NDUSTRIAL AGGLOMERATION AND FOREIGN DIRECT INVESTMENTS. UKRAINIAN DISTRICTS EXAMPLE

by

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Abstract

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In this thesis work, the investigation of influence of key determinants on foreign direct investments inflow to the Ukrainian district level is presented. Moreover, we reveal the pattern of the relationship between foreign direct investments and investments in fixed assets made by local entrepreneurs. Then we explore the impact of industrial agglomeration, presented by accumulated investments, on FDI attraction and additionally we present the spatial spillover effect of agglomeration and FDI.

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Finally, I give all the rest of thanks to all my friends for discussing different issues and just for having fun during study.

GLOSSARY

FDI – Foreign direct investments

SARAR – Spatial autoregressive spatial error model

Chapter 1

INTRODUCTION

The world economy has gone through incredible changes over the last century, moving away from relatively closed economies, isolated from the world in terms of trade and investments, to a more globalized one, where countries are involved in the constant process of integration into the world economic system.

According to the Organization for Economic Co-operation and Development, Foreign direct investments are a crucial part of economic development of any emerging or transition economies because they lead to the infrastructure development of the host country, creation of new employment opportunities for local population, inflow of new technology and as a result FDI leads to economic growth of a host country. Moreover, new businesses bring greater competition to the economy that motivates other enterprises to reconsider their activity and efficiency. As a result, we may observe increasing productivity inside the economy.

Therefore, it is very important for both government and entrepreneurs to know what factors have the most influence on its FDI inflow. Thus, the main aim of my thesis is to look into the factors, which plays a significant role in investors' decision-making, and figure out how the industrial agglomeration of the Ukrainian economy affects the FDI inflow to the district level.

The novelty of this work is that we make use of the district level data set, the smallest territorial administrative unit of Ukraine, and consequently we are going

to have more observations and more precise estimates. Additionally, there are no research papers regarding the investigation of the relationship between spatial allocation of FDI and industrial agglomeration of the Ukrainian economy. Moreover, instead of using employment of a district as proxy for agglomeration we make the preposition of using business capitalization (in our case these are accumulated investments in fixed assets made by local entrepreneurs) for proxy of industrial agglomeration.

The data set was obtained from the National and Regional Bureau of Statistics of Ukraine. For the research I use foreign direct investments to 667 Ukraine districts as the dependent variable and export per capita in second lag, the total population of a district, the number of people with higher education, categorical variable with value 1 if a district has the land border with other country and 2 if it has both the land border and access to sea, distances to the nearest airport, road and railway as independent variables.

Moreover, we investigate the relationship between FDI and internal accumulated investments in fixed capital with the third lag, which stands for the proxy of industrial agglomeration. As the process of fixed assets formation is complex and time consuming, we decided to include the third lag in order to show the endogenous growth of capital in the past, expressed via reinvestments of local business affects the decision of foreign investors in the future. Moreover, it takes place that foreign direct investments and investments in fixed capital by local entrepreneurs are considered as complements if they occur within one enterprise and at the same period of time. Thus, including the third lag helps us to figure out the problem of endogeneity.

For estimating the model we use Tobit regression over the pooled data for the period of time 2003-2011, because there are many zero values among dependent variable. Then for investigating the spatial relationship between FDI in

neighboring districts we use spatial autoregressive spatial error (SARAR) model and spatial Tobit autoregressive model for the year of 2011.

The thesis has the following structure: Introduction, Literature review, Data and Methodology, Empirical results, Conclusions and Cited works.

Chapter 2

LITERATURE REVIEW

There are many research papers related to the FDI issue due to its importance for both developing and developed countries. The purpose of the thesis is to investigate factors, which influence FDI inflow to districts, and the second question is to find out whether industrial agglomeration contributes to FDI attraction. I include the discussion of variables belonging to different groups: economic activity, business environment, infrastructure and geographical distribution of FDI.

There are a lot of research papers related to the discussion of FDI and export relationship. For example, Jannicki and Wunnava (2004) show that foreign direct investments and export are treated to be complements. Moreover, Nonnenberg and Cardoso de Mendosa (2004) argue that the openness to trade can be used as a proxy of country willingness for receiving FDI. Zhang (2004) finds that FDI in China affects positively the export and in addition foreign capital is more efficient than domestic one in export promotion and its effect is greater in labor-intensive industries.

Undoubtedly, human capital plays a significant role in FDI attracting because it reduces the costs on staff education for the foreign investor. This idea was supported by Jannicki and Wunnava (2004) who stress the human capital to be another important determinant of FDI apart from the labor costs and unemployment. Blomstrom and Kokko (2003) find limitations in spillover effect of FDI explained by the absence of skilled labor force.

It is quite obvious that any investor takes into account the presence of necessary infrastructure of a particular country or region. Loree and Gruisinger (1995)

investigate the effect of transportation and communication infrastructure and state that their development affects positively FDI. Khadaroo and Seetanah (2010) claim that a good infrastructure is a necessary condition for business operations of foreign investors, meanwhile undeveloped infrastructure leads to the reduction of the efficiency in terms of higher transportation costs.

