THE EFFECT OF ARMED CONFLICT IN DONBAS ON THE PERFORMANCE OF UKRAINIAN FIRMS

by

Oleksandr Voronin

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Thesis Supervisor: _____ Professor Volodymyr Vakhitov

Approved by _____
Head of the KSE Defense Committee, Professor [Type surname, name]

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Date _____

Kyiv School of Economics

Abstract

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Economic consequences of armed conflicts have been an attractive topic for many scholars, but there are still only a few empirical researches in this direction. Ukraine has been suffering from the hostilities on the East since 2014, so it is suitable evidence to proceed with a study on this topic. In this work we examine whether total factor productivity of Ukrainian firms was affected by armed conflict and how did this effect vary over time and through different proximities to the demarcation line. We found that there is a significant and negative effect of war on the productivity of Ukrainian firms. Moreover, this effect diminishes with the distance from the demarcation line and in time. In 2016 this effect died out.

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Chapter 1

INTRODUCTION

Since the dawn of humankind conflicts and wars have plagued humanity. (Hedges 2007) claims that only 8% of the recorded history humanity was in peace, the rest of the time people suffered from armed conflicts. Even now two billion people live in countries affected by fragility, conflict, and violence. There are plenty of papers concerning the consequences of armed standoffs on the state or the regional levels but only a few papers on the economic impact of wars on the firm level. Our research is supposed to fill this gap with microeconomic evidence from Ukraine.

Ukraine is a suitable country for such research because since 2014 it has been suffering from hostilities on the East and the South. The background of this conflict was the revolution within Ukrainian society, which leads to the overthrow of the President and his escape to Russia. Taking advantage of an unstable situation within the country, the President of Russian Federation Vladimir Putin sent military forces wearing unmarked uniform into Crimea and soon with their help initiated a referendum to join Russia, which was not recognized as a legitimate by Ukraine and most European counties. After that eastern rebels supported by the Russian Federation started to destabilize the situation in Donetsk and Lugansk oblast. The Ukrainian government considered these actions as terrorist activity, and Ukraine began to the anti-terrorist operation on the East. According to the (Office of the United Nations High Commissioner 16 February to 15 May 2017), more than 10300 people were killed since that time, nearly 3000 of which were civil. More than 24000 were injured, more than third of which were civil. Ukraine faced severe destruction of infrastructure, which caused that lives of approximately 600000 people worsened, more than two million people were forced to leave their homes.

From the economic point of view, the first two years of this conflict were marked by 6.6 and 9.8% GDP drop respectively. The unemployment rate increased from 7.2% in 2013 to 9.5% in 2017 (The World Bank 2018). There negative effect of hostilities is visible, but there is a lack of results of studies on how firms were affected. In particular, the object of interest is the effect of military conflict on the firms' productivity. (Bloom and Van Reenen 2010) distinguish several factors, which define the productivity of firms: technology, capital, organizational structure, and management. (Iranzo, Schivardi and Tosetti 2008) extended this list by the amount of labor and its skills. Each of the mentioned components may be affected by armed conflict.

There are several papers on the economic effect of hostilities on the macro-level, but lack of evidence for the firm-level. Especially this problem is peculiar for Ukraine. Our research aims to test whether there is a significant effect of the distance from the frontline (as a proxy for on the total factor productivity of firms using data came from annual firms' statements submitted to State Statistical Service of Ukraine). Also, we check how does this negative effect vary across distances from the demarcation line as well how does the negative impact changed since the war started. The initial guess is that lower firms' proximity to the conflict zone decreases its' TFP.

Our contribution is that, unlike previous studies, we test whether the effect of the conflict diminishes with the increase of the distance from the demarcation line and with the time. We presume that enterprises located near the conflict zone are more likely to be affected than enterprises located 50 or 100 kilometers away from it. Also, we suppose that in 2014, when the war started and hostilities were the most active, Ukrainian firms suffered more than in 2016 when the conflict is sluggish, and enterprises have adapted.

The structure of this paper is following: Chapter 2 is about the review of the related literature on the impact of armed conflicts on the economy and in particular firms' performance; Chapter 3 describes the methodology used for

the analysis and the description of models used in our thesis; Chapter 4 is dedicated to the data description; the results of the empirical analysis are listed in Chapter 5; Chapter 6 describes the main findings of the paper and suggests policy implications as well as directions for further research.

