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DP# 24 **May 2010**

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Effects of Ownership on Agglomeration Economies: Evidence from Ukrainian Firm Level Data

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Abstract

We use establishment level longitudinal data to estimate agglomeration economies in the Ukraine for machine manufacturing and hi-tech industries. We differentiate state-owned, private-domestic-owned and private-internationally-owned firm types. Our baseline results are comparable to other firm level measures of similar industries and to other research in the former Soviet Union. We find that state owned firms accrue little or no agglomeration benefits, while privately-owned firms are able to take advantage of agglomeration effects. Foreign-owned firms may gain the most from agglomeration. These results suggest that agglomeration economies are typically gained at the management level.

JEL classification: O1, P2, R1, R3
Keywords: agglomeration, localization economies, ownership structure, transition, production function

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1. Introduction

A long history of work has documented and measured the existence and extent of agglomeration economies. An excellent review can be found in Rosenthal and Strange (2004). Two types of agglomeration economies have been posited in the literature. Localization economies accrue to firms within the same industry who locate in close proximity. They gain from features like easy access to a skilled labor pool or proximity to specialized input services. Perhaps more importantly, the sharing of information, both formally and informally, leads to spillovers across the labor pool and rapid accumulation of industry specific human capital. The second type of agglomeration economy is a general location effect called urbanization economies. These accrue to firms across many industries who locate in close proximity and are due to a broad and deep labor market as well as multiple services. Henderson (2003) finds strong evidence of localization economies and weak evidence of urbanization economies.

While the literature has established that agglomeration economies are present for some industries in Western economies (typically the U.S., Japan and the U.K.), we are unaware of any previous work which has measured agglomeration economies in the former Soviet Union, or any transition economy. This paper begins to fill this gap by estimating plant level production functions and plant location as a long term investment. Firms and plants, especially in manufacturing, do not relocate quickly. Hence the plant locations in the Ukraine, studied here, were largely determined in the Soviet Era, but are evolving prior to and through the sample period. The Soviet era was marked by production processes focused upon internal scale effects. Dyker (1983) named the "tendency to overbid for investment resources," "a lack of coordination between state bodies responsible for investment decisions," and "elements of operational inefficiency at the design and construction stages" among others as factors that have ultimately determined the composition and location of production assets in the former Soviet Union. It is unclear whether these decisions took any agglomeration externalities into consideration. One important concern about agglomeration economies is that the measurements may be overstated if more productive managers make location decisions to capture the agglomeration economies. This may be alleviated in part in these data in that the location decisions were made much earlier by a different kind of management. More importantly though, in transition economies we can observe three types of management: state-owned, private-domestic-owned and private-foreign-owned. Work by Brown et al. (2006) using post Soviet data suggests that privately-owned firms are more productive than state-owned, and that firms of foreign ownership are even more productive. Meta-analysis by Djankov and Murrel (2002) suggests that multinational firms are more productive in general than domestic firms. We examine whether different ownership types, something difficult to quantify in Western economies, gain more from agglomeration economies and inform how that may affect estimates of agglomeration economies in general.

We use an establishment level longitudinal data set of Ukrainian firms and focus on two industries: machinery manufacturing and high-tech. The data are similar to those used by Henderson (2003) and Rosenthal and Strange (2003), allowing for rich comparisons to be made for the agglomeration measurements. They are also similar to data used by Brown et al. (2006) allowing for comparisons on the effect of ownership structure. This research focuses on the interaction of ownership and agglomeration economies to extend and expand upon our understanding of both. Our results support those of both strands of literature. We find evidence of localization economies for both industries although the magnitude is typically larger for high tech in our preferred specification. Overall, foreign-owned firms are the most productive, state-owned firms are least productive and private-domestic-owned fall somewhere in the middle. This supports conclusions of Brown et al. (2006) concerning private- as compared to state-owned firms as well as Djankov and Murrel (2002) comparing domestic to foreign ownership. We find that foreign-owned firms gain more from agglomeration economies than any other ownership. While private-domestic-owned firms may gain some from agglomeration, it is clear that state-owned firms simply are not exploiting these externalities. If type of management matters, then this suggests that the estimates by others using Western data, but not accounting for management ability, may overstate the impact for some types of firm, and understate it for others. It may also suggest that there is potential for gain for many types of firms. Another important possibility is that the age and type of capital may matter in gaining from externalities. It may be that multi-national companies use different capital structure, though it is difficult to disentangle this effect from management. Our results are robust to a number of specifications and are consistent with existing literature.

