IMPACT OF TRADE BARRIERS ON FIRMS' PRODUCTIVITY AND EXPORT REALLOCATION

by

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A thesis submitted in partial fulfillment
of the requirements for the degree of

MA in Economic Analysis

Kyiv School of Economics

2017

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Kyiv School of Economics

Abstract

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This work examines the effect of Russian trade restrictions on Ukrainian manufacturing exporters using difference-in-differences OLS estimation. Furthermore, this paper compares the productivity levels of exporters to Russia with other exporters and provides the estimates of productivity trajectories for different types of exporters within 2 years from entering/exiting the export market. Finally, this thesis provides the decomposition of aggregate annual productivity changes of all exporters into two effects: own-productivity effect and export reallocation effect. Based on the KSE data center firm-level data for 2001-2015 it is shown that there is a significant negative effect of trade barriers on Ukrainian manufacturers. It is also proven that exporters to Russia on average are less productive than exporters that do not trade with Russia. The estimated productivity trajectories clearly indicate the productivity gains from entering export market and productivity losses in the case of exits. The positive reallocation effect of exporting to countries other than Russia on aggregate productivity change of all exporters shows that more productive firms reallocate their exports from Russian direction towards more lucrative countries. All these results imply that Ukrainian manufacturers should orient their trade activity to some developed countries in order to benefit from learning by exporting and boost their own productivity.

TABLE OF CONTENTS

TABLE OF CONTENTS - Continued

LIST OF FIGURES

Number *Page*

LIST OF TABLES

ACKNOWLEDGMENTS

The author wishes to the express deepest appreciation to his thesis advisor, Professor Volodymyr Vakhitov, for the important comments, ideas and engagement through the learning process of this master thesis. Special thanks to him for providing the data for implementing all initial ideas.

I am especially grateful to KSE researcher Mykola Ryzhenkov for his time spent on reviewing all the details of the thesis and providing reasonable suggestions for improving the context.

I would also like to acknowledge all my groupmates and first-year KSE students for being worried about my progress and supporting me in any situations.

Finally, I am immensely thankful to my parents for motivating me and believing in my success better than myself and to my girlfriend Liliia for her patience and encouragement during the days spent to complete this research.

GLOSSARY

CIS – Commonwealth of Independent States. A regional organization formed during the dissolution of the Soviet Union

DD – difference-in-differences. The regression specification based on the indicator variables approach, used for evaluation of the policy impact

EU – European Union

KSE – Kyiv School of Economics

KVED – classification of economic activities. A part of the state system of classification and coding of technical, economic and social information in Ukraine. It is harmonized with statistical classification of economic activities in the European Community (NACE)

OECD – Organization for Economic Co-operation and Development. An intergovernmental economic organization with 35 member countries, founded in 1960 to stimulate economic progress and world trade

OKPO – unified state register of enterprises and organizations. Now EDRPO – unique identification number of legal entity in the unified state register of firms and organizations

OLS – ordinary least squares. The most commonly used method of regression model estimation. It allows to find coefficients between linearly dependent variables through minimization of sum of squared errors of the estimate

R&D – research and development

UKRSTAT – State Statistics Service of Ukraine

US – United States of America

Chapter 1

INTRODUCTION

Recent dramatic political events between Ukraine and Russia caused big changes in the structure of Ukrainian exports. They also had a large impact on firms' productivity. Many Ukrainian firms had to find other export partners due to the blockade on goods they traded with Russia, while numerous small businesses closed up or exited the export market because of the trade ban. It is interesting to evaluate the impact of this ban on firms' productivity. Our initial guess is that the most productive firms are more diversified and less dependent on Russia, meaning that they have higher shares of exports to other countries. That is why, they suffered less than exporters with an high Russian export share. If we compare purely non-Russian exporters versus Russian exporters we can also find productivity differences between those groups. Another important idea of this thesis is to prove the fact that more productive manufacturing firms are able to not only enter or stay in the export market, but also to redirect their exports towards more lucrative countries when political situation requires to do so. In this section we look at the dynamics of total Ukrainian exports and trade exposure to Russia over the recent years. Then we describe the literature evidence of the link between export activity and productivity. The presence of this link explains our idea about productivity losses that are caused by export restrictions.

1.1. Evolution of trade war with Russia

The first actions of the recent trade war are dated on August 14 2013, when Russian customs service put Ukrainian exporters to the list of "risky", which led

to the trade ban on the goods exported from Ukraine to Russia. About a week later Russian customs officers unreasonably started total checking all the vehicles transporting goods of Ukrainian manufacturers. This led to huge lines with hundreds of trucks and trains accumulating at the Ukraine-Russia border.

At that period Russian sanitary service implemented a prohibition on supply of products of Roshen company, allegedly because of the disruption of sanitary norms by those products, however other countries did not manage to find any problems with the same products even after some tests were conducted. These events were called "Chocolate war" in the Ukrainian mass media. This so-called "war" leads to the idea that trade blockade is a part of measures taken by Russia against Ukraine's intentions to sign the Association Agreement with the European Union as the next step of Ukrainian integration into the EU.

Many of those trucks in huge lines on the Ukrainian-Russian border carried meat, vegetables, confectionary goods and other perishable goods, which spoiled during the period of staying in lines. In some cases, all checking procedures and all documentation checks could last for up to 15 days for particular transporters, which resulted in losses of Ukrainian producers. Some of them, for instance "Obolon" stopped supplying their products to Russia almost immediately.
During the rest of 2013 the control actions were changed few times. Restrictions were lifted up, but at the beginning of 2014 they were enhanced again without further reductions. All this clearly led to productivity distortions of Ukrainian manufacturers.

From January 1, 2016 Russian Federation terminates the Agreement on free trade zone within CIS in relation to Ukraine. Furthermore, it was decided to introduce so-called "food embargo" on some Ukrainian agricultural products. Thus, from January 1, 2016 two modes of "bounded trade" of Ukrainian goods to be applied:

1) introduction of export duty rates in the amount EAEU common customs tariff to all products originating from Ukraine;

2) a complete ban on exports of certain food products ("food embargo").

Only 10 days later, on January 11, another action by Russian Federation took place: transit restrictions of Ukrainian goods through Russia. Some media agencies (economics.unian.ua) estimate total losses for Ukrainian economy from trade embargo from the beginning of the conflict to be 1 bln USD.

Overall, the trade conflict caused a significant drop in Ukrainian export (Figure 1). The exported volume to Russia felt from 19,819,616.2 thousands USD in 2011 to 3,591,795.7 thousands USD in 2016, which is almost 82% decrease. Total export to Russia in 2011 constituted about 16% of Ukrainian GDP, meaning that this trade partner is very important for Ukraine and its economy.

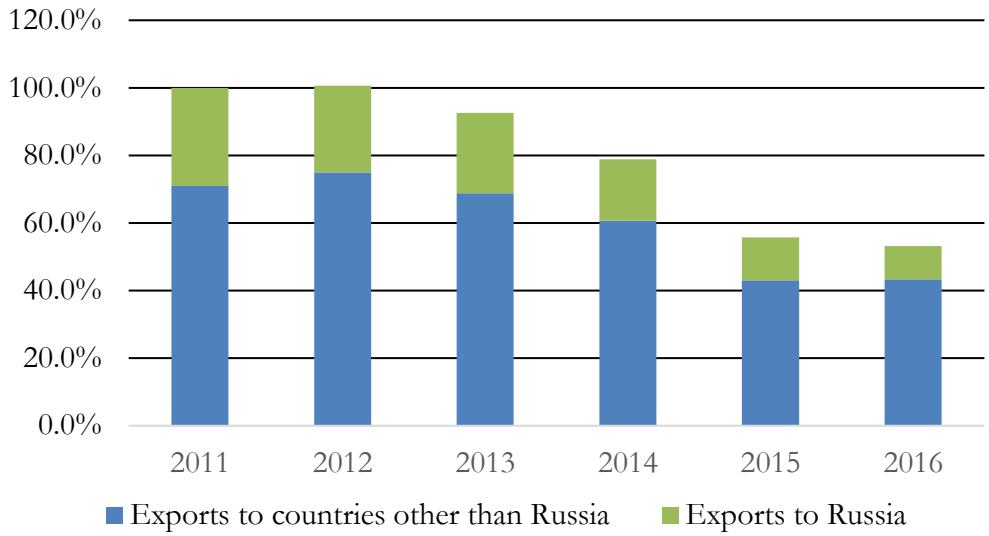

Figure 1. Composition of total export volumes in percentage terms relative to year 2011
Source: State Statistics Service of Ukraine[1]

The literature also suggests a high exposure to Russia of Ukrainian exports. According to Movchan et al. (2014), the sectoral exposure reaches 22% for "manufacture of machinery and equipment" meaning that 22% of output in this

[1]http://ukrstat.gov.ua/operativ/operativ2016/zd/eip_kv/eip_kv_u/eip2016_u.htm

sector is shipped to Russian Federation. It is clear that trade restrictions will lead to substantial problems for this sector The regional exposure is more even: the most highly exposed regions, Lugansk and Zaporizhzhia Oblasts, account for 10% of total regional exports that is being traded to Russia.

1.2. Link between productivity and export status

Since some firms were forced to quit their export to Russia or even stop export activity at all, the recent trade blockade led to productivity losses for the whole Ukrainian industry. In this section we consider the empirical evidence from the existing literature to figure out the relationship between the export activity and productivity gains/losses.

In classical papers on trade economics scientists compare profits and market share allocation before and after entering the export market. They perform empirical tests on whether this was always the case that only most productive firms were able to enter the export market crowding out the least productive ones (Melitz, 2003). In recent papers this approach is extended with the concept of "new" gains from trade in addition to the "traditional" ones, because the latter were not consistent with the last empirical results. This inconsistency arises from treating exit of domestic low-productivity firms from the market as a gain, while in fact it was a welfare loss for the industry (Hsieh et al., 2016). That is why we think that the firms that are forced to quit export activity due to Russian trade restrictions will decrease the aggregate performance of the industry.