Chapter 2

LITERATURE REVIEW

The economic impact of war can be considered from two polar points of view. Before the First World War, it was regarded as only beneficial for the economy. (Luce 1891) stated that wars stimulate countries' growth and solve problems of domestic and political economy because of human progress and development of the law. Such an approach is peculiar even for modern economists. (Stiglitz and Bilmes 2008) gives an example of increased demand for tanks during the Second World War, which provided stimulation of demand for labor and decreased unemployment. From the other point of the view costs of war can be harmful to the economy. (Arunatilake, Jayasuriya and Kelegama 2001) on the example of Sri Lanka show that there are direct and indirect costs of armed conflicts. The first group includes the costs of destruction of physical capital, costs of damage to infrastructure and expenditures provided for displaced and injured people. Indirect costs refer to forgone investments, income reduction due to an injury of physical capital and reduction of human capital as well reduction of income borne by tourism. (Humphreys 2003) also mentions the change in total factor productivity as a critical effect of the civil war on the economy. (Field 2008), considering the U.S. economy after the Second World War had concluded empirically, that the war significantly slows down the TFP growth.

Economic consequences of armed conflicts on the micro level seem to be relatively understudied. The first serious attempt to assess the effect of conflict on firms empirically was undertaken by (Collier and Marguerite 2010). Initially, the author studied the impact of conflict intensity (based on survey data) on the number of firms, controlling the industry and number of firms by sector. He found that there is no significant instant effect of conflict on firms exit. But the intensity of the armed conflict lowers the average size of the enterprises as well

as their income. (Camacho and Rodriguez 2013) show a positive effect of armed conflict in Columbia on exit decision on the example of plants, controlling for endogeneity using an instrumental variable, in this case, lagged government deterrence measures. The authors emphasize, that results cannot be generalized for all plants, but only for those who have more than ten employees and just for the manufacturing sector.

A different approach was used by (Petracco and Schweiger 2012). They developed an empirical model to study the impact of the armed conflict in Georgia in 2008 on firms' performance. Having data on firms' financials before and after the Georgian-Russian battle, they tested the hypothesis that conflict negatively affects exports, sales and employment rates of at least part of firms. Armed conflict is modeled by a dummy variable equals one if a district has experienced bombing or it has taken part in serious hostilities directly, and several times it was directly affected with the armed conflict in this model. The battle has positive but not always significant coefficient (showing a positive effect on financial indicators). Also, the authors included control variables for firms such as size and age finding that small and young firms find it more challenging to deal with the armed conflict and its consequences. They suggest that armed conflict had a significant adverse effect on export and sales for a bunch of firms and as well young and small-sized firms are more likely to exit being not able to cope consequences of conflict. Unlike (Collier and Marguerite 2010) and (Camacho and Rodriguez 2013) authors included a fixed effect to capture specific characteristics of regions which can influence performance on firms located within them.

The most related to our topic is the paper by (Klapper, Richmond and Tran 2013). Unlike previous studies, they used TFP as firms' performance and tested a hypothesis that conflict has a significant negative effect on total factor productivity. Data used in a paper is very similar to ours. Authors used panel data on firms' financial activity. But the emphasis in this work was made on the

presence of foreign employees and foreign capital within a firm and how can it affect the negative impact of the conflict on productivity. As in case of (Petracco and Schweiger 2012), conflict variable appears in a model twice: as a dummy variable indicating a period and as a conflict intensity which makes up a geographical variation of conflict and locations of firms. Interesting results are that initially, firms with at least one foreign employee have higher TFP, but interaction with conflict variable shows that such firms are more likely to suffer from armed conflicts and its' TFP decrease more rapidly. To be more specific, they found that one standard deviation increase in the conflict intensity lower TFP by 10-11% and each additional percentage point increase in the share of foreign employees increase this effect about one percentage point.

The problem of mentioned works is that authors did not make any difference between the proximity of firms to the conflict zone. As opposed to them, (Gabriel, et al. 2015) proposed to check how the economic effect changes with the proximity to the Central Business District across the demarcation line. They studied the impact of building the Berlin Wall on floor space prices in West Berlin. Their findings suggest that there is a small difference in prices of pre-wall and after-wall periods in case if areas are distant from CBD. Conversely, if the land is located in close proximity to the Business Centre, there is a negative and significant effect of building a Berlin Wall. As a robustness check, they also studied the reverse effect using data after falling off the wall and concluded that it is significant too but less in magnitude.