Additionally, in some cases the distance of the location to the national borders with other countries matters for FDI attraction. Diaz-Bautista (2006) investigates the determinants of FDI to Mexico from the US and finds that distance to the border affects inversely the concentration of economic activity and FDI in the northern part of Mexico. He states that the distance affects the investors' decision in terms of lower transportation costs to the market. The same result for Mexico has Jordaan (2011). He estimates the conditional probability of FDI inflow to the region and shows that the increase in regional distance from Mexico City to the US lowers the probability that a region is selected by new FDI firms.

There is sufficient number of studies which looking into the spatial allocation of foreign direct investments and how it contributes to the economic development of the regional economy. Moreover, there are a number of studies, which investigate the impact of agglomeration economy on the FDI inflow.

Head, Ries and Swenson (1995) find agglomeration effects between the U.S. states, which are closely located during their analysis of Japanese foreign investment.

For example, Bloniguen, Davies, Waddell and Naughton (2005) managed to show that space impacts on the FDI allocation and moreover they find that the coefficient by the lagged dependent variable is negative, which is the evidence of substitution effect and means that provinces compete with each other for foreign direct investments: the increase in FDI by 10% in neighboring districts leads to

FDI decrease by 3.3% in the district of interest. They also control for such factors as infrastructure, domestic market size, unemployment human capital, presented by the years of schooling

Another research study, Coughlin and Segev (2005), finds positive endogenous spatial lag of the FDI across 29 Chinese provinces. They also support the theory based on gravity model as there is huge inflow of foreign investments from top 5 economies of the world to provinces with large market size, transportation infrastructure, distances between countries, proximity to country border, low labor costs and high quality of human capital.

Other researchers, Tanaka and Hashiguchi (2009), find positive spatial spillovers from FDI agglomeration in China. These spillovers contribute to increase of productivity not in only one particular industry, but also to another one and moreover, they positively affect the productivity of the whole county and counties neighboring to one where the FDI inflow was observed.

Crespo, Proença and Fontoura (2010) find that space matters for FDI inflow and commonly domestic firms benefit from spatial spillovers and also they show that the dimensions of spatial spillovers are limited. Moreover, they show that spillovers effects usually occur in case of inter-industry relationships and the location of multinational companies is important for potential technology transfer to domestic firms.

Gamboa (2012) shows there is an evidence of complementarity between the FDI received and FDI invested in neighboring states. Also he shows the case of estimation without controlling for fixed effects are appropriate for a long-run estimation and opposite in case of controlling for fixed effects.

Referring to the impact of industrial agglomeration on FDI inflow, Crozet, Mayer and Mucchielli (2002) show a strong positive agglomeration effect on firms clustering belonging to such economic sectors as computers, car parts, machine tools and office machinery. They find that a 10 % increase in competitors number in certain location leads to almost 40% increase in probability of investing in that location. Moreover, they show foreign direct investments are located in that kind of France regions, which are close to domestic market of investor, and additionally they show that this pattern is consistent in terms of time.

Chapter 3

DATA AND METHODOLOGY

The main aim of the thesis are, firstly, to find out what key factors have the most influence on the investor decision-making and, secondly, I am going to investigate the industrial agglomeration effect of FDI inflow to districts by applying spatial autoregressive spatial error (SARAR) model.

For conducting the empirical analysis, we use the pooled data set over 667 Ukrainian districts starting from 2003 till 2011, received from the National Bureau of Statistics.

My dependent variable is foreign direct investments in per capita terms and the independent variables are following: export in per capita, the total population of a district, the number of people with higher education, distances to airports, national roads and railway stations, categorical variable, access to border, which equals to 0 if a district does not have any access to border, 1 if a district has one access to border and 2 if it has accesses to two borders (whether 2 land borders or 1 land border and 1 access to sea). Also there are other independent variables, which are included in empirical analysis, such as investments in fixed assets by local businesses and accumulated investments in fixed assets, treated as a proxy of industrial agglomeration.

From the Table 1 we can see that all variables have the right skewed distribution. This is because the data set includes not only districts, but also large administrative cities such as Kyiv, Dnepropetrovsk, Donetsk, Lvov, Odessa, Kharkov and etc. There are districts where FDI equals to zero (1726 districts for all 9 years and 523 districts for the years of 2009 – 2011) and the mean is pretty low due to the very low inflow of FDI to districts (there are 217

districts whose FDI value are greater than 2 standard deviations for 2003 – 2011). The number of districts, where export equals to zero is 911 and the number of districts where both FDI and export equals to zero is 618.

Table 1 – Descriptive statistics of the data set used in empirical analysis

Variable	Number of observation	Mean	Std. Dev.	Min	Max
Foreign direct investments	6003	129.86	432.63	0	7800.95
Export	6003	330.93	1133.9	0	21492.66
Total population	6003	383.67	438.14	30.08	3423.34
Number of people with higher education	6003	46.77	45.46	7.45	1146.03
Distance to airport	6003	62.7	34.7	2	182
Distance to national roads	6003	25.5	24.3	1	111
Distance to railways	6003	7.9	9.8	1	62
Access to border*	6003	0.21	0.45	0	2
Investments in fixed assets by local business	6003	1.776	3.19	0	68.774
Proxy for industrial agglomeration	2001	5.5	8.12	0	109.343

*Note: * - 0 if no access to border; 1 if access to one border; 2 if access to two borders*

Moreover, there are 14 districts, where investments in fixed capital by local entrepreneurs equal to zero for 2003 – 2011 and 217 districts have higher amount of investments in fixed capital than 2 standard deviations.