Bernard and Jensen (2004) develops another idea about how economic activity reallocates from less productive to more productive firms and how productivity evolves when firms go in and out of the export market. We would like to see the evidence from Ukraine for the same concepts and to compare Russian exporters with other manufacturing firms involved in the international trade.

The main findings of this thesis are the negative impact of trade war with Russia on productivity of Ukrainian producers, relatively low productivity of exporters to Russia and reallocation of export from Russia to other countries by more productive manufacturers.

In this thesis we deal with the unique firm-level dataset of Ukrainian manufacturing firms in 2001-2015. The data were obtained from statistical records submitted annually to the State Statistics Service of Ukraine by all manufacturing and service firms in Ukraine. It contains the information from firms' financial statements and export customs declarations.

The structure of this paper is the following: Chapter 2 describes the literature on relation between productivity and export activity; Chapter 3 provides the methodology of the analysis and model specifications; data sources and issues are reviewed in Chapter 4; the main empirical results are presented in Chapter 5; Chapter 6 summarizes all key findings of the paper and brings ideas for the further research.

Chapter 2

LITERATURE REVIEW

This chapter starts with the theoretical literature review relating international trade and firm's performance. The second part of the chapter presents the most influential empirical papers.

2.1. Theoretical studies

Melitz (2003), a seminal paper in the field, developes a dynamic model of trade with heterogeneous products in monopolistically competitive industry with general equilibrium setting. This allowed Melitz to get identical aggregate outcomes the same as for representative firms despite the product heterogeneity. The model was very tractable because of using a single "sufficient" statistic such as the average firm productivity level. A considerable part in his paper was devoted to the discussion of sunk market entry costs for both domestic and export market. The paper describes how trade activity forces the least productive firms to exit the export market. We can conclude that for our case of Ukrainian industry the trade restrictions imposed by Russia will lower the productivity of exporters and, thus, will lead to many exits from international trade arena. Melitz (2003) also develops the idea about inter-firms reallocations from less productive firms to more productive ones due to exposure to export activity, which leads to overall welfare gain.

Wagner (2011) is a great summary of all ideas from academic papers being the most closely related to the thesis topic since 2006. The author summarizes all changes in the literature trends and opinions over the last 10 years. He composes both sides of the literature: theoretical, which started with Melitz (2003) and

empirical micro-level ones from Bernard and Jensen (1995). This composition gives us a clear understanding of all causal effects in international trade and provides thorough explanation of relationships between productivity and export activity of firms. A general idea is that entering the export market is costly because of transition costs and firms can afford that only by increasing their productivity. They do so because of the so-called learning effect: they learn something new by trading and further increase their productivity and competitiveness. So export helps to increase productivity and only productive firms can enter this market – the causality is two-sided.

Raa and Shestalova (2011) describe four different approaches to the measurement and decomposition of productivity growth. We decide to implement the Solow residual analysis (Solow, 1957) for this thesis because this is the most commonly used productivity measure and all needed variables are available in our dataset.

Olley and Pakes (1996) provide the estimation algorithm for productivity measurement based on the production function estimation and obtaining the Solow residuals. We use similar a methodology of estimating the productivity of firms while running cycle of regressions for each sector separately to account for cross-industry productivity differences, which exist according to Acemoglu and Zilibotti (2001).

The extension of the Olley and Pakes (1996) decomposition method was proposed by Melitz and Polanec (2012). The paper accounts for both firm entry and exit effects on aggregate productivity changes. Technical part of the paper helps to understand how the aggregate productivity decomposition can be theoretically modified. We use a similar approach to extend the decomposition of Bernard and Jensen (2005) by accounting for the effect of activity reallocation towards a particular country separately from all other countries' reallocation effects. We also substitute shares of output by the shares of exports in order to see the reallocation of export volumes instead of output reallocations among

domestic producers. By doing so we narrow the scope from the whole industry to all exporters, however, this allows us to test one of the main hypotheses about reallocation of exports towards more lucrative countries by more productive exporters.

One of the recent ideas in trade policy analysis (i.e., Hsieh, et al., 2016) is to distinguish "new" trade gains from "traditional ones". The former consist of the selection variety for customers due to foreign entries into exporting and productivity effects due to domestic exits out of production. Those exits of low productivity firms previously considered as a gain because of the increased average productivity in the industry, but in fact they are welfare reduction. The paper argues that all the previous literature has a biased account of the welfare effects of selection. Hsieh et al. (2016) uses difference-in-differences (DD) specification to account for "new" welfare losses. It gives us the idea to use DD regression for evaluating the productivity losses from trade restrictions in case of Ukrainian industry under the Russian trade ban.

2.2. Empirical studies

Tybout (2001) provides empirical evidence of the relationship between trade policy effects on firms' mark-ups, sizes, exports, productivity and profitability. Among his conclusions he mentioned that "literature is mixed on whether international activities cause these characteristics or vice versa". By "these characteristics", he meant high productivity, big firm size and high quality of goods. Martins and Yang (2009) conduct a meta-analysis of more than 30 papers to figure out the causality between trade activity and productivity. It finds that the effect of export activity on productivity is higher at developing economies than at developed ones. Another finding is that learning-by-exporting effect, corresponding to the productivity increase, is higher in the year of entry to the export market than in the later years of export activity. Applying the mentioned

findings to the case of Ukraine we can notice that it is important for our manufacturers to set up the trade agreements with countries, which have higher learning-by-exporting potential because this will allow for enjoying significant productivity gains.

Ciżkowicz et al. (2013) uses the labor productivity as a productivity measure in a panel-data analysis of its link with export activity using the data for 16 regions of Poland in 1999-2008, when this economy was similar to Ukraine. The results are consistent with other relevant papers and prove the positive relationship between status of exporter and productivity gains. We are going to use the labor productivity as an alternative productivity measure in order to show the robustness of our findings.

Wilhelmsson and Kozlov (2007) show that the productivity difference between Russian exporters to OECD and CIS countries is insignificant. We would like to check whether this is true for Ukraine that exporters to Russia, a main CIS trade partner, are not statistically different from other exporters in terms of productivity.

Colacelli (2009) provides an interesting idea on what can be done with the available data. Colacelli (2009) decomposes the overall changes in exports into two parts: intensive (changes due to increase/decrease of exports of existent companies) and extensive (changes due to increasing the number of companies that enter/exit export market) margins. This paper proposes a model, which can show these two effects separately as well as clear definitions of how extensive and intensive margins are determined and calculated.

A similar idea of decomposing some changes into two main components was used by Bernard and Jensen (2004). They split the change in aggregate productivity into the reallocation effect and own-productivity effect. This decomposition allows them to show that overall productivity increases due to reallocation of resources from less productive to more productive firms. Bernard and Jensen (2004) also describe the model of productivity trajectory for different

types of firms and export statuses across years. We make a good use of a modified version of such model to make it applicable to the hypothesis of that we are going to test. In the next chapter we provide details about the modification.

The recent studies on Ukraine's exports to Russia and effects of the trade blockade are in Ryzhenkov et al. (2016) and Cenusa et al. (2014). They provide descriptive statistics and forecasts of trade restrictions impact.

Our contribution to the literature on international trade and productivity is the extension of the model proposed by Bernard and Jensen (2004) to allow for tracking the productivity of exporters to a chosen country, which is Russia in our case, separately from other countries and comparing two productivity paths within one model. It was found that not only the original model works with Ukrainian firm-level data, but also our modified version does so and gives interesting results.

Moreover, we transformed the decomposition of aggregate productivity change (Bernard and Jensen, 2004) by using shares of export instead of output shares in the definitions of own-productivity and reallocation effects. We also distinguish these two effects between exports to a chosen country, i.e. Russia, and other exports.

Chapter 3

METHODOLOGY

In this section we proceed in three steps of the analysis. We start with evaluating the impact of trade ban on productivity of food exporters. The next step is estimating the productivity trajectory of exporters to Russia and comparing it to other exporters. Finally, we decompose the productivity change into export reallocation and own-productivity effects.

Firm-level productivity, which is a key variable in this paper, is estimated using several methods in order to guarantee robustness of results. In order to do so we estimate a cycle of regressions for each manufacturing sector separately because the TFP varies a lot across different sectors.

Two-factor Cobb-Douglas production function was estimated separately for each manufacturing KVED/NACE 2-digit manufacturing industry applying Olley-Pakes approach (Olley and Pakes, 1996) for the following specification:

$$\log(output) = \beta_0 + \beta_1 \log(labor) + \beta_2 \log(capital) + \varepsilon, \qquad (1)$$

where "output" is the total value of goods produced by the firm, "labor" is the number of employees at firm, "capital" is the total assets of the firm at the end of the year.

We predict TFP from the residuals of the model.

3.1. Impact of trade blockade on productivity

First of all, we evaluate the impact of trade war on firms' productivity. We decided to use the difference-in-differences (DID) methodology by Slaughter

(2001) adding controls for the firm's size and cross-sector differences. This model allows us to analyze a clear policy effect on the dependent variable net of time trend and industry effect. In order to estimate such a model we have to construct special dummy variables to distinguish between observations before and after the beginning of trade war and between affected, so called treatment group, and not affected firms – a control group.

We define a set of year dummies, as well as a treatment group dummy. We decided to indicate a firm as affected by trade war if at least one of exported goods by that firm was in the prohibition list (Appendix E) in any year.

The 4-digit harmonized system (HS) codes of prohibited goods were web-scrapped from the prohibition act documentation. Those codes were then merged to the main dataset and matched observations by the same HS code indicated the treated firms.