Their next experiment was to check if the effect of proximity is present when the dependent variables are the productivity of studied areas and amenities. As the expected, the impact was the same: the closer the block is to pre-wall CBD, the larger is a drop of productivity for firms, located within its borders. To make sure, their findings are statistically significant and robust, authors used "difference-in-differences" estimator. Authors state that their quantitative framework is suitable for capturing changes in economic indicators within

territories in response to other intervention. In the empirical part of our research, we will implement a similar approach, but in this case, it will be the military intervention, and we will consider proximity directly to the demarcation line.

There are several methods to capture the total factor productivity. (Gal 2013) distinguishes four approaches: Solow residuals, ordinary least squares residuals, excellent index, and Wooldridge method. (Frija, et al. 2015) also suggest non-parametric methods: DEA and the Malmquist index. TFP as OLS residuals is a benchmark for all methods based on the production function, but (Breunig and Wong 2005) claim that for firm-level panel data OLS method for either balanced panel or full sample might be not suitable because of positive bias. The similar problem might also occur in case of fixed effects, but with a negative bias.

The suggested solution is to use the semiparametric method introduced by (Olley and Pakes 1996). It allows obtaining reliable estimate controlling for such biases. These method helps to avoid simultaneity using investments as a proxy for unobservable productivity shocks and selection problem using exit variable. (Levinsohn and Petrin 2003) argue that this method is not multipurpose because only a bunch of firms invests. They suggest intermediate input as a suitable proxy.

Considering groundwork on this topic, we will perform similar research with evidence from Ukraine. Following (Klapper, Richmond and Tran 2013) we will build an empirical model to capture the effect of the conflict on the East of Ukraine on total factor productivity of firms as (Petracco and Schweiger 2012). Considering TFP differences for subindustries as (Collier and Marguerite 2010) suggested, we will calculate it separately for different types of manufacturing.

As (Gabriel, et al. 2015) we will study the effect of the proximity of enterprises to the demarcation line. In their work authors divided territory by blocks; in

our case, it is better to create intervals of different length and check whether the impact differs through them. Authors used "difference-in-differences" estimator in order to capture the effect of building of the Berlin Wall. We will use the same approach in one of the specification because we have data before and after the occurance of the conflict on the East Ukraine.

Chapter 3

METHODOLOGY

Our methodology consists of two steps: find total factor productivity from the production function and build a model which describes the effect of the conflict on the TFP of Ukrainian firms. In the empirical part of our research, we will majorly emphasize the second part of estimation as there is a lot of literature describing the methods of calculation of TFP from the production function having necessary data. However, a few works are dealing with capturing the effect of armed conflict on the productivity of firms.

In contemporary practice, there are two methods widely used to estimate production function. The first one was suggested by (Olley and Pakes 1996). Authors criticize other production function estimators because of bias. They emphasize selection problem due to less productive firms are more likely to exit the market and simultaneity problem due to a correlation between unobservable productivity shocks and inputs. In their model, authors introduced an exit variable to avoid selection bias and use investments as a proxy for unobservables to get rid of simultaneity bias.

The second estimator was proposed by (Levinsohn and Petrin 2003). Their method is similar to the previous one, but authors state that investments are inappropriate proxy because there are many firms with zero investments, means monotonicity condition is violated for these observations. So, the authors suggest intermediate output as a proxy instead of investments.

However, in our dataset the majority of firms did not report their investments and material costs, especially starting from 2014 when the war started, so we cannot instrument unobservables using methods mentioned above. Instead of this, we estimated production function using fixed effects with only capital (as the value of physical capital) and labor (as the number of employees). Due to

the fact, that output and capital enter our model in monetary terms we used the table of PPIs to deflate them.

After production function estimation, it is necessary to capture total factor productivity. The simplest way to find TFP empirically is to predict residuals from the regression of factors (labor and capital) on the output of firms. On this stage, we created a variable which consists of TFPs, predicted for different industries separately. It was done to capture the variation of productivity of firms across subindustries because naturally total factor productivity varies depending on the type of manufacturing

Before studying the effect of the conflict on the total factor productivity of firms, we created the conflict variable as a dummy. In order to do this step, we constructed the demarcation line on the map and distances of our interest: 25, 50, and 100 kilometers from it. Then we checked which localities belong to these areas. After, having their territorial codes and the same codes for enterprises, we found out which firms are located on areas directly affected with the conflict and created dummy variables for each distance indicating whether the firms are located in cities directly affected by war at least one time. We considered only localities which are under control of the Ukrainian government because temporarily occupied territories do not report their balance sheet statements and P&L statements to Derzhstat.