For investigating whether the industrial agglomeration of the Ukrainian economy affects the FDI inflow, besides other variables discussed in the literature review, I estimate the following two models:

$$FDI = \beta_1 \exp\_lag2 + \beta_2 pop + \beta_3 edu + \beta_4 dist\_air + \beta_5 dist\_road + \beta_6 dist\_rail + \beta_7 nei + \beta_8 fix + \varepsilon \quad (1)$$

$$FDI = \beta_1 \exp\_lag2 + \beta_2 pop + \beta_3 edu + \beta_4 dist\_air + \beta_5 dist\_road + \beta_6 dist\_rail + \beta_7 nei + \beta_8 ac\_fix + \varepsilon \quad (2)$$

where:

FDI_t – the amount of foreign direct investment calculated in per capita terms

$export_{t-1}$– the amount of export per capita

$population_t$ - total population of the district

$people\ with\ higher\ education_t$ - the number of people with higher education on 1000 people

$accumulated\ investments_{t-2}$– the amount of internal accumulated investments in fixed capital, computed in per capita terms

$dist\_airport_t$, $dist\_road_t$ and $dist\_road_t$ – are the distances in kilometers to the nearest airport, railway and road.

According to the theory of international trade, foreign direct investments and export are considered as complements and in our model it may cause the endogeneity problem. Consequently, in order to figure out this issue I include the second lag of export value, because it is very difficult to find instrumental variable for export. Additionally, export stands for the indicator of economic activity characterizing the external orientation of the business in a district. Considering the total population of the district, it stands for the availability of labor force in a district and simultaneously it characterizes the potential market for goods or services, to be produced by investor. The number of people with higher education in our model stands for the human capital and it is expected to have a

positive influence on FDI due to saving the investors' funds for the process of workers training. According to the research papers, which reveal the importance of infrastructure for the foreign investor's decision-making, I include the distance to the nearest airport, road and railway for estimation of infrastructure influence on FDI.

There is an evidence from the previous studies that foreign direct investments and internal investments by local businesses may be substitutes (FDI crowds out domestic industry) or FDI complements investments by local businesses. Thus, by including the investments in fixed capital by local entrepreneurs in the first model we test whether FDI and local investments are substitute or complement each other. Moreover, including the third lag of accumulated internal investments in fixed assets in the model, which stands for the proxy of industrial agglomeration and business capitalization of a district, allows to test whether the invested stock of capital of a host district, which is the result of investment activity by local businesses in the past, matters for FDI attraction in the future.

In this case applying just usual OLS for model estimating will lead to bias estimates because we cannot disregard with these zero values in our analysis due to its leading to the problem of sample selection. Thus, in order to figure out this issue we estimate both models by applying the Tobit regression, which allows to control for censored values of dependent variable (in our case for values censored at zero).

Additionally, we intend to investigate the geographical allocation of FDI and check whether the FDI spillovers exist between Ukrainian districts. For answering this question we to apply the spatial autoregressive spatial error (SARAR), model which shows the spatial relationship of FDI in neighboring districts. The following model is going to be fitted:

$$FDI = \lambda WFDI + X\beta + u$$

$$u = \rho Mu + Q \tag{3}$$

In this model FDI is the N × 1 vector of observations of foreign direct investments; X is the N × k matrix of observations on the independent variables; W and M are N × N contiguity spatial-weighting normalized matrices that parameterize the distance between neighborhoods (the ijth element of W is 1 if points i and j are neighbors and is 0 otherwise); also this model allows the disturbance term u to depend on a weighted average of the disturbances corresponding to other units and Q are independent and identically distributed disturbances. λ and ϱ are scalars that measure, respectively, the dependence of FDI_i on nearby FDI_j and the spatial correlation in the errors respectively. The model is estimated by applying maximum likelihood method.

Also our attention should be paid to the fact that as there are many values, being equal to zero, we additionally estimate spatial Tobit regression to check the estimation results received form the model (3). In this case dependent variable is FDI allocation in 2011 and independent variable as a multiple between FDI in 2011 and contiguity spatial-weighting normalized matrix in order to control for zero values and deal with the problem of sample selection. We also control for other independent variables such as the total population of a district in the year of 2011, the amount of exports per capita in 2009 (as was mentioned we include the second lag of export in order to deal with problem of endogeneity arisen from the international trade theory), the number of people with higher education (stands for the human capital), categorical variable, which stands for a district proximity to the number of borders with other countries and we also include

distances to infrastructure such as airport, railways and railroads . Then the following model should be estimated:

$$FDI_{2011} = \beta_1 \exp_{2009} + \beta_2 pop_{2011} + \beta_3 edu_{2011} + \beta_4 dist\_air_{2011} + \beta_5 dist\_road_{2011} + \beta_6 dist\_rail_{2011} + \beta_7 nei + \beta_8 ac\_fix_{2008} + \beta_9 FDI\_spweigthed_{2011} + \varepsilon \quad (4)$$

where $FDI\_spweigthed_{2011}$ is foreign direct investments in the year of 2011 multiplied by the spatial-weighting normalized matrix. Coefficient by the variable of interest has a value in the range between -1 and 1 due effect of normalization. The positive sign of the coefficient by this type of interaction between spatial weighting matrix and foreign direct investments in the year of 2011 indicates that there is a positive spillover effect from FDI between districts.