The DID model finally has the following form:

$$lnTFP = \beta_0 + \beta_1 after2013 + \beta_2 treat + \beta_3 interaction + Z + \varepsilon, \quad (2)$$

where $lnTFP$ is the total factor productivity of the firm, $after2013$ is the dummy that is equal to 1 if the observation was in the year 2014 or later and 0 otherwise, $treat$ is the dummy variable being equal to 1 if the firm has prohibited goods among traded goods, $interaction$ is a product of dummies $after2013$ and $treat$, Z is the set of controls for firm's size, time trend and industry specifics. The coefficient β_3 is of main interest, because it shows the clear effect of the embargo on productivity. The expected sign of this coefficient is negative, meaning that firms became restricted in their trade and faced additional costs associated with reallocating their exported goods to other markets. The latter issue forced out some firms out of the market because costs were too high to overcome them, while other firms survived.

3.2. Productivity trajectories of different firm types

In order to test the hypothesis that exporters to Russia are less productive than other exporting firms, we use the OLS estimation of the modified models proposed by Bernard and Jensen (2004). Firstly, we estimate the model of the productivity trajectory over time for different types of firms using interactions of specific indicator variables for export firm types and for export status of the firm in a particular year. Those interactions give us a picture of productivity levels of all types of firms as they move in and out of exporting. Then we decompose productivity changes into two effects: own-productivity effect and reallocation effect.

Modification of the model was made in order to incorporate the differences between productivity trajectories for exporters to Russia and other exporters in one model. We created our own set of mutually exclusive dummies for those two groups of exporters in order to separate their paths and clearly see the differences.

Our version of the model of trade and productivity (before and after entry) has the following form:

$$lnTFP = \beta_0 + \sum_{x \in X} \sum_{t \in T} Dx * Dt + \varepsilon, \qquad (3)$$

$lnTFP$ is logarithm of total factor productivity, X is the set of different firm types, T is the set of export statuses within considered 5-year interval.

Dx is the set of dummies for export firm type:

- alwaysR = 1 if exports to Russia in all five years,
- alwaysE = 1 if exports to other countries except Russia in all years,
- starterR = 1 if starts exporting to Russia in the current year and does not re-switch,
- starterE = 1 if starts exporting to anywhere, but Russia, in the current year and does not re-switch,

- other = 1 if changes export status more than once in a given period,
- stopperR = 1 if stops exporting to Russia in the current year and does not re-switch,
- stopperE = 1 if stops exporting to anywhere, but Russia, in the current year and does not re-switch,
- never = 1 if does not export in any year.

Dt is the set of dummies for firm's export status that year:

- exp_2 = 1 if exported 2 years ago,
- exp_1 = 1 if exported last year,
- exp = 1 if currently exports,
- exp1 = 1 if exports next year,
- exp2 = 1 if will export in 2 years.

The difference from original model of Bernard and Jensen (2004) is in distinguishing exporters to Russia and to other countries for groups "always", "starter" and "stopper".

For the model described above we should come up with two sets of dummies. We consider 5-year intervals and determine dummies within those intervals to look at TFP path. The export status dummy is just an indicator variable of firms with positive export volume. The export status of the previous year and next year are the lagged and forwarded values of the current export status dummy respectively.

We construct the dummies for export firm types in the following way:

1) if the sum of export status dummies for 5-year interval equals to 5 meaning that firm exports in all three years of the considered time interval, then it falls into the group of dummies "always". We created dummies "alwaysR" and "alwaysE" in the same procedure, but separately for firms, which at least once exported to Russia and for exporters, which never exported to Russia respectively;

2) if the firm did not exported for the last 2 years (i.e. in year -2 and -1, so exp_1==exp_2=0) but starts exporting in the current year (i.e. in year 0, so exp=1, current status - exporter) and continue exporting in the next year, then it falls into the group of dummies "starter". We separated dummies "starterR" and "starterE" in the same way as for group "always";
3) if the firm switched from exporters to non-exporters or vice versa more than once or had missing values in a 5-year interval, then it is indicated with dummy "other";
4) if the firm exported last 2 years (i.e. in year -1 and -2, exp_1=exp_2=1) but stops exporting in the current year (i.e. in year 0, exp=0, current status – non-exporter) and does not export in the next year as well, then it falls into the group of dummies "stopper". We separated dummies "stopperR" and "stopperE" in the same way as for group "always";
5) if the sum of export status dummies for 5-year interval equals to 0 meaning that the firm does not export in any year of the considered time interval, then it is indicated with dummy "never".

3.3. Decomposition of aggregate productivity change

The model proposed by Bernard and Jensen (2004) was aimed to show that the aggregate productivity change is driven by two effects: due to more rapid expansion of high-productivity firms relative to low-productivity firms (reallocation effect) and due to the productivity growth at individual firms (own-productivity effect). Such decomposition gives us a possibility to quantify the extent to which productivity growth is caused by more productive firms growing larger or they become more productive. Some positive reallocation effect results from the increasing share of total output at firms with higher than average productivity.

Our idea is to modify this decomposition by substituting the output share by share of exports to Russia. The modified model allows us to evaluate the change in productivity due to the change of exports share to Russia. We expect this effect to be negative because we assume that the decrease of Russian share in total exports at firms with higher average productivity increased the aggregate productivity.

The model by Bernard and Jensen(2004) has the following form:

$$\Delta TFP_A = \sum_{i=1}^{N} \Delta(TFP_i * SH_i) = \sum_{i=1}^{N} \Delta SH_i * \overline{TFP_i} + \sum_{i=1}^{N} \Delta TFP_i * \overline{SH_i}, (4)$$

N is the number of manufacturing firms,

ΔTFP_A is the aggregate annual change in total factor productivity,

ΔSH_i is the annual change in share of output,

$\overline{TFP_i}$ is the annual change in TFP of the firm,

$\overline{SH_i}$ is the change in average share of firms' output,

ΔTFP_i is the change in average firms' TFP.

Our modified version of the model is described below.

$$\sum_{i=1}^{N} \Delta(TFP_i * SH_i) = \sum_{i=1}^{N} \Delta\left(TFP_i * (SH_i^R + SH_i^E)\right) = \sum_{i=1}^{N} \Delta {SH_i}^R * \overline{TFP_i} +$$

$$+ \sum_{i=1}^{N} \Delta TFP_i * \overline{SH_i}^R + \sum_{i=1}^{N} \Delta {SH_i}^E * \overline{TFP_i} + \sum_{i=1}^{N} \Delta TFP_i * \overline{SH_i}^E, \quad (5)$$

SH_i is the share of export of the firm in our model. We split this variable into two components: share of exports to Russia among total export of the firm, SH_i^R, and share of exports to elsewhere (except Russia), SH_i^E. Then we decompose the total change in productivity into 4 effects in a similar way as Bernard and Jensen (2004) did. Only exporters are considered in this model in order to avoid many zero values in share of exports variable for non-exporting goods because those zeros can lead to underestimated values of all effects.

Chapter 4

DATA DESCRIPTION

In this thesis we deal with the unique firm-level dataset of Ukrainian manufacturing firms in 2001-2015. The data were obtained from KSE Data Center. There are two main datasets: one from customs declarations, which include the key information about traded goods (ie. weight of goods, invoice prices of goods in UAH, value of goods in USD, country of destination, firm OKPO etc.), and another dataset includes the main financial statements such as Financial Results Statement, Balance Sheet Statement, Enterprise Performance Statement, Sectoral Expenditures Statement.

4.1. Data preparation

Before the productivity estimation, it is important to adjust financial data for inflation in financial indicators. The annual Produced Price Indices were obtained from UKRSTAT and used to deflate the output and capital. For TFP estimation we had to deal somehow with the different KVED codes for before and after 2010 because in that year the recoding of economic activities took place. Using the information from UKRSTAT about the old codes of each KVED2010, we transformed all observations in terms of KVED2005 in our dataset (Appendix A).

Preparation of exports data included the following steps:

1) aggregating all customs transactions in order to get total amount of exports of a particular firm to a particular destination country;
2) preparation of data for each year separately and appending all years in one dataset;

3) calculation of shares of exports to Russia for each firm
4) merging exports and financial datasets and keeping manufacturing firms with appropriate KVED and OKPO codes only;

4.2. Sample Composition

Initially after all aggregations we had on average 347,487 firms with some financial records in each year. We are interested in manufacturing firms only in this thesis because service firms, which also report exports of the goods, are intermediaries and do not produce export goods. They resell goods of the manufacturing firms, which produced those goods. Therefore, some manufacturing firms, which produce some goods for export, cannot be identified as exporters because we cannot track the path from manufacturer to intermediary. Unfortunately, the firm-level database of exports of services does not exist. That is why, we will consider only the group of manufacturing firms for our further analysis. Our sample averages 46,265 of such firms annually.

We separate manufacturing firms from other exporters based on their KVED codes. Manufacturers have sector D with codes from 15 to 37 according to KVED 2005 (harmonized with NACE Rev.1). The description of each code is given in Appendix A. The path of the number of firms in each subsample is described in Table 1. We should notice the pattern of decrease in the number of operating firms over the last two years in our sample. This is a result of financial reporting cessation by the firms in the occupied territories.

Since we have the data of prohibited goods (The Russian Government, 2014) only on food products, we use the sample of firms with KVED sector D, subsector DA, codes 15 (producing of food products and drinks) and 16 (tobacco producers). There are some manufacturing firms with different KVED codes, which exported some food products, but we excluded them from consideration. It is unlikely that some steel producer, for instance, trades food

to somewhere. Therefore, we treat that firms as outliers and consider only firms with food production as a major economic activity. The number of such firms in each year is described in the last column of Table 1. The average number of food and beverage exporters is 724 in each year.