The idea behind the second step is to show empirically, whether there is a significant negative relationship between TFP and the presence of armed conflict and how does productivity change with the increase of the distance from the enterprise to the demarcation line and over time. As a measure of conflict, we use a dummy variable indicating whether the firm is located in less than 25 kilometers from the edge of demarcation with occupied territories. Also, we will test 50, and 100 kilometers distances.

Besides, we created three dummy variables indicating whether the firms are located in 0-25, 25-50, and 50-100 kilometers intervals away from the demarcation line. It allows us not only to check cumulative distances but to include each interval separately. As (Gabriel, et al. 2015) broke down the territory of Berlin on blocks in order to capture how did the effect of building of The Berlin Wall change through these blocks due to an increase of the distance from Central Business District, we will do the similar thing but with our three areas.

The initial hypothesis is that the conflict variable has a negative impact on total factor productivity. Moreover, we presume that with the increase of distance, the effect of conflict diminishes. To isolate the impact of violent conflict, we included the first lag of total factor productivity. We do not include industry dummies, because we have already captured their effect calculating TFP variable. We run regressions for each year separately starting from 2013 to 2016 because of the fixed effects of our conflict variable, which does not vary in time. Our first model specification is presented in equation 1.

$$TFP_{it} = \beta_0 + \beta_1 TFP_{it-1} + \beta_2 conflict_{it} + \varepsilon \quad (1)$$

where $conflict_{ij}$ – dummy variable indicating whether the firm is located in less than 25 (also less than 50 and less than 100 for corresponding specifications) kilometers from the line of demarcation with occupied territories, ε –residuals, β_0 , β_1, β_2, – coefficients.

While the number of firms, located in 25, 50 and even 100 kilometers distance from the demarcation line is relatively small nationwide, we test our hypotheses for three areas separately. Firstly, we estimated our models for the entire

Ukraine. After this, we estimated the same model but limited our dataset for only enterprises located in left-bank Ukraine. Finally, we considered only firms located in oblasts directly affected with the war and their neighbors: Luhansk, Donetsk, Zaporizhia, Dnipropetrovsk, and Kharkiv oblasts. We anticipate the higher impact for areas located near Donbas (because these areas were directly affected by the armed conflict) and lower for the entire country (because the activity of the most part of enterprises was affected due to changes in trade policy, financial crisis, and other indirect factors).

After running the bunch of previous regressions for each year separately, as (Gabriel, et al. 2015) suggested, we estimated our next model, using "difference-in-difference" method. It allows us to consider changes in total factor productivity for Ukrainian enterprises from a dynamic point of view. "Difference-on-differences" estimator captures the time trend and checks the response of Ukrainian firms on intervention. We compared changes in TFP over time between pre-war firms (control group) with post-war enterprises (treatment group). Similar to previous models, we run regressions for three groups of firms: for entire country, for left-bank Ukraine and only Luhansk and Donetsk oblasts + oblasts neighboring with them.

(Wooldridge 2015) also suggests this estimator in case of having data before and after the occurrence of the accident to observe a treatment effect. Since we have pre-war data and data of war years, we can use this specification. The model 2 presents difference-in-difference estimator.

$$TFP_i = \beta_0 + \beta_1 TFP_i + \beta_2 year + \beta_2 conflict + \quad (2)$$

$$+\beta_2 conflict_t * year + \varepsilon$$

In this case we are interested only in $\beta_2 conflict_t * year$ term. It shows how on average did total factor productivity change due to hostilities on the Eastern part of Ukraine. In this model, a dummy variable is not cumulative like in previous ones, but it indicates whether the firm is located in 0-25 kilometers distance from the demarcation line, 25-50 and 50-100-kilometers distance.

Chapter 4

DATA

For our research, we have panel data on the financial activity of Ukrainian firms since the 2010 year. Dataset consists of balance sheet statements and P&L statements reported by Ukrainian firms. Data came from annual firms' statements submitted to Derzhstat. For our purposes, we concern only manufacturing firms. Also, it is essential that we have KOATUU for each enterprise which allows us to check whether it belongs to a zone located near the conflict.