For making decision what model fits the data better, Spatial autoregressive spatial error (SARAR) or Spatial Tobit autoregressive model, we are going to compare the Akaike information criterion and Bayesian information criterion for both models.

In the end we would like to test presence of spillover effect of agglomeration from neighboring districts on FDI attraction or in other words whether FDI and agglomeration are complements in terms of space. For investigating this issue we apply Tobit regression with foreign direct investments as a dependent variable and proxy for agglomeration multiplied by spatial-weighting normalized matrix as an independent variable. Additionally, we include other independent variables such as export of 2009, total population of a district in 2011, people with higher education, infrastructure variables and categorical variable, which stands for the district's access to borders. Finally the following model is estimated:

$$FDI_{2011} = \beta_1 \exp_{2009} + \beta_2 pop_{2011} + \beta_3 edu_{2011} + \beta_4 dist\_air_{2011} + \beta_5 dist\_road_{2011} + \beta_6 dist\_rail_{2011} + \beta_7 nei + \beta_8 ac\_fix\_spweighted_{2008} + \varepsilon \quad (5)$$

where $ac\_fix\_spweighted_{2008}$ is the proxy for agglomeration and business capitalization located in a district.

Chapter 4

EMPIRICAL RESULTS

In this chapter we present the estimated results for 5 models discussed in data and methodology chapter. First of all, we consider the result, received from estimation of equation (1) and (2).

Table 2 – Results of estimated coefficients from equations (1) and (2)

Variable	Coefficients of Model 1	Coefficients of Model 2
Export lag 2	0.085***	0.138***
Number of people with higher education	0.434***	0.169
Total population	0.217***	0.399***
Distance to airport	-1.77***	-2.095***
Distance to national roads	-1.52***	-1.93***
Distance to railways	-4.10***	-4.43***
Access to border		
1 if access to 1 border	-8.80	-16.97
2 if access to 2 borders	95.53*	100.97
Investments in fixed assets by local business	41.12***	
Proxy for industrial agglomeration		16.05***
Sigma	456.34***	607.43***
N	6001	2001

*Note: legend * p<0.1, ** p<0.05 and *** p<0.01*

Let us discuss the results received for the model 1from the Table 2. First of all, we can see that almost all coefficients are highly significant and the effect of human capital, presented by the number of people with higher education, is pretty large, meaning if we observe the increase in a 1000 people, who belong to this group, we expect to have, on average, FDI increase by 434 UAH. Increase in

export in the second lag by 1000 UAH, on average, leads to the increase in FDI inflow by 85 UAH. Additionally, we can see that the availability of labor also matters for FDI attraction and if the total population of a district increases by 1000 people, we observe, on average, the increase of FDI by 217 UAH. Considering the effect of the infrastructure, we can observe that the investors value the most the access to railway station and increase in the distance to this type of transportation by 1 km leads, on average, to decrease of FDI inflow by 4.1 UAH. Also it is interesting that districts with access to 2 borders, on average, have 96 UAH higher foreign direct investments than districts without any access and the district's access just to one border does not explain FDI inflow to this particular location. Regarding to revealing the relationship between FDI and investments in fixed assets by local businesses, we can observe that these two variables are complements, meaning that if investments by local business increases by 1000 UAH in the current year, we observe, on average, the increase in FDI in the current year by approximately 41 UAH.

From the second model we can see that our variable of interest, proxy for industrial agglomeration in the third lag, is highly significant and we can conclude that the investment activity of local business in the past affects the future FDI inflow: so if accumulated investments by local entrepreneurs increase by 1000 UAH, we observe, on average, the increase in FDI inflow by 16 UAH in three years. Other variables' effects of the second model are consistent with the first model's ones, except the insignificance of human capital and access to borders. Finally the second model has higher sigma, which is treated as MSE in OLS regression, than the first one due to the lower number of observations included.

Considering the spillover effect of FDI from neighboring districts, let us present the geographical allocation of FDI in 2011 among Ukrainian districts, which are presented on the picture below.