Table 1. Sample composition

Year	Initial sample size	Manufacturing firms	Firms with key financials **	Exporters	Exporters to Russia	Food exporters with TFP
2001	287,710	45,313	30,125	4,271	2,202	662
2002	318,437	48,453	31,589	4.555	2,128	741
2003	324,817	49,488	32,456	4,734	2,185	759
2004	335,404	50,095	32,579	4,999	2,290	802
2005	346,476	50,772	32,653	5,007	2,270	740
2006	365,134	53,073	33,556	4,959	2,175	645
2007	383,560	52,860	32,863	5,264	2,335	680
2008	363,225	46,816	31,357	5,301	2,402	691
2009	464,093	58,046	29,390	5,295	2,260	718
2010	351,056	46,115	28,835	5,343	2,416	668
2011	340,048	41,999	29,336	5,406	2,620	692
2012	337,677	41,292	28,916	5,621	2,741	710
2013	360,898	41,485	27,689	5,381	2,743	711
2014	317,990	34,317	19,538	5,351	2,223	791
2015	315,794	33,860	19,127	5,426	1,895	853
Total	5,212,310	693,984	440,009	76,913	34,885	10,863

Notes: Table shows the number of observations of the main sample and each subsample for different years. ** Key financials include total employment and capital – inputs to production function for TFP estimation. For some our regressions we will also use material costs as additional control (Appendix D).

For the rest of our empirical analysis we use the sample of firms with all key financial statements (Table 1) needed for TFP estimation. This means that there should not be any missing or negative values in the variable "capital" (total assets

at the end of year), "labor" (total employment of the firm) and "output" (the total value of goods produced).

4.3. Evolution of key variables across years

One of the reasons why we think that exporters to Russia are less prepared to changes in the political situation is the fact that they usually depend mainly on Russia in trade activity, they have less export partners and are less diversified against any risks. However, it appears that this is not the case about the average number of export partners. The mean number of export partners of Russian exporters is 7.22 compared to 3.39 of exporters, which never exported to Russia (Table 2). This result could be explained by the fact that a high number of export partners does not necessarily means enough diversification level. It is possible that exporters to Russia just have more export partners but at the same time the share of exports to Russia is very high, thus, diversification is low in fact.

The series of simple Spearman correlation tests can show some good insights about relationships among productivity, number of export partners, shares of exports to Russia and give a possibility to compare Russian and non-Russian exporters. We strongly reject the hypothesis of independency between productivity and number of export partners (Appendix B), the correlation is positive as we expected. At the same time, there is a strong negative correlation between the status of exporter to Russia and productivity. The correlation between productivity and share of exports to Russia also proves to be negative. All those facts prove our idea about diversification described above.

In order to compare diversification levels we should better look at the Herfindahl indexes. To make it clear we can look at the average share of exports to Russia among exporters to this country. The pattern of this value over years is shown in Table 2.

Table 2. Evolution of key variables over last years

Year	Mean number of export partners		Mean share of exports		Mean export volumes, USD	Mean export volumes to Russia, USD
	Exporters to Russia	Other exporters	To Russia among exporters to Russia	To main export partner		
2011	6.92	3.17	0.67	0.51	10,796,344	3,931,935
2012	6.82	3.17	0.67	0.51	8,599,108	2,643,498
2013	6.90	3.18	0.66	0.50	8,037,016	2,184,201
2014	7.82	3.45	0.62	0.57	8,994,618	1,555,189
2015	7.99	3.87	0.61	0.60	6,781,723	868,164
Mean	7.22	3.39	0.65	0.54	8,639,898	2,240,236

Notes: First two columns show the average number of the trade destination countries for a particular firm (separately for exporters, which have Russia among trade destinations and which have not); third column shows the average ratio of total export volume to Russia to the total volume of exports of a firm; the last two columns show the average value of total annual exports of a firm and the average value of total annual exports to Russia of a firm, respectively.

The average share of exports to Russia is about 65%. According to this evidence, we can tell for sure that the value of Herfindahl index for this set of exporters is at least 0.42 (calculation: 0.65*0.65+0+...+0=0.4225), assuming that all other countries have very small, close to zero, shares of exports among total exports of a particular firm. This value indicates a very high concentration of exports towards Russia, thus very low diversification level and lower productivity. The average share of exports to main trade partners other than Russia is about 54% over the last 5 years of our sample and confirms our abovementioned arguments.

4.4. Extensive versus intensive margin

For better understanding of the consequences of trade war with Russia, it is important to see how both intensive and extensive margins changed. If we look

at the column of exporters' number in Table 1, we can observe that the number of exporting firms was unchanged over the last three years. However, the number of exporters to Russia decreased substantially. This means that there were no considerable distortions through the extensive margin caused by trade war. The number of firms, which had to quit their export activity, was rather small, but many firms had to stop exporting to Russia. Comparing this fact to changes through the intensive margin, we can observe a bit different picture. The average volumes of export trade, despite some increase in 2014, generally experienced a slight drop over the last years (Table 2). If we look at changes of volumes exported to Russia, there is a considerable drop. It was mainly caused by decrease in the number of exporters to Russia. Thus,

We can conclude that overall changes occurred through the intensive margin to higher extent than through the extensive margin. However, we just described a general picture of all exports together. If we consider exports to Russia separately, the changes were much more drastic here: the export volumes to Russia decreased by more than threefold over the last 4 years (Table 2). The number of exporters to Russia also decreased considerably: from about 2800 exporters in 2013 to 1900 in 2015. It is clearly visible that bad times came for exporters to Russia, but according to our findings those firms, which quit Russian exporting, probably did not quit the exporting activity as a whole and many of them could reallocate huge export volumes from Russia to other partners.

Chapter 5

EMPIRICAL RESULTS

This chapter describes the estimation results of three main models stated in Chapter 3. So, we will proceed in 3 steps: 1) showing the results of the diff-in-diff model and explaining the impact of trade war on firms' productivity, 2) presenting the estimates of productivity trajectories of different firm types and comparing exporters to Russia with exporters to other countries and 3) reporting the decomposition of aggregate productivity change into reallocation and own effects.

5.1. Impact of trade war on firms' productivity

In this model we aim to see the difference between firms that exported prohibited goods starting from 2013 and firms that traded only allowed goods before 2013. The DD specification gives us a possibility to see the direct impact of trade ban net of time trend effects (firms can become more/less productive just because of macroeconomic conditions within few years interval) and the selection effect (firms that trade prohibited goods are more/less productive just by nature). Table 3 shows the estimates of the policy impact on average productivity of firms.

The model was estimated by using OLS with robust standard errors in order to avoid the heteroscedasticity issue, which appears in the regular OLS model. The residuals of the model were checked for normality and proved to be normally distributed.

In this model we consider only food-producing exporting firms because we obtained only the list of prohibitions in this economic sector. We remind that

the firm is in the treatment group if it produces the good from the prohibition list at least in one of the years.

Table 3. Results of difference-in-differences estimation of trade blockade impact on food exporters

Dependent variable	Coefficients			
	Treat	After2013	Interaction	Constant
TFP	0.1358***	0.4214***	-0. 1354**	-0.2389***
	(0.0173)	(0.0476)	(0.0442)	(0.0657)

Notes: The coefficients show the estimation results of difference-in-differences OLS regression with controls of firm's size (logarithm of total employment and material costs), year dummies and industry dummies. Main variable of interest is "Interaction"; it shows the average effect of trade restrictions (relative productivity of the firms under restrictions from the beginning of 2014 compared with firms without restrictions in 2013 and earlier years) on the firms' productivity net of time, size, cross-industry and other effects. Number of observations: 10222 (Appendix D, last column), R^2=0.5785. Standard errors in parentheses. * if p-value < 0.05, ** if p-value < 0.01, *** p < 0.001.

Our main coefficient of interest here is the coefficient at variable "Interaction", which is the product of indicator variables for treatment group and observations from 2014 and later. As can be seen, the coefficient is statistically significant and has the value of -0.135. This implies that the trade embargo negatively influences the firms' productivity. Firms that fall into the treatment group are 13.5% less productive on average from year 2014 than other exporters and this difference is caused by the Russian trade blockade. This result meets our expectations about some negative impact of the trade policy. Movchan et al. (2014) shows that "food processing" sector of Ukrainian economy ranks only 11th in terms of exposure to the Russian market with only 3% of all output being traded to Russia. This means that the effect was much higher for many other sectors, such as "manufacture of machinery and equipment" or "metallurgy and metal processing" with exposures of 22% and 14% respectively.

The negative effect occurs because firms are faced with additional costs. They built expectations on their transportation costs, their revenues from trade and

planned their operational budgets accordingly. But restrictions on trade caused a drop in their revenues, they became unable to sell their goods to one of their trade partners (for many firms even a main trade partner). As a result, it is the firms that should make prudent steps with all that banned goods, some of which could be spoiled in pretty short terms. Spoiled goods cannot be sold even at low prices, so firms just lost opportunity revenues from them, however, they cost the money for the firms to produce them. That was a short-term effect of the policy. In the longer term firms are faced with the costs of finding new trade partners, agreements on trade conditions with them and transportation costs to new trade directions. According to Wagner (2007), the range of extra costs of entering new export markets includes transportation costs, distribution or marketing costs, skilled personnel to deal with foreign networks, or production costs of modifying current products to foreign consumption.

5.2. Productivity comparison of exporters to Russia with exporters to other countries

At the stage of our analysis we want to show how firms' productivity changed as firms went in and out of the export market and to compare the paths for exporters to Russia and exporters to all other countries.

First, we want to look at the differences in productivity among different firm types. After we create the dummies for each type we run simple OLS regression of TFP on those type dummies with additional controls. The estimation results are presented in Table 4.

The coefficients in Table 4 represent the relative productivity levels compared to continuous non-exporters (type "never" described in Chapter 3). We can notice that starters of export activity and continuous exporters have significantly higher productivities than continuous non-exporters, however, firms that quit exporting within considered time intervals performs significantly lower than the

same comparison group. If we compare exporters to Russia with other exporters, we can see that the latter ones are more productive across all firm types. Moreover, this difference in productivity is significant for always exporters and starters of exporting. It is interesting to note that firms, which stop exporting to any country, are on average less productive than non-exporters within 5-year intervals. This can be explained by the fact that their productivity drops very quickly as they exit the export market. That is why, it could be useful to look at firms' productivity dynamics over considered time intervals. The estimates of the model proposed by Bernard and Jensen (2004) allows us to see those trajectories. Figure 2 presents the visual interpretation of the results of our replication of the original Bernard and Jensen model based on Ukrainian firm-level data (Appendix C).