Our dataset contains firms' unique index, its' classification of types of economic activity, territorial code (KOATUU), output, amount of capital in monetary terms, number of employees and wages for each year. Also, there is a number of investments and material cost for a bunch of firms, but the majority of them did not report these data. We presume that smaller firms were affected more critically by of hostilities in the Donbas region; however, we dropped all enterprises which have 5 or fewer employees because of the low quality of data they often report.

The other part of the data concerns conflict variable is obtained by constructing the demarcation line on the map based on official coordinates reported by governors and creating three other lines with interval 25, 50 and 100 kilometers. Afterward, we created the lists of localities which belong to these intervals. Having unique KOATUU for each area allows us to examine whether the firm is located inside the range and create a dummy variable (a proxy of the conflict).

For the first two models, we created three dummies indicating whether firms are located in less than 25, 50, and 100 kilometers distance from the zone of conflict, respectively. For the difference-in-differences model, we divided 100

kilometers interval by 0-25, 25-50, and 50-100 bands and indicated whether firms are inside these bands.

The effect of hostilities on firms located on the other side of the demarcation line is unobservable because they do not report their financials to the Derzhstat. After cleaning the data, we left with 50,380 observations over six years: from 2011 to 2016. We included columns representing amounts of firms for each year for whole Ukraine, left-bank Ukraine and Donbas and its neighbors (Zaporizhia Oblast, Dnipropetrovsk Oblast, and Kharkiv Oblast). The most substantial amounts of observations are in 2011 2012 and 2013 years (see Table 1).

Table 1. Number of observations by years for entire Ukraine

Year	Ukraine	Left-band	Neighbors
2011	11,597	4,657	3,761
2012	9,138	3,866	3,093
2013	8,600	3,722	3,010
2014	6,961	2,691	2,010
2015	7,890	2,588	1,916
2016	7,194	2,646	1,929
Total	50,380	20,170	15,719

The average number of the total output for entire Ukraine increased year by year regardless of the war (except 2013, when the amount of capital slightly decreased). The average amount of deflated capital continuously grew except 2016 when it imperceptibly decreased comparing to 2015. The average number of employees slightly dropped after 2014 and dropped again even more in 2016 (see Table 2).

Table 2. Mean values of output, capital and labor for entire Ukraine

Year	Output	Capital	Labor
2011	34127.35	8235.61	79
2012	43636.66	11773.88	94
2013	43507.11	13294.58	95
2014	53991.16	19428.51	98
2015	75865.21	21992.22	96
2016	78241.70	20954.97	85

For left-bank Ukraine, the situation with the deflated output is similar - it grew continuously since 2011. As for deflated capital and labor, it slightly dropped in 2016, but there was no instant shift after 2014 when the war started. (see Table 3)

Table 3. Mean values of output, capital and labor for left-bank Ukraine

Year	Output	Capital	Labor
2011	60104.27	13938.67	107
2012	72892.33	19287.59	126
2013	68226.17	21119.17	122
2014	91959.73	36785.55	134
2015	130894	44826.08	138
2016	135503.9	42974.56	117

For firms located in neighboring with Donetsk and Luhansk oblasts, average values for deflated output and capital as well as labor changed similarly as for left-bank Ukraine: all indicators grew continuously since 2011, but there was a decline in the amount of labor and capital after 2015 (see Table 4).

Table 4. Mean values of output, capital and labor for neighbors of Donbas region

Year	Output	Capital	Labor
2011	60038.05	15085.93	107
2012	70460.94	21209.08	127
2013	66387.13	23216.10	122
2014	97243.94	44737.08	138
2015	141421.60	55292.98	147
2016	149737.20	53161.71	121

Even provided, we concern only manufacturing enterprises for our research, TFP naturally varies through different subindustries of manufacturing. For instance, the highest total factor productivity is peculiar for the processing of tobacco products (12), production of coke and refined products (19) and metallurgical manufacturing (24). The lowest total factor productivity is characteristic for the manufacturing of clothing (14), wood processing and wood/cork manufacturing, except furniture; manufacture of straw products and vegetable materials for weaving (16), furniture production (31) and other manufacturing (32) for each year starting from 2012 (see Table 5).