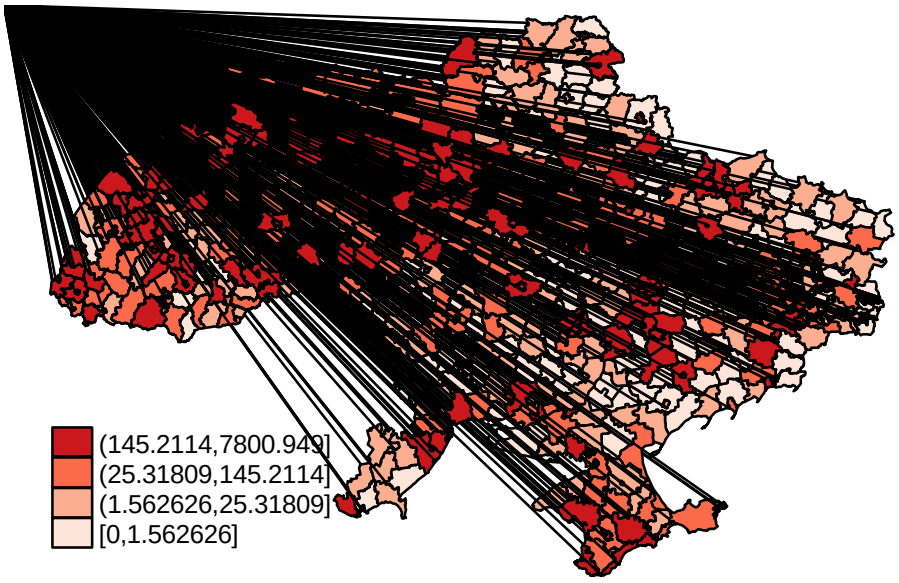

Figure 1 – Geographical allocation of FDI among Ukrainian districts in 2011

From the Figure 1 we can see there is obvious clustering of FDI among Ukrainian districts and it is quite observable the following clusters around the following large cities: Kiev, Lvov and Ivano-Frankovsk (seemed as the whole one big cluster), Uzhgorod, Dnepropetrovsk , Kharkov, Donetsk, Odessa, Southern Crimea and etc. Additionally, foreign direct investments are observed to be distributed unequally in Ukraine: so the clusters in the Northern and Western parts of Ukraine are larger in comparison to other parts of Ukraine.

Next, we present the estimators of coefficients from the SARAR model of FDI in the year of 2011. The coefficient by lagged dependent variable takes into account all spatially unobserved factors of independent variables. The results are presented below.

Table 3 – Results of estimated coefficients from SARAR model

Variable	Coefficients of Model 3
Export 2009	0.137***
Total population in 2011	0.349***
Number of people with higher education in 2011	3.695***
Distance to airport	0.22
Distance to national roads	-0.2
Distance to railways	-0.85
Proxy for industrial agglomeration in 2011	10.39***
Constant	-253.33***
Lambda	0.65**
Rho	-0.35
sigma2	309774.39***
N	667

*Note: legend * p<0.1, ** p<0.05 and *** p<0.01*

From the Table 3 we can see that the amount of export in the second lag is highly significant and if we increase the export from the district by 1000 UAH, we will observe, on average, the increase in FDI inflow to the district by 137 UAH in 2 years. The total population and human capital of a district influence a lot on foreign direct investments: so if we observe the increase in district's total population and people with higher education by 1000, the FDI inflow, on average, will be increased by 349 UAH and 3695 UAH respectively. Thus, from this point of view the presence of human capital is very crucial for foreign investors' decision-making. On the other hand, the infrastructure of a district does not affect the FDI inflow to this district at all due to its statistical insignificance. Moreover, agglomeration matters a lot in case of controlling for spatial spillovers from FDI and if accumulated investments increase by 1000 UAH, FDI inflow, on average, will be increased by 10.35 UAH in 3 years.

For deciding whether there is some spatial interdependence between FDI allocations to neighboring districts, we should look at lambda and rho

coefficients. Lambda, which is the coefficient by the spatial-weighting normalized matrix and shows spatial relationship between dependent variable and spatially lagged dependent variable , is significant and quite large and it justifies the positive spillover effect of FDI between Ukrainian districts, meaning that FDI inflow to neighboring districts affect positively FDI inflow to the district of interest and vice verse. Another point, which is very important, is that rho estimation, which shows the average level of correlation between disturbances, and in our case it is insignificant and we can say about precise estimates of lambda coefficient.

As for prediction of FDI allocation in the next period we apply reduced form of prediction, which has the following form

$$FDI = [I - \lambda W]^{-1} X\beta \tag{6}$$

where I is a unit matrix, W – spatial-weighting normalized matrix, X– vector of variables and β is vector of coefficients. SARAR model also allows for the linear prediction and naïve form of prediction. We chose particular reduced form of transformation because it allows to reveal how the change to a covariate of observation affects the entire system. Consequently, the predicted FDI allocation is presented on the picture below.

