^{-1}f_x^{-1}\frac{\rho f_x\phi\psi(\sigma-1)}{1-\rho+\delta\rho}L_{t+1}^{P}\right)^{-\psi\phi\frac{\sigma-1}{\sigma}}\left(L_{t+1}^{P}\right)^{-(1-\phi)\frac{\sigma-1}{\sigma}-\frac{1}{\sigma}} \\ &= \Psi_{t+1}\left(\left(\frac{w^P}{1-\phi}\right)(\sigma-1)^{-1}f_x^{-1}\frac{\rho f_x\phi\psi(\sigma-1)}{1-\rho+\delta\rho}\right)^{-\psi\phi\frac{\sigma-1}{\sigma}}\tau_{RW,t+1}^{\frac{\sigma-1}{\sigma}}\left(L_{t+1}^{P}\right)^{-\psi\phi\frac{\sigma-1}{\sigma}-(1-\phi)\frac{\sigma-1}{\sigma}-\frac{1}{\sigma}} \\ &= \widetilde{\Psi}_t\tau_{RW,t+1}^{\frac{\sigma-1}{\sigma}}\left(L_{t+1}^{P}\right)^{-\frac{1}{\sigma}(\psi\phi(\sigma-1)+(1-\phi)(\sigma-1)+1)} = \widetilde{\Psi}_t\tau_{RW,t+1}^{\frac{\sigma-1}{\sigma}}\left(L_{t+1}^{P}\right)^{-\frac{1}{\sigma}([1-\phi+\psi\phi](\sigma-1)+1)}.\end{aligned}$$