In light of the abovementioned, we need to capture the natural differences of total factor productivities among subindustries. In order to solve this problem, we will predict total factor productivity separately for each of them using loop in Stata.

Table 5. TFP through subindustries

	years				
kv2	2012	2013	2014	2015	2016
10	4.38	4.40	4.40	4.40	4.35
11	4.24	4.29	4.15	4.09	4.09
12	5.93	6.65	7.49	7.57	8.57
13	3.56	3.57	3.64	3.66	3.67
14	2.57	2.58	2.60	2.64	2.65
15	3.20	3.33	3.39	3.36	3.36
16	2.83	2.81	2.86	2.89	2.89
17	3.81	3.99	3.98	3.93	3.91
18	2.97	2.99	2.99	2.97	2.97
19	5.73	6.21	6.57	6.56	6.52
20	4.33	4.41	4.43	4.31	4.31
21	4.66	4.81	4.86	4.90	4.86
22	3.89	3.92	3.89	3.85	3.83
23	3.77	3.73	3.78	3.72	3.75
24	5.15	5.06	5.12	5.12	4.96
25	3.42	3.46	3.44	3.38	3.36
26	3.64	3.58	3.66	3.65	3.64
27	4.11	4.19	4.09	4.07	3.96
28	3.99	3.97	3.97	3.90	3.87
29	4.24	4.26	4.40	4.25	4.26
30	4.31	4.83	5.08	5.08	4.75
31	2.96	2.94	3.06	3.02	3.04
32	2.92	2.89	2.87	2.98	2.95

The total number of observations indicated as located within 25 kilometers interval away from the demarcation line with temporary occupied territories is 1,006, within 50 kilometers – 2,113 and within 100 kilometers – 2,683 (see Table 6). But these observations are distributed among seven years from 2011 to 2016. The number of distinct firms located in these areas are 349, 689 and 854 respectively.

Table 6. Number of observations from 25, 50 and 100 kilometers intervals from the demarcation line

year	km25	km50	km100
2011	266	540	654
2012	198	404	507
2013	190	381	484
2014	128	275	362
2015	116	259	342
2016	108	254	334
Total	1,006	2113	2,683

Chapter 4

ESTIMATION RESULTS

This chapter presents the empirical results of our research and the discussion of the main findings. To conduct our research, we run several regressions to check whether the negative effect of hostilities on the East diminishes over distance from the demarcation line and over time. The results are presented in the following way: the first specification considers observations from entire Ukraine, the next specification is built based on observations limited by left-bank Ukraine, and the last one considers only firms neighboring with Donbas region (see Tables 7-9).

Table 7. Main model for entire Ukraine over 2013-2016 years

		2013	
	25 kilometers	50 kilometers	100 kilometers
dist	-0.0100	-0.00803	-0.00425
	(0.0250)	(0.0193)	(0.0165)
N	7020	7020	7020
		2014	
	25 kilometers	50 kilometers	100 kilometers
dist	-0.180***	-0.159***	-0.153***
	(0.0478)	(0.0307)	(0.0274)
N	6079	6079	6079
		2015	
	25 kilometers	50 kilometers	100 kilometers
dist	-0.169***	-0.155***	-0.142***
	(0.0483)	(0.0300)	(0.0248)
N	5786	5786	5786
		2016	
	25 kilometers	50 kilometers	100 kilometers
dist	-0.0528	-0.0489	-0.0481
	(0.0513)	(0.0278)	(0.0246)
N	5959	5959	5959

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

These results support our hypothesis about diminishing with the distance and the time effect of the conflict. According to the regression output, in 2013, before the war started, the coefficients were statistically insignificant. In 2014 the effect was the highest which can be explained with the instant destruction of the physical capital, labor movements, termination of trading with the Russian Federation, etc. As we expected, firms, located in 25 kilometers zone were affected more than distant ones; moreover, firms located in 50 kilometers zone were affected more than firms from 100 kilometers interval. The negative effect dropped a bit in 2015 but remained significant and diminishing with the distance. In 2016 there was no influence of the war on the total factor productivity. It seems that firms have adapted until 2016.

The number of firms, located in 100 kilometers interval from the military operation, is relatively small compared with the whole bunch of Ukrainian firms. That's why we have decided to check our results using the sample containing only firms from left-bank Ukraine. The results seem to be pretty similar.