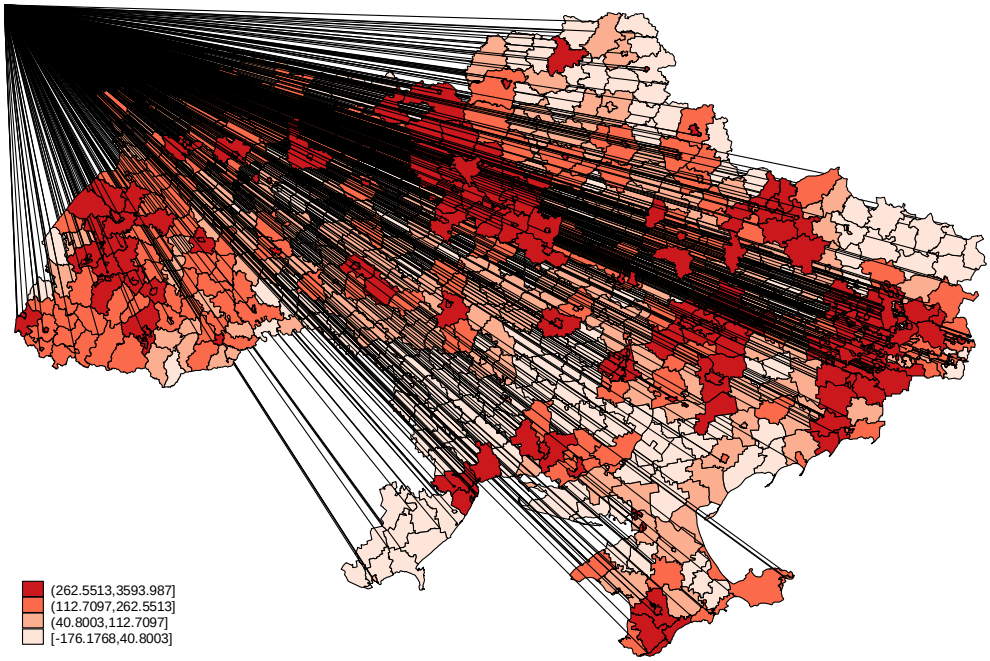

Figure 2 – Predicted geographical allocation of FDI among Ukrainian districts based on SARAR model and reduced form of transformation

From the Figure 2 we can observe definite large clusters of FDI allocation around such cities as Kyiv, Dnepropetrovsk, Donetsk, Kharkov and Lvov and medium clustering around such cities as Odessa, Nikolayev and Simferopol. The small clusters are observed around other capitals of Ukrainian regions. Moreover, we should mention that very little amount of FDI is expected in Odessa, Kirovograd and Kherson regions.

Additionally, we should mention that SARAR model above does not take into account the zero values of FDI and in order to deal with this problem we apply spatial Tobit autoregressive model, which includes spatial lagged of dependent variable, foreign direct investments in 2011. The estimated results are presented below:

Table 4 – Results of estimated coefficients of spatial Tobit autoregressive model

Variable	Coefficients of Model 4
Export in 2009	0.135***
Total population in 2011	0.193**
Number of people with higher education in 2011	2.403***
Distance to airport	-1.77***
Distance to national roads	-1.61
Distance to railways	-4.57*
Access to border	
1 if access to 1 border	-9.44
2 if access to 2 borders	47.16
Proxy for industrial agglomeration in 2011	9.77***
Spatially weighted FDI in 2011	0.97***
Sigma	603.88***

*Note: legend * p<0.1, ** p<0.05 and *** p<0.01*

From the Table 4 we can observe that almost all coefficients are statistically significant, except distance to roads and access to border. So, for example, if the export is increased by 1000 UAH, we observe increase of FDI, on average, by 135 UAH in 2 years. Also, there is a strong impact of human capital, which is also supported by SARAR model, on investors' decision-making: if the number of people with higher education increases by 1000 people, we observe the increase of FDI inflow, on average, by approximately 2400 UAH. As for the impact of infrastructure on FDI attraction, the distance to railway stations matter the most for foreign investors: so if the distance to railway station increases by 1 km, the observed average decrease of FDI to the district is 4,6 UAH. Considering the effect of agglomeration on FDI, we can conclude that after controlling for spatial dependence of FDI inflow between districts, investment activity in the past influence the FDI: so far if the proxy for agglomeration is increased by 1000 UAH, the FDI inflow to a district is increased, on average, by 9.8 UAH in 3 years. Coefficient by the spatially weighted FDI in 2011, which stands for lambda

in spatial autoregressive spatial error model, is highly statistically significant and its value is 0.97, which is very high (the range of coefficient value is between -1 and 1 due to normalized values of spatial weighting matrix). We can conclude that there is a strong evidence of very large spillovers effect of FDI from neighboring districts and finally it means that FDI allocation in Ukrainian districts are very interdependent.

In order to compare which of two models, SARAR model or spatial Tobit autoregressive model, is more precise, let us discuss AIC and BIC for two models, presented in the table below.

Table 5 – Comparison of SARAR and spatial Tobit autoregressive models

Model	Obs	Likelihood	df	AIC	BIC
SARAR model	667	-5167.3	11	10356.6	10406.12
Spatial Tobit autoregressive model	667	-4618.5	11	9259.1	9308.6

From the table above we conclude that spatial Tobit autoregressive model outperforms the SARAR model due to the significant difference between AIC and BIC: so the AIC and BIC for SARAR model is 1000 higher than AIC and BIC for spatial Tobit autoregressive model.