Table 4. TFP levels by firm export types

Dependent variable	Firm's export type					
	Stopper to Russia	Stopper to other	Starter to Russia	Starter to other	Always to Russia	Always to other
TFP	-.0993***	-.0923***	.1857***	.2402***	.0490***	.3333***
	(.0302)	(.0239)	(.0260)	(.0219)	(.0069)	(.0084)

Notes: The coefficients represent productivity levels of different types of the firms relative to continuing non-exporters. Each firm is tracked over 5 consecutive years (from 2 years before entry/exit of the export market to 2 years after that), and then is referred to one of the mutually exclusive groups according to its export status over those years. Additional controls in this regression: firm's employment, material costs, year dummies, industry dummies. Number of observations: 381,037 (Appendix D, second column), R^2=0.4676. Standard errors in parentheses. * if p-value < 0.05, ** if p-value < 0.01, *** p < 0.001.

We have to choose an appropriate 5-year interval for this model to avoid economic shocks within the period and make the model representative of any randomly chosen 5 consecutive years while aiming the model to work with the most recent data. We have chosen an interval from 2009 until 2013 because that

is after the crisis of 2008 and before the trade restrictions of 2014. The effect of the crisis is usually long-term, that is why we can observe a slight decrease in productivity of almost all export groups (except starters) in all the years from 2009 to 2013. We can also argue about the huge productivity drop of the stoppers: the productivity downside of exit of the export market is aggravated by the long-term effects of the crisis decreasing the productivity to even below the never exporters' levels. We should notice that entrants to export market catch up with continuing exporters just in 2 years after the start of export activity. This confirms the findings of Bernard&Jensen (2004), however, the results for stoppers are somewhat different in our paper: stoppers decrease below the non-exporters productivity levels. This difference in obtained results may occur because Bernard and Jensen worked with the US data, data from the developed economy, while we consider Ukrainian industry. Developing economies are more sensitive to any financial difficulties or instability than developed ones are. That is why exit of the export market, which associated with some problems, is more harmful in our case.

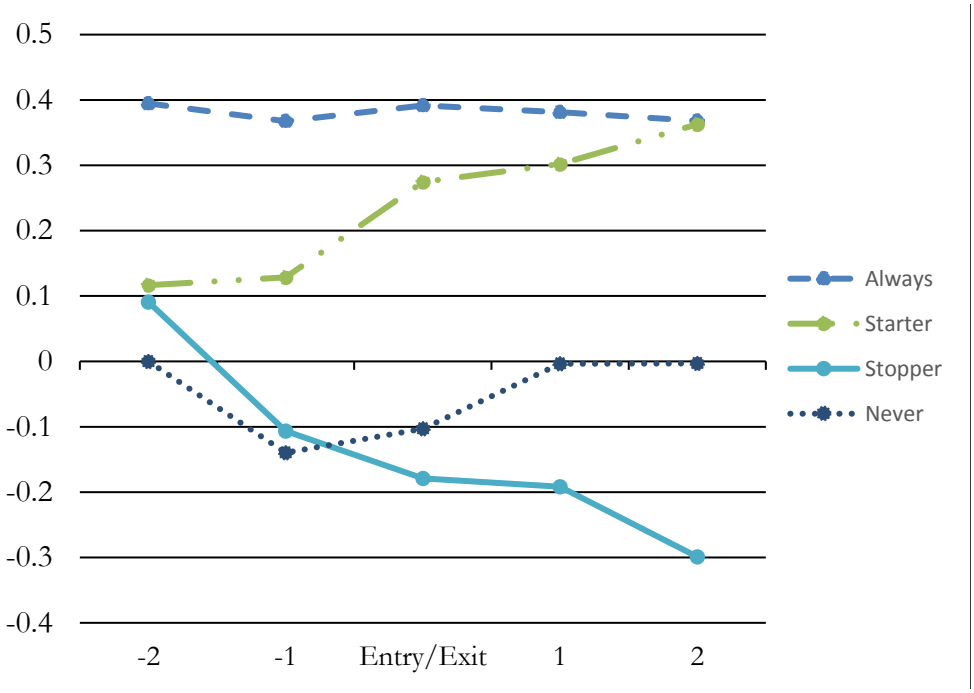

Figure 2. TFP trajectories within a 5-year period from 2009 to 2013

The results from Figure 2 confirm our idea about the reasons of lower productivity of stoppers relative to never exporters from Table 4. As we can see, the productivity of stoppers drops dramatically through the year of exit of the export market, however, 2 years before exit they are almost on the same productivity level as always exporters. Exactly the opposite picture can be observed among always exporters and starters of export activity: the productivity of the latter ones reaches even higher levels than of the former ones after a year of entry to the international trade arena. These results are the only difference from the results obtained by Bernard and Jensen (2004). The reason of such a high increase in productivity of the starters compared to always exporters and drastic drop in productivity of the stoppers relative to never exporters, as we already mentioned, is the long-term effects of the crisis of 2008, which has a negative impact mainly on continuous exporters and stoppers of exporting.

The estimates of our modification of the model by Bernard and Jensen (2004) are given in Table 5; the considered time-period is the same as in Figure 2: form 2009 to 2013. The graphical analogue of Figure 2 for this modified model is provided in Figure 3. Table 5 presents the results in a similar way as Table 4 does: all the coefficients are the relative productivities of different firm types compared to the continuing non-exporters in a year 1 of the 5-year interval.

The results show us that starters of export activity are not statistically different from non-exporters before entering the export market, but have a significant increase in TFP just from the year of entry. We may notice a higher increase in productivity of the entrants to Russian export market than of the entrants to other markets. The explanation behind this fact lies under historically lower costs of trading with Russia: common language, similar legal systems, common border and other reasons. This gap would probably vanish if we considered longer time interval due to long-term benefits of trading with other countries.

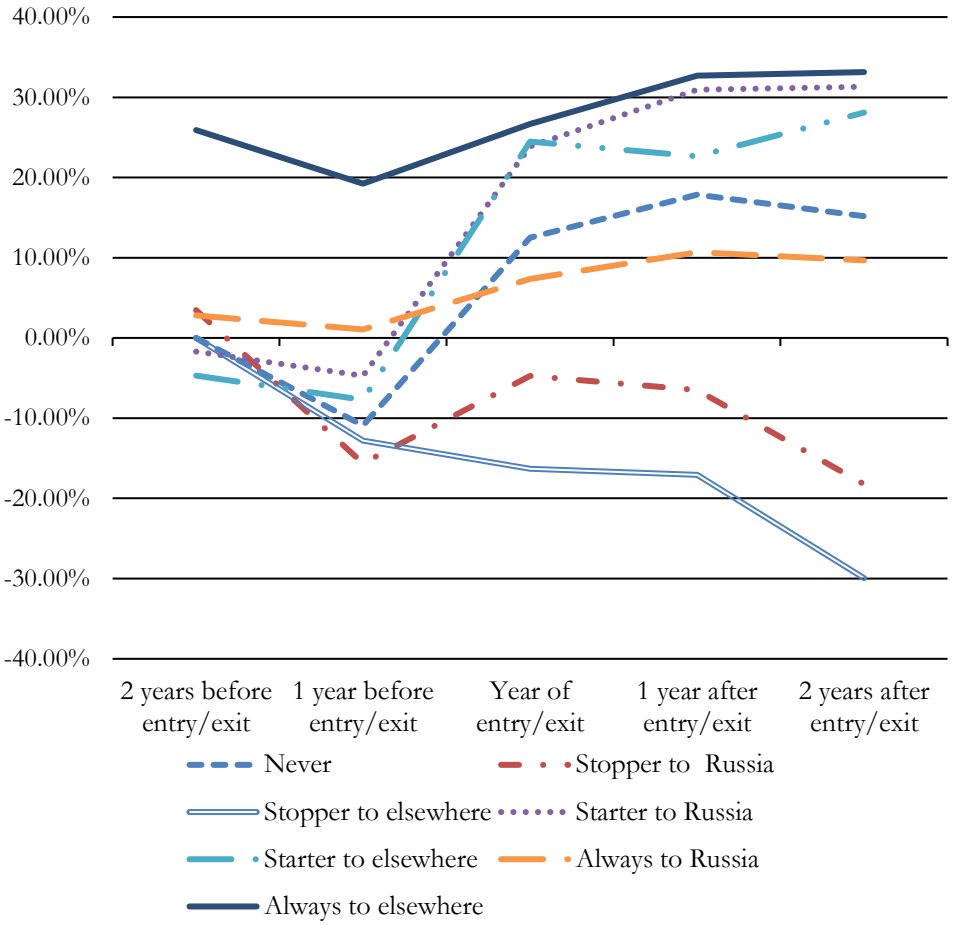

Figure 3. Productivity trajectories comparison of exporters to Russia and exporters to other countries.

The increase in productivity of the entrants to export market slows down from the next year of exporting. This result coincides with the findings of Martins and Yang (2009) described in the Chapter 3 of our thesis. We observe a low productivity before the entry because firms should accumulate some assets during the preparation to entering a new market, as they will be faced with some entry costs. This may restrict their activity compared to non-exporters. The productivity boost in the entry year is the ordinary response to the start of export activity. This result coincides with all the literature on international trade. We can also comment on the coefficients on exits from export market. Such firms have are not significantly different from non-exporters in their productivity

levels two years before the exit. They experience a significant decrease in productivity a year before exit and then have a further decrease in the productivity.