Table 8. Main model for the left-bank Ukraine over 2013-2016 years

		2013	
	25 kilometers	50 kilometers	100 kilometers
dist	-0.0153	-0.0138	-0.0100
	(0.0254)	(0.0199)	(0.0173)
N	3075	3075	3075
		2014	
	25 kilometers	50 kilometers	100 kilometers
dist	-0.155**	-0.137***	-0.134***
	(0.0481)	(0.0315)	(0.0283)
N	2389	2389	2389
		2015	
	25 kilometers	50 kilometers	100 kilometers
dist	-0.145**	-0.135***	-0.123***
	(0.0488)	(0.0307)	(0.0257)
N	2185	2185	2185
		2016	
	25 kilometers	50 kilometers	100 kilometers
dist	-0.0440	-0.0406	-0.0414
	(0.0515)	(0.0287)	(0.0256)
N	2227	2227	2227

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

We found that according to this specification there was no effect in 2013, highest and very significant coefficients in 2014, lowered a bit, but still significant effect in 2015 and no influence of in 2016. The interesting finding is coefficients are smaller in magnitude comparing to the same ones from the whole sample and less significant for 25 kilometers zone. Next, we checked if the effect is the same for neighbors of Donbas.

Table 9. Main model for neighbors of Donbas over 2013-2016 years

	2013		
	25 kilometers	50 kilometers	100 kilometers
dist	-0.0123	-0.0107	-0.00676
	(0.0257)	(0.0203)	(0.0177)
N	2468	2468	2468
	2014		
	25 kilometers	50 kilometers	100 kilometers
dist	-0.145**	-0.129***	-0.127***
	(0.0484)	(0.0321)	(0.0289)
N	1790	1790	1790
	2015		
	25 kilometers	50 kilometers	100 kilometers
dist	-0.133**	-0.124***	-0.113***
	(0.0491)	(0.0312)	(0.0263)
N	1599	1599	1599
	2016		
	25 kilometers	50 kilometers	100 kilometers
dist	-0.0500	-0.0478	-0.0500
	(0.0518)	(0.0293)	(0.0264)
N	1611	1611	1611

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

We can see, that the situation remains the same: conflict variable is insignificant in 2013, in 2014 the negative influence is very significant, but it slightly decreased in magnitude comparing to left-bank Ukraine. In 2015 the effect dropped a bit and in 2016 became statistically insignificant.

For all three areas, we considered, our initial hypothesis was supported: there is a significant negative effect of hostilities on the East of Ukraine on total

factor productivity of Ukrainian firms, it diminishes over the increase of the distance and over time. In previous models, we considered an effect of hostilities on total factor productivity for each year separately. But it is necessary to observe it from a dynamic perspective. For this purpose, as (Gabriel, et al. 2015) suggested, we built a "difference-in-difference" model. It allows us to capture the time trend and check the response of Ukrainian firms on intervention. We compared the changes in TFP over time between pre-war firms (control group) with post-war enterprises (treatment group). Similarly to previous models, we run regressions for three groups of firms: for the entire country, for left-bank Ukraine and only Luhansk and Donetsk oblasts + oblasts neighboring with them (see Tables 10-12).

Table 10. Difference in difference estimator for entire Ukraine

		2014	
Diff	-0.173***	-0.132**	-0.132*
	(0.0524)	(0.0454)	(0.0607)
N	13099	13099	13099
		2015	
Diff	-0.161**	-0.133**	-0.102*
	(0.0519)	(0.0462)	(0.0418)
N	12806	12806	12806
		2016	
Diff	-0.0464	-0.0435	-0.0536
	(0.0577)	(0.0405)	(0.0603)
N	12979	12979	12979

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Our findings suggest that in 2014 for entire Ukraine there was a negative effect of 0-25 kilometers distance on TFP significant on 0.001 level. As for 25-50

kilometers distance, the effect was smaller in magnitude, but still significant on 0.01 level. For firms within 50-100 kilometers zone, the effect was significant on 0.05 level. In 2015 the impact became smaller in magnitude and less significant for the first area. For 25-50 it remained unchanged and became smaller for 50-100 kilometers. In 2016 there was no significant effect for any zone, which supports our previous findings of diminishing of the negative impact in time.