Finally, as the spatial Tobit autoregressive model fits the data of foreign direct investments allocation in 2011 better than spatial autoregressive spatial error model does, basing on the results presented in Table 6, we present the linear prediction of FDI allocation according to the spatial Tobit autoregressive model, which is presented on the picture below:

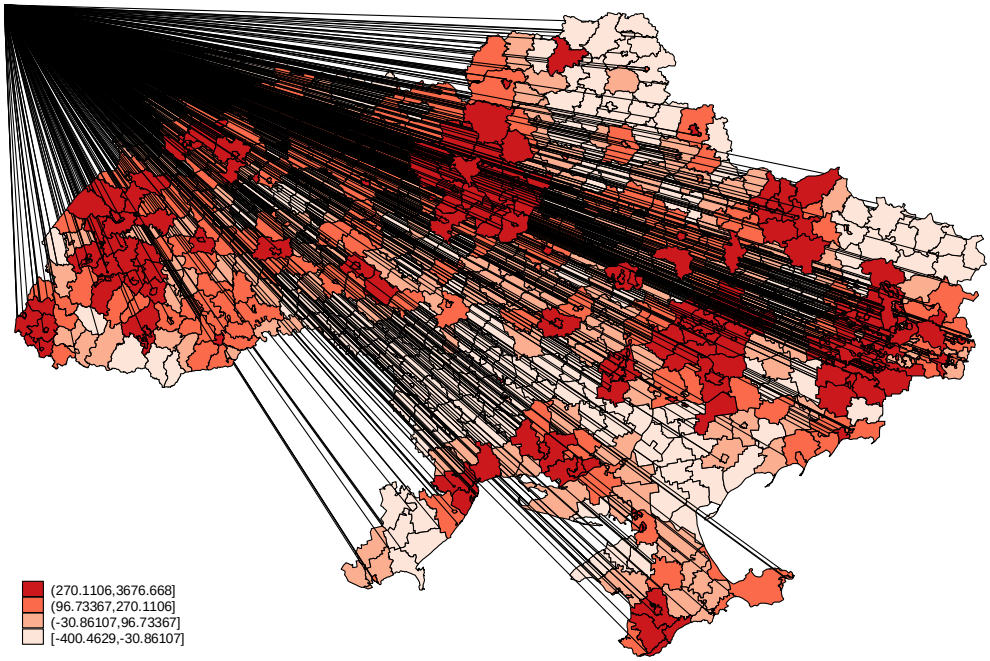

Figure 3 – Linear prediction of FDI allocation based on the spatial Tobit autoregressive model

From the Figure 3 we can observe that there are 5 large predicted clusters of FDI allocation, located around such cities as Kyiv, Kharkov, Dnepropetrovsk and Kremenchug (are considered as one large cluster), Donetsk, Lvov and Ivano-Frankovsk. Additionally, there are 5 medium clusters located around such cities as Uzhgorod, Lutsk and Rovno (one cluster), Odessa, Nikolayev and Simferopol. The model predicts no FDI allocation in the Northern part of Odessa region, Zaporozhe region, Western part of Kirovograd region and Northern part of Lugansk region.

Next we are going to discuss the estimates of spatial Tobit lag model, where the dependent variable is foreign direct investments in 2011 and the variable of interest is a spatial proxy for agglomeration in 2011. The aim is to reveal whether the agglomeration spillover effect from neighboring districts on FDI exists in the

future and firstly, let us discuss geographical distribution of a proxy for agglomeration.