Table 5. TFP trajectories by firm export types

Time period	Firm's export type				
	2 years before entry/exit	1 year before entry/exit	Year of entry/ exit	1 year after entry/exit	2 years after entry/exit
Never	-	-.1092***	.1249***	.1786***	.1518***
		(.0106)	(.0131)	(.0131)	(.0138)
Stopper to Russia	.0347	-.1564**	-.0475	-.0651	-.1824**
	(.0397)	(.0369)	(.0505)	(.0562)	(.0666)
Stopper to elsewhere	-.0342	-.1281**	-.1632**	-.1708***	-.2994***
	(.0311)	(.0370)	(.0481)	(.0467)	(.0552)
Other	-.0178	.1389***	.1122***	.1235***	.1061***
	(.0117)	(.0111)	(.0142)	(.0144)	(.0155)
Starter to Russia	-.0172	-.0472	.2388***	.3095***	3131***
	(.0384)	(.0440)	(.0495)	(.0501)	(.0518)
Starter to elsewhere	-.0469	-.0771	.2447***	.2263***	.2809***
	(.0421)	(.0432)	(.0444)	(.0460)	(.0442)
Always to Russia	.0282	.0106	.0736***	.1068***	.0965***
	(.0195)	(.0189)	(.0283)	(.0215)	(.0232)
Always to elsewhere	.2590**	.1923***	.2665***	.3270***	.3314***
	(.0213)	(.0224)	(.0263)	(.0271)	(.0292)

Notes: The coefficients show productivity levels of different exporters within 5-year period from 2 years before entry/exit to 2 years after that. All productivities are relative to continuing non-exporters in the first year of 5-year period. "Never" firms does not export in any year. "Stopper" firms quit exporting in the third year. "Starter" manufacturers start export activity in year 3. "Always" plants export in all 5 years. "Other" are those who switch more than once within 5-year period. Additional controls are the firm's size and industry dummies. N=91093, R2=0.3547. Standard errors in parentheses. * if p-value < 0.05, ** if p-value < 0.01, *** p < 0.001.

We should note that exits from other export markets than Russian have the highest productivity drop. The reason for this is the high exit cost, opportunity loss in terms of learning new technologies or use of old ones due to canceling of trade agreements.

The most interesting result of our modified model is the relatively low productivity of continuing exporters to Russia compared to continued non-exporters. This problem may occur again because of the crisis 2008 long-term consequences. We observe a slight drop in productivity in all our groups between 2 years before exit/entry and a year before that, i.e. in years 2009-2010, right after the crisis. Trying a different 5-year period, from 2004 to 2008 for instance, for the analysis shows that continuing exporters to Russia are not statistically different from continuing non-exporters (Appendix G).

Overall, we can claim that the results from Table 5 confirm our initial hypothesis of lower productivity of exporters to Russia relative to other exporters.

5.3. Positive reallocation effect of exporters to countries other than Russia

This part of our analysis is aimed to show that more productive firms reallocate their export activity from Russia to other countries. In addition, we want to show how their own-firm productivity effects and reallocation effects discussed in Chapter 3 contribute to the aggregate productivity change.

We consider only the period since 2009 at this stage of our analysis because we want to look at the aggregate change in the TFP level of exporters after the trade ban compared to several previous years since the previous economic shock occurred. Table 6 summarizes the results of decomposition.

The aggregate productivity change appears to be negative in the last sample year for exporting firms because of the trade war. Moreover, productivity change in year 2015 is even lower than in the year 2009, after the world crisis.

Table 6. Firm-level decomposition of productivity growth of exporters

Year	Productivity change due to				Total productivity change
	Own effect		Reallocation effect		
	Exports to Russia	Exports to other countries	Exports to Russia	Exports to other countries	
2009	-.0009 (-1.0%)	-.0239 (-27.5%)	-.0159 (-18.3%)	.2348 (269.9%)	.0870 (100%)
2010	.0038 (46.3%)	.0210 (256.1%)	.4142 (5051.2%)	-0.5088 (-6204%)	.0082 (100%)
2011	.0135 (3.6%)	.0033 (0.9%)	.6670 (178.9%)	-.3358 (-90.1%)	.3729 (100%)
2012	-.0187 (5.3%)	.0039 (-1.1%)	-.6625 (186.3%)	.3587 (-100.9%)	-.3556 (100.0%)
2013	.0014 (0.4%)	.0156 (4.3%)	-.2039 (-56.8%)	.5865 (163.4%)	.3589 (100%)
2014	.0034 (0.6%)	.0693 (11.2%)	-.8902 (-144.5%)	1.5429 (250.4%)	.6161 (100%)
2015	-.0023 (0.7%)	.0034 (-1.0%)	-.4738 (139.2%)	.1360 (-40.0%)	-.3403 (100%)
Total	.0002 (0.0%)	.0926 (12.4%)	-1.1650 (-155.9%)	2.0143 (269.6%)	.7471 (100%)

Notes: "Own-productivity effect" shows the change in average productivity of all exporters owing the increase in productivities at individual plants. "Reallocation effect" presents the average productivity change due to more rapid increase in export shares to Russia or to other countries of more productive firms relative to less productive ones. Positive reallocation effect to other countries indicates that more productive firms tend to export to other countries more than to Russia. Percentage of total growth in a particular year in prentices.

We define the annual change in the aggregate TFP as sum of productivity changes on the plant-level weighted by their shares in the total export volume (we define it in the same way as it is defined in Bernard&Jensen (2004)). This negative change indicates that majority of the exporting firms have negative TFP changes in the years of trade blockade.

When we look at the decomposition of this change, we can observe that its main driver is the reallocation effect of exports to countries other than Russia. This positive effect results from the increasing share of exports to all countries except Russia at firms with higher than average productivity. The within-firm productivity (own effect) decreased over the periods of instability, but the between-firm productivity (reallocation effect) experienced an increase. By decomposing this reallocation effect into the effect of reallocation towards Russia and that of reallocation towards other countries we make it clear that the latter one contributes the most to the overall positive increase in productivity.

Our results suggest that during the crises more productive firms decide to redirect their exports from Russia (probably to the West). They understood that the future of Ukraine is connected with Europe, not Russia. As we already know from Chapter 2, one of the main drivers of productivity increase of exporters is, so called, learning by exporting. Ukrainian firms can learn much more when trading with Europe or other developed economies. The majority of new technologies come from those countries because they value R&D and invest in it much more than Russia does.

If we look at the effects in percentage terms, we can observe that the increase in aggregate productivity due to the increase in productivity of foreign-oriented firms (not Russia-oriented) constitutes a bigger share of the total change from year to year. The total reallocation effect towards other countries than Russia is even higher than the aggregate productivity change over the period from 2009 to 2015. Reallocation effect of exporting to Russia is the main contributor to the negative TFP change.

There could be an issue here that the decrease in the share of export to Russia and corresponding increase of the share to somewhere else can be caused by the overall decrease of the export volumes. We mean that if the firm stops exporting to Russia and all the goods are not traded to anywhere, the total exports of the firm decreases, export volumes to other countries remains the same, however,

now it constitutes a relatively bigger share of exports of the considered firm. In order to make sure that taking this into account will not change the results we can create the same table, but add the condition of non-negative change in the export volume (Table 7). This condition will allow us to look only at firms, which did not experience a drop in the total export volume, so if the share of exports to other countries increases compared to the share of exports to Russia, this indicates that the volumes of goods exported to other countries have also increased. The condition of non-negative export growth is included in the results of Table 7.

Table 7. Firm-level decomposition of productivity growth of firms with non-negative export growth

Year	Productivity change due to				Total productivity change
	Own effect		Reallocation effect		
	Exports to Russia	Exports to other countries	Exports to Russia	Exports to other countries	
2009	0.0035	0.0085	0.6520	1.5082	2.2264
2010	0.0075	0.0281	0.8779	0.7889	1.8033
2011	0.0144	0.0052	0.9015	0.2109	1.1802
2012	0.0014	0.0168	0.1885	1.0363	1.2415
2013	0.0029	0.0112	0.4023	1.0883	1.5321
2014	0.0057	0.0714	-0.1179	2.127	2.0309
2015	0.0004	0.0245	-0.0928	1.3379	1.2888
Total	0.0359	0.1657	2.8116	8.0976	11.3032

We still observe a similar picture for the firms with non-negative export growth. The only negative signs here can be observed on the reallocation effect of exporting towards Russia in years 2014 and 2015. Our conclusion about these results is the tendency of more productive firms to reorient their export activity from Russia to countries other than Russia.

Chapter 6

CONCLUSIONS

This paper investigates the effect of the recent Russian trade blockade on the productivity of Ukrainian manufacturing firms. It also compares the productivity levels of exporters to Russia with other exporters. Finally, this paper shows that more productive firms reallocate their export activity towards countries other than Russia. Regular OLS regression analysis combined with descriptive statistics were applied to the firm-level data in order to get all the results.

The findings of this paper offer several contributions to the international trade literature. First, we provide the extension of the model proposed by Bernard and Jensen (2004) to allow for tracking the productivity of exporters to a chosen country separately from other exporters and comparing two productivity paths within one model. We found that both the original model and our modified version works with Ukrainian firm-level data and gives interesting results. Second, we transformed the decomposition of aggregate productivity change (Bernard and Jensen, 2004) by using shares of export instead of output shares in the definitions of own-productivity and reallocation effects and distinguish these two effects between exports to a chosen country and other exports. This methodology can be replicated in other countries, which heavily depend on one particular export partner when the political situation is tense, there is a high probability of worsening trade relationships and new trade directions have to be found.

The effect of the trade embargo proved to be significantly negative. The impact of trade policy change was evaluated on the sample of food-producing firms by using DD specification. Firms that traded prohibited goods has a 13.5% drop of productivity due to trade restrictions.

In order to compare exporters to Russia with other exporters the firms were followed within 5-year intervals. Exporters to Russia appeared to be less productive than exporters to somewhere else with estimated productivity differences from continuing non-exporters of 4.9% and 33.3% respectively. Export market entrants to Russia perform on average 5.5% worse than entrants to other markets within 5-year intervals. The estimates of our model of productivity paths, the modified version of the productivity trajectories model by Bernard and Jensen (2004), suggests that continuing exporters to Russia are 23.5% less productive than continuing exporters to other countries in the last year of considered time interval. However, on average entrants to Russian export market experience a slightly higher productivity boost than entrants to other export markets because of historically low entry costs to the Russian market. The results on firms that exit the export market are somewhat surprising: the productivity drops significantly to the levels lower than that of non-exporters. All estimates are robust to the different productivity measures and different specifications (Appendix F, Appendix G).