Table 11. Difference in difference estimator for left-bank Ukraine

	2014		
Diff	-0.142**	-0.0999*	-0.0997
	(0.0452)	(0.0432)	(0.0576)
N	5464	5464	5464
	2015		
Diff	-0.131**	-0.102*	-0.0691
	(0.0450)	(0.0427)	(0.0568)
N	5260	5260	5260
	2016		
Diff	-0.0311	-0.0283	-0.0393
	(0.0473)	(0.0435)	(0.0582)
N	5302	5302	5302

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

These results suggest that in 2014 for left-bank Ukraine there was an effect of war significant at 95% confidence level for firms located in 0-25 kilometers and 25-50 kilometers zones from the demarcation line. For more distant enterprises there was no effect at all. In 2015 the effect became smaller for 25 kilometers zone and slightly increased for 25-50 kilometers zone (with the same

significance level) and no impact for 50-100 kilometers. In 2016 the effect for all three areas was statistically insignificant, which supports our previous findings. Comparing to evidence from entire Ukraine, results became smaller in magnitude and less statistically significant.

To our surprise, the effect of distance from the demarcation line decreased for enterprises located in the Donbas region and its neighbors. For each period coefficients became smaller in magnitude with the same significance level. The overall trend remained the same: the most substantial impact is peculiar for the 2014 year and enterprises located in 25 kilometers distance. This effect decreases in magnitude for more distant enterprises and also for next year after the war started. There is no significant effect of armed conflict on TFP for enterprises located farther than 50 kilometers and also the effect died out at all in 2016 (see Table 12).

These results are consistent with our previous findings: the effect of war on total factor productivity is higher for entire Ukraine than for restricted samples. What is more, coefficients on distance as a proxy of war is more prominent in magnitude and more statistically significant for left-bank Ukraine than for Donbass and neighboring oblasts.

Table 12. Difference in difference estimator for neighbors of Donbas

		2014	
Dist	-0.134**	-0.0918*	-0.0911
	(0.0467)	(0.0447)	(0.0594)
N	4258	4258	4258
		2015	
Dist	-0.121**	-0.0917*	-0.0581
	(0.0463)	(0.0442)	(0.0584)
N	4067	4067	4067
		2016	
Dist	-0.0399	-0.0373	-0.0487
	(0.0490)	(0.0451)	(0.0600)
N	4079	4079	4079

Standard errors in parentheses
* p<0.05, ** p<0.01, *** p<0.001

Chapter 4

CONCLUSIONS AND POLICY RECOMENDATIONS

The purpose of this thesis was to fill the gap in Ukrainian economic studies, considering conflict in the East of Ukraine. Studies are stating that war hurts the economy and firms' productivity in particular. This work checks empirically whether this effect is significant using data from financial reports of Ukrainian firms and own data on conflict. Moreover, our initial hypothesis was that this effect diminishes with the expanding of the distance from the firms to the demarcation line.

We built models for the sample of the firms from entire Ukraine and two subsamples: left-bank Ukraine and only neighbors of regions directly affected with hostilities. We showed empirically, for each of mentioned sample effect of the conflict on total factor probability is significant and negative. However, it reveals that for smaller samples the influence is less significant in magnitude, compared with the whole of Ukraine. The reason might be a relatively small number of enterprises belonging to these areas.

Also, among the main findings is that the negative effect of war on the productivity of Ukrainian enterprises diminishes with the time and in the 2016 year there is no effect anymore, according to all specifications. We interpret it as an adaptation of firms to adverse condition. The highest impact is we observe in 2014 when the war started.

Due to the difference-in-difference estimator, the highest impact was attributed to 2014 and 25-kilometers distance. For 25-50 kilometers area, the influence was slightly lower and died out at all for 50-100 kilometers zone. In 2015 the effect was similar, but the coefficients were lower than in 2014. The statement about running out of the impact in 2016 was supported by difference-in-difference results too. An interesting fact is that according to this estimator as

well as the previous one, entire Ukraine was affected much more than smaller areas approximate to the demarcation line.

As we expected the impact of hostilities in the East of Ukraine diminishes over the increase of distances to proxy conflict. When we talk about 25 kilometers proximity to the combat zone, the coefficient is much more harmful, than in the case of 50, or 100-kilometers intervals.

According to our research, there was no substantial drop in deflated output, capital, or amount of labor after 2014. Moreover, as we have shown until 2016, firms adapted and conflict do not have any significant effect on total factor productivity. It means that from policy perspectives, it is not correct anymore to state that the low performance of Ukrainian firms is substantially due to hostilities in the East.

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