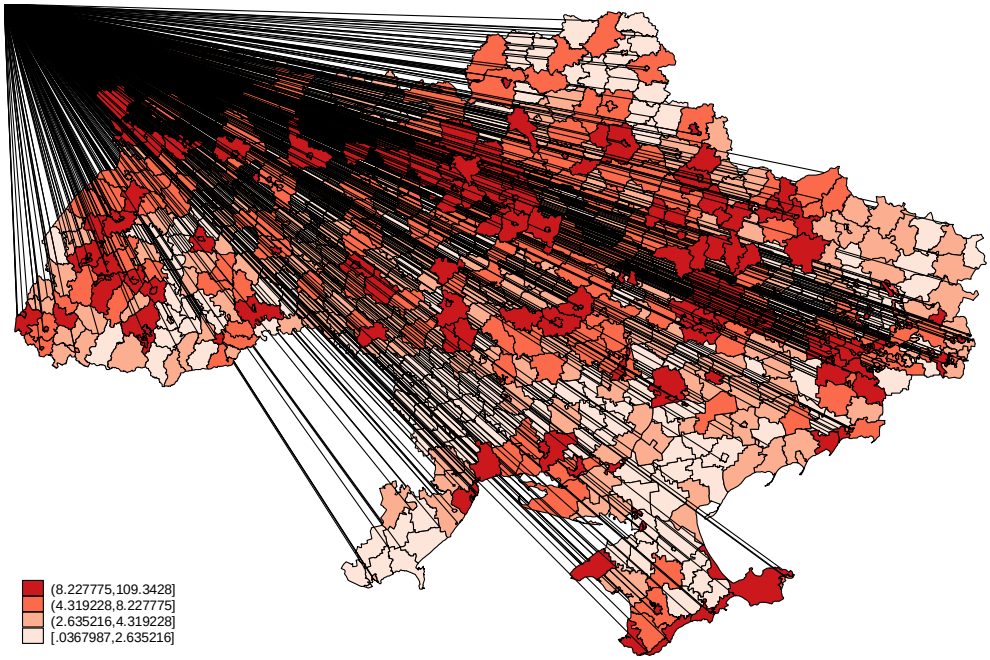

Figure 4 – Spatial visualization of agglomeration in 2008

From the Figure 4 we can observe that there are large clusters of agglomeration around such cities as Kyiv, Dnepropetrovsk, Kremenchug, Donetsk and Lvov. Additionally, we can conclude that there are many small clusters around such Ukrainian cities as Uzhgorod, Odessa, Nikolayev, Kirovograd, Vinnitsa, Kerch, Sumy etc. Thus, we conclude that this type of investments are distributed unequally and mostly concentrated around large industrial cities.

Now we present estimates of spatial Tobit lag regression model. The estimated results are presented in the Table 7

Table 6 – Results of estimated coefficients of spatial lag Tobit model

Variable	Coefficients
Export in 2009	0.154***
Total population in 2011	0.430***
Number of people with higher education in 2011	3.55***
Distance to airport	-1.86***
Distance to national roads	-1.78*
Distance to railways	-3.82
Access to border	
1 if access to 1 border	-39.69
2 if access to 2 borders	8.65
Spatial proxy for agglomeration in 2011	-0.09
sigma	618.75***
N	667

*Note: legend * p<0.1, ** p<0.05 and *** p<0.01*

From the Table 7 we observe that in case of controlling for spatial spillover of agglomeration on FDI, the effect of export is still highly statistically significant and if the export increases by 1000 UAH, we will observe the increase in FDI, on average, by 154 UAH in 2 years. As for human capital, presented by the number of people with higher education, and total population of a district, we can say that the increase in human capital and total population by 1000 people leads to the increase of FDI, on average, by 3555 UAH and 430 UAH respectively, which is consistent with previous models and studies, discussed in the literature review. So far in this model the most important infrastructure facilities are the distance to the airport and national roads and increase in distance to airport and roads by 1 kilometer causes the decrease of FDI, on average, by approximately 1.9UAH and 1.8 UAH respectively. Moreover, access to border in our model does not have any effect on FDI attraction and finally we conclude that due to statistical insignificance of the coefficient by a spatial proxy for agglomeration, there is no

spillover effect from neighboring districts' agglomeration in the past on FDI in the district of interest and vice versa.

Chapter 5

CONCLUSIONS

This thesis work contributes to the empirical analysis of FDI inflow to Ukraine, particularly it investigates the key determinants of foreign direct investments attraction to the level of Ukrainian districts. Additionally, it reveals the findings about relationship between industrial agglomerations of the Ukrainian economy and FDI inflow to districts. Moreover, we provide the results of investigation of FDI spillover from neighboring district on FDI inflow to the district of interest.

For analysis conducting, we used the pooled data for the year from 2003 until 2011. The dependent variable is FDI in per capita terms and independent variables are export per capita, the total population of a district, the number of people with higher education (stands for the human capital), investments in fixed assets by local entrepreneurs, infrastructure variables (distances to airport, national roads and railway stations), access to border and accumulated investments in fixed assets by local businesses, which stands for the proxy of agglomeration.

For analysis, we used Tobit regression models (many values of FDI are left censored at zero and SARAR model for revealing spatial spillovers. We found that foreign direct investments and investments in fixed assets by local businesses are complements, meaning that there is cooperation between investment activities of foreign investors and local entrepreneurs.

As for the effect of proxy of agglomeration on foreign direct investments attraction, we found that accumulated investments of internal businesses have a positive influence on FDI inflow: so increase in agglomeration by 1000 UAH leads to FDI increase, on average, by 16 UAH in three years.

Applying SARAR model for investigating the FDI spillover effect between districts, we found that lambda coefficient is statistically significant and has a value of 0.65, meaning that there are positive spillover effects from FDI inflow in the neighboring districts on the districts of interest and vice verse. The same result was obtained by applying spatial Tobit autoregressive model, which allows controlling for zero values of FDI and has higher goodness of fit in comparison to SARAR model basing on AIC and BIC.

Moreover, we investigated the spillover effect of agglomeration on FDI inflow by applying spatial Tobit lag model and we have not found any support for this hypothesis.

Finally, we provide the predicted clusters of FDI allocation based on spatial Tobit autoregressive model and reduced form of transformation: so there are five large predicted clusters of FDI allocation, located around such cities as Kyiv, Kharkov, Dnepropetrovsk, Kremenchug, Donetsk, Lvov and Ivano-Frankovsk. Additionally, there are predicted five medium clusters located around such cities as Uzhgorod, Lutsk and Rovno (one cluster), Odessa, Nikolayev and Simferopol. No FDI allocation is predicted in the Northern part of Odessa region, Zaporozhe region, Western part of Kirovograd region and Northern part of Lugansk region.

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