The change in the aggregate TFP of exporters from year 2014 to year 2015 appeared to be negative indicating again a significant impact of Russian restrictions. Reallocation effect contributes the most to the overall productivity change. Our decomposition of this reallocation effect into effect of export to Russia and that of export to other countries allows us to conclude that more productive manufacturers tend to increase their shares of export to other countries while decreasing the shares of export to Russia, especially during the years of Russian trade restrictions. Looking at the exporters with non-negative export growth we observed a clear evidence of export reallocation from Russia by more productive firms over the last two sample years. These findings suggest that Ukrainian exporters should orient their long-term plans towards countries with high learning-by-exporting potential and do not rely heavily on the post-Soviet trade relationships. Following these objectives will boost the productivity of Ukrainian exporters and allow them to catch up with developed countries.

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APPENDIX A

Description of KVED 2005 codes

Table 8. Description of KVED 2005 codes of sector D (manufacturing) and their KVED2010 analogues.

KVED Sub-Sector	KVED 2005 codes[2]	KVED 2010 analogue[3]	Type of economic activity
DA	15; 16	10; 11; 12	Production of food, beverages and tobacco
DB	17; 18	13; 14	Textile production; clothes, fur
DC	19	15	Manufacture of leather, leather and other
DD	20	16	Treatment of wood and production of wood, except furniture
DE	21; 22	17; 18	Paper Products; publishing
DF	23	19	Production of coke, petro-making and nuclear materials
DG	24	21	Chemical Industry
DH	25	22	Manufacture of rubber and plastic
DI	26	23	Manufacture of other non-metallic mineral products
DJ	27; 28	24; 25	Metallurgical production and production of finished metal products
DK	29	28	Manufacture of machinery and equipment
DL	30; 31; 32; 33	26; 27	Production of electric, electronic and optical equipment
DM	34; 35	29; 30	Production of vehicles and equipment
DN	36; 37	31; 32	Other industries

[2] http://kved.ukrstat.gov.ua/KVED2005/SECT/KVED05_D.html

[3] http://kved.ukrstat.gov.ua/KVED2010/kv10_i.html

APPENDIX B

Results of Spearman correlation tests for exporters

Test 1. Independence between TFP and number of export partners

H0: tfp and number of export partners are independent

Spearman's rho = 0.1567

P-value = 0.0000 => rejection of H0

Test 2. Independence between TFP and status of exporter to Russia

H0: tfp and status of exporter to Russia are independent

Spearman's rho = -0.0851

P-value = 0.0000 => rejection of H0

Test 3. Independence between TFP and share of exports to Russia

H0: tfp and share of exports to Russia are independent

Spearman's rho = -0.0943

P-value = 0.0000 => rejection of H0

APPENDIX C

Regression estimates of original Bernard&Jensen model of productivity trajectories

Table 9. Regression estimates of original Bernard&Jensen model of productivity trajectories

Time period	Firm's export type				
	2 years before entry/exit	1 year before entry/exit	Year of entry/exit	1 year after entry/exit	2 years after entry/exit
Never	-	-.1397***	-.1031***	-.0037	-.0032
		(.0156)	(.0158)	(.0156)	(.0161)
Stopper	.0909*	-.1065*	-.1789***	-.1918***	-.2989***
	(.0393)	(.0424)	(.0480)	(.0484)	(.0538)
Other	.0027*	.1518***	.1171***	.1277***	.1075***
	(.0163)	(.0164)	(.0167)	(.0163)	(.0163)
Starter	.1166*	.1286**	.2747***	.3019***	.3627***
	(.0459)	(.0454)	(.0391)	(.0382)	(.0386)
Always	.3947***	.3675***	.3918***	.3814***	.3683***
	(.0219)	(.0225)	(.0221)	(.0220)	(.0228)

Notes: The coefficients show productivity levels of different exporters within 5-year period from 2 years before entry/exit to 2 years after that. All productivities are relative to continuing non-exporters in the first year of 5-year period. "Never" firms does not export in any year. "Stopper" firms quit exporting in the third year. "Starter" manufacturers start export activity in year 3. "Always" plants export in all 5 years. "Other" are those who switch more than once within 5-year period. Additional controls are the firm's size and industry dummies. N=96,526; R2=0.0407. Standard errors in parentheses. * if p-value < 0.05, ** if p-value < 0.01, *** p < 0.001.

APPENDIX D

Extension to the sample composition table

Table 10. Number of firms with non-missing material costs within particular subsamples of the sample composition

Year	Firms with key financials**	Exporters	Exporters to Russia	Food exporters with TFP
2001	28,322	4,102	2,149	651
2002	29,719	4,417	2,082	733
2003	30,196	4,591	2,137	747
2004	30,536	4,881	2,253	793
2005	30,552	4,893	2,234	735
2006	30,735	4,840	2,150	641
2007	30,113	5,117	2,299	675
2008	28,991	5,174	2,373	686
2009	26,992	4,999	2,179	714
2010	26,105	5,020	2,323	661
2011	27,737	5,274	2,589	686
2012	27,321	5,466	2,697	704
2013	25,790	5,225	2,692	704
2014	4,062	2,503	1,360	530
2015	3,866	2,409	1,144	562
Total	381,037	68,911	32,661	10,222

APPENDIX E

List of prohibited goods

Table 11. List of prohibited goods (in Russian).

TV04 code	Code description
0201	Мясо крупного рогатого скота, свежее или охлажденное
0202	Мясо крупного рогатого скота, замороженное
0203	Свинина свежая, охлажденная или замороженная
0207	Мясо и пищевые субпродукты(внутренние органы: печень, почки, лёгкие, желудочки и пр.) домашней птицы, указанной в товарной позиции 0105(Домашняя птица живая, то есть куры домашние (Gallus domesticus), утки, гуси, индейки
0210**	Мясо соленое, в рассоле, сушеное или копченое
03	Рыба и ракообразные, моллюски и прочие водные беспозвоночные
0301	Живая рыба:
0302	Рыба свежая или охлажденная, за исключением рыбного филе и прочего мяса рыбы товарной позиции 12.6666666666667
0302900000	- печень, икра и молоки
0303	Рыба мороженая, за исключением рыбного филе и прочего мяса рыбы товарной позиции
030390	- печень, икра и молоки:
0304	Филе рыбное и прочее мясо рыбы (включая фарш), свежие, охлажденные или мороженые:
0305	Рыба сушеная, соленая или в рассоле; рыба копченая, не подвергнутая или подвергнутая тепловой обработке до или в процессе копчения; рыбная мука тонкого и грубого помола и гранулы из рыбы,
0305100000	- рыбная мука тонкого и грубого помола и гранулы из рыбы, пригодные для употребления в пищу
0305200000	- печень, икра и молоки рыбы, сушеные, копченые, соленые или в рассоле
0306	Ракообразные, в панцире или без панциря, живые, свежие, охлажденные, мороженые, сушеные, соленые или в рассоле; ракообразные копченые, в панцире или без панциря, не подвергнутые или подвергнутые тепловой обработке до
0307	Моллюски, в раковине или без раковины, живые, свежие, охлажденные, мороженые, сушеные, соленые или в рассоле; моллюски копченые, в раковине или без раковины, не подвергнутые или подвергнутые тепловой обработке до
030760	- улитки, кроме липариса:
0308	Водные беспозвоночные, кроме ракообразных и моллюсков, живые, свежие, охлажденные, мороженые, сушеные, соленые или в рассоле; водные беспозвоночные, кроме ракообразных

Appendix E continued

TV04 code	Code description
030830	- медузы (Rhopilema spp.):
030890	- прочие:
0401	Молоко и сливки, несгущенные и без добавления сахара или других подслащивающих веществ:
0402	Молоко и сливки, сгущенные или с добавлением сахара или других подслащивающих веществ:
0403	Пахта, свернувшиеся молоко и сливки, йогурт, кефир и прочие ферментированные или сквашенные молоко и сливки, сгущенные или несгущенные, с добавлением или без добавления сахара или других подслащивающих веществ, со
0404	Молочная сыворотка, сгущенная или несгущенная, с добавлением или без добавления сахара или других подслащивающих веществ; продукты из натуральных компонентов молока, с добавлением или без добавления сахара или других подслащивающих
0405	Сливочное масло и прочие жиры и масла, изготовленные из молока; молочные пасты:
0406	Сыры и творог:
07	Овощи и некоторые съедобные корнеплоды и клубнеплоды
0701	Картофель свежий или охлажденный:
0701100000	- семенной
070190	- прочий:
070200000	Томаты свежие или охлажденные:
0703	Лук репчатый, лук шалот, чеснок, лук-порей и прочие луковичные овощи, свежие или охлажденные:
070310	- лук репчатый и лук шалот:
0703200000	- чеснок
0703900000	- лук-порей и прочие луковичные овощи
0704	Капуста кочанная, капуста цветная, кольраби, капуста листовая и аналогичные съедобные овощи из рода Brassica, свежие или охлажденные:
0704100000	- капуста цветная и брокколи
0704200000	- капуста брюссельская
070490	- прочие:
0705	Салат-латук (Lactuca sativa) и цикорий (Cichorium spp.), свежие или охлажденные:
0706	Морковь, репа, свекла столовая, козлобородник, сельдерей корневой, редис и прочие аналогичные съедобные корнеплоды, свежие или охлажденные:
070610000	- морковь и репа:
070690	- прочие:
070700	Огурцы и корнишоны, свежие или охлажденные:

Appendix E continued

TV04 code	Code description
0708	Бобовые овощи, лущеные или нелущеные, свежие или охлажденные:
0708100000	- горох (Pisum sativum)
0708200000	- фасоль (Vigna spp., Phaseolus spp.)
0708900000	- бобовые овощи прочие
0709	Овощи прочие, свежие или охлажденные:
0709200000	- спаржа
0709300000	- баклажаны (бадриджаны)
0709400000	- сельдерей прочий, кроме сельдерея корневого
070960	- плоды рода Capsicum или рода Pimenta:
0709700000	- шпинат, шпинат новозеландский и шпинат гигантский (шпинат садовый)
0710	Овощи (сырые или сваренные в воде или на пару) замороженные:
0710100000	- картофель
0710300000	- шпинат, шпинат новозеландский и шпинат гигантский (шпинат садовый)
0710400000	- сахарная кукуруза
071080	- прочие овощи:
0710900000	- овощные смеси
0711	Овощи консервированные для кратковременного хранения (например, диоксидом серы, в рассоле, сернистой воде или в другом временно консервирующем растворе), но в таком виде непригодные для непосредственного употребления в пищу:
071120	- маслины, или оливки:
0711400000	- огурцы и корнишоны
071190	- овощи прочие; овощные смеси:
0712	Овощи сушеные, целые, нарезанные кусками, ломтиками, измельченные или в виде порошка
0712200000	- лук репчатый
071290	- овощи прочие; овощные смеси:
0713	Овощи бобовые сушеные, лущеные, очищенные от семенной кожуры или неочищенные, колотые или неколотые:
071310	- горох (Pisum sativum):
0713200000	- нут
0713400000	- чечевица
0713500000	- бобы кормовые, или конские, крупносеменные (Vicia faba var. major) и бобы кормовые, или конские, мелкосеменные (Vicia faba var. equina, Vicia faba var. minor)
0713600000	действует по 41517 - голубиный горох (Cajanus cajan)
071360000	действует с 41518 - голубиный горох (Cajanus cajan):

Appendix E continued

TV04 code	Code description
0713900000	действует по 41517 - прочие
071390000	действует с 41518 - прочие:
0714	Маниок, маранта, салеп, земляная груша, или топинамбур, сладкий картофель, или батат, и аналогичные корнеплоды и клубнеплоды с высоким содержанием крахмала или инулина, свежие, охлажденные, замороженные или сушеные, целые или
071410	- маниок (кассава):
071420	- сладкий картофель, или батат:
071430	- ямс (Dioscorea spp.):
071440	- таро (Colocasia spp.):
071450	- карибская капуста (Xanthosoma spp.):
071490	- прочие:
08	Съедобные фрукты и орехи; кожура цитрусовых плодов или корки дынь
0801	Орехи кокосовые, орехи бразильские и орехи кешью, свежие или сушеные, очищенные от скорлупы или не очищенные
0802	Прочие орехи, свежие или сушеные, очищенные от скорлупы или неочищенные, с кожурой или без кожуры:
0802700000	- орехи колы (Cola spp.)
0802800000	- орехи ареки, или бетеля
080290	- прочие:
0803	Бананы, включая плантайны, свежие или сушеные:
080310	- плантайны:
080390	- прочие:
0804	Финики, инжир, ананасы, авокадо, гуайява, манго и мангостан, или гарциния, свежие или сушеные:
080410000	- финики:
080420	- инжир:
080430000	- ананасы:
0804400000	- авокадо
080450000	- гуайява, манго и мангостан, или гарциния:
0805	Цитрусовые плоды, свежие или сушеные:
080510	- апельсины:
080520	- мандарины (включая танжерины и сатсума); клементины, вилкинги и аналогичные гибриды цитрусовых:
0805400000	- грейпфруты, включая помелло
080550	- лимоны (Citrus limon, Citrus limonum) и лаймы (Citrus aurantifolia, Citrus latifolia):
0805900000	- прочие
0806	Виноград, свежий или сушеный:
080610	- свежий:

Appendix E continued

TV04 code	Code description
080620	- сушеный:
0807	Дыни (включая арбузы) и папайя, свежие:
0807200000	- папайя
0808	Яблоки, груши и айва, свежие:
080810	- яблоки:
080830	- груши:
0808400000	- айва
0809	Абрикосы, вишня и черешня, персики (включая нектарины), сливы и терн, свежие:
0809100000	- абрикосы
080930	- персики, включая нектарины:
080940	- сливы и терн:
0810	Прочие фрукты, свежие:
0810100000	- земляника и клубника
081020	- малина, ежевика, тутовая ягода, или шелковица, и логанова ягода:
081030	- смородина черная, белая или красная и крыжовник:
081040	- клюква, черника и прочие ягоды рода Vaccinium:
0810500000	- киви
0810600000	- дуриан
0810700000	- хурма
081090	- прочие:
0811	подслащивающих веществ:
081110	- земляника и клубника:
081120	- малина, ежевика, тутовая ягода, или шелковица, логанова ягода, смородина черная, белая или красная и крыжовник:
081190	- прочие:
0813	Фрукты сушеные, кроме плодов товарных позиций 801 - 0806; смеси орехов или сушеных плодов данной группы:
0813100000	- абрикосы
0813200000	- чернослив
0813300000	- яблоки
081340	- прочие фрукты:
081350	- смеси орехов или сушеных плодов данной группы:
1601	Колбасы и аналогичные продукты из мяса, мясных субпродуктов или крови; готовые пищевые продукты, изготовленные на их основе
1901	Готовые продукты, включая сыры и творог на основе растительных жиров

APPENDIX F

Robustness check: using labor productivity as firms' productivity measure instead of TFP

Table 12. Results of difference-in-differences estimation of trade blockade impact on food exporters (labor productivity as a dependent variable)

Dependent variable	Coefficients			
	Treat	After2012	Interaction	Constant
Labor productivity	0.1278***	0.3195***	-0.1380***	2.2695***
	(0.0171)	(0.0493)	(0.0405)	(0.0430)

Note: R2=0.5647, number of observations: 10561; * if p-value < 0.05, ** if p-value < 0.01, *** p < 0.001.

Table 13. TFP levels by firm export types (labor productivity as a dependent variable)

Dependent variable	Firm's export type					
	Stopper to Russia	Stopper to other	Starter to Russia	Starter to other	Always to Russia	Always to other
Labor productivity	.1108***	.2935***	-.0114	-.0185	..2409***	.2802***
	(.0010)	(.0117)	(.0290)	(.0237)	(.0300)	(.0269)

Note: R2=0.5625, number of observations: 430481; * if p-value < 0.05, ** if p-value < 0.01, *** p < 0.001.

Appendix F continued

Table 14. TFP trajectories by firm export types (labor productivity as a dependent variable)

Time period	Firm's export type				
	2 years before entry/exit	1 year before entry/exit	Year of entry/ exit	1 year after entry/exit	2 years after entry/exit
Never		-.1426***	.0869***	.1390***	.1258***
Stopper to Russia	-.0279	-.1554**	-.0228	-.0336	-.1332*
Stopper to elsewhere	.0165	-.0684	-.1384***	-.1090**	-.1919***
Other	-.0108	.1604***	.1289***	.1448***	.1291***
Starter to Russia	-.0032	-.0599	.2301***	.2903***	.3116***
Starter to elsewhere	.0168	-.0438	.3276***	.2846***	.3635***
Always to Russia	.0903	.0413	.1025***	.1468***	.1503***
Always to elsewhere	.2181***	.1391***	.2011***	.2922***	.3045***

Note: R2=0.4931, number of observations: 100223; * if p-value < 0.05, ** if p-value < 0.01, *** p < 0.001.

APPENDIX G

Robustness check: different specifications of regressions

Table 15. Results of difference-in-differences estimation of trade blockade impact on food exporters (different specifications)

Dep. var. TFP	Coefficients					
	Treat	After 2012	Interaction	Constant	R2	N
Without controls	.1446***	.5968***	-.3333***	.6823***	0.0225	10863
Industry and year dummies	.1663***	.8091***	-.3485***	-.6148***	0.0548	10863
Firm size and material cost	.1262***	.1990***	-.1217**	.0040***	0.5549	10222

Note: * if p-value < 0.05, ** if p-value < 0.01, *** p < 0.001.

Appendix G continued

Table 16. TFP levels by firm export types (different specifications)

Dep. var. TFP	Firm's export type					
	Stopper to Russia	Stopper to other	Starter to Russia	Starter to other	Always to Russia	Always to other
Without controls	1158**	.1215***	.6536***	.6844***	.4998***	.7438***
Industry and year dummies	.1317**	.1279***	.6747***	.6878***	.4944***	.7203***
Firm size and material cost	-.1166**	-.0569*	.2106***	.2996***	.1080***	.5765***

Note: without controls – R2 = 0.0100, N = 440,009;
industry and year dummies – R2 = 0.0459, N = 440,009;
firm size and material cost – R2 = 0.4083, N = 381037;
* if p-value < 0.05, ** if p-value < 0.01, *** p < 0.001.

Appendix G continued

Table 17. TFP trajectories by firm export types (years 2004-2008)

Time period	Firm's export type				
	2 years before entry/exit	1 year before entry/exit	Year of entry/ exit	1 year after entry/exit	2 years after entry/exit
Never		-.0169*	.0196**	.0272***	.0521***
Stopper to Russia	-.0000	-.0561	-.0316	-.1181**	-.1129**
Stopper to elsewhere	.0261	-.0312	-.0783**	-.1130***	-.1184***
Other	-.0115	.0458***	.0253**	.0400***	.0807***
Starter to Russia	-.0097	-.0351	.0225	.0544*	.0296
Starter to elsewhere	.0506	.0563	.1050**	.0966**	.0924**
Always to Russia	-.0401*	-.0366*	-.0110	.0213	.0001
Always to elsewhere	.2065***	.1738***	.2113***	.2132***	.1711***

Note: R2= 0.6126, N= 96,180, * if p-value < 0.05, ** if p-value < 0.01, *** p < 0.001.