In section two we describe in more detail the data and economic climate for post Soviet Ukraine. In section three we present the model and discuss estimation strategies and potential problems. In section four we present the empirical results and in section five we draw final conclusions.

2. Environment and Data

Most large firms which have formed the core of the Ukrainian economy were established decades ago. Decisions about investment and location of firms in the Soviet planned economy were often based on different principles than the market economy would imply. Dyker (1983) pointed out that the obsession with constructing huge plants and the call for development of unpopulated areas were declared in the doctrinal principles of the Soviet economy. In 1971, about ten percent of industrial firms employed about sixty percent of the total industrial personnel and produced about two thirds of the total industrial output in the USSR, and the average size of a large manufacturing enterprise exceeded 1000 employees. (Dunaev, 1973). External scale economies were not absent in the Soviet Union altogether. Not only in the established urban areas, but even in green field developments, the public infrastructure and service industries soon followed the leading firms thereby reducing production costs via urbanization effects. The organization of firms from several supplementary industries into vertically integrated "territorial-production complexes" (Lonsdale, 1965) was also designed to minimize costs. Hence, it is possible to assume that both urbanization and localization economies were present in the Soviet economy, at least to some extent.

The transition period in the USSR and countries of the Eastern Europe began in the late 1980s. Deterioration of the socialist economic system, beginning in early eighties and having reached its culmination with the collapse of the Soviet Union in 1991, gave a rapid start to mass privatization in new independent states. The data from the Ukrainian State Property Fund show that the first privatization deals in Ukraine were registered in early 1992. A peculiarity of Ukrainian privatization was its rather slow pace compared to the neighboring countries of Eastern Europe and Russia. Paskhaver et al. (2003) argue that the first stage, "mass privatization," lasted from 1994 to 1998. During that period, mostly small firms were privatized through the distribution of shares among managers and workers. Brown et al. (2006) claim that this privatization scheme resulted in a low concentration of ownership and substantial levels of state control. By the end of the nineties, the process sped up and the next stage of privatization began, when large shares in big manufacturing firms were traded via auctions and stock exchanges or through direct sales. Paskhaver et. al (2003) report that by 2000, private firms employed more than a half of the labor force and produced almost two-thirds of the total output in the Ukraine. The focus has shifted towards the transfer of the remaining shares of the formerly state firms and privatization of remaining large firms. Today the process is almost complete.

According to Derzhkomstat (2006), only two to three per cent of all firms in manufacturing were completely state-owned at the beginning of 2006. According to Derzhkomstat (2006), the entire decade of the nineties in the Ukraine was marked by an output drop; the national output started to increase in 2000 for the first time since independence was pronounced in 1991. Very often large firms designed as a part of the all-Soviet production chain had to downsize, since the Ukrainian market was too narrow for them, and they were not efficient enough to compete internationally. This process was exacerbated by a rapid drop in population and, therefore, in the total labor force. One of the effects of the privatization was downsizing of most firms: large firms split into smaller entities, and newly established firms were smaller than the former Soviet enterprises. Very rapid changes in the business environment, downscaling of the former Soviet enterprises and reallocation of production to other sectors were the most pronounced features of the first phase of transition in the Ukraine.

All commercial firms must submit an Enterprise Performance statement, a Financial Results statements, and a Balance Sheet statement to the National Statistics Office (Derzhkomstat) every year. The resulting data set, provided by Derzhkomstat [1], is similar to U.S. data such as the U.S. Longitudinal Research Database (LRD) described in Henderson (2003) and Dun and Bradstreet's Marketplace File described in Rosenthal and Strange (2003). The data are annual establishment level measures of both output and input measures spanning the years from 2001 to 2005. Output measures derive from the Financial Results Statement. One can construct several possible definitions of output in the data (total sales, sales adjusted for materials, gross sales vs. sales net of excise and value-added tax). We chose the value of sales net of taxes because it was available for most firms and has a sound justification as an appropriate measure. Employment was taken from the Enterprise Performance Statement. A standard measure of employment in the literature is the hours worked. Unfortunately, this variable is not available for all years in Ukrainian data. Hence we use a close approximation, the year-average number of enlisted employees. This measure takes into account both part time and part year workers, which make it superior to a simple head count.

The annual Balance Sheet Statement was the source for the capital variable. The capital measure is based on the nominal end of year value of the

[1] These data are restricted and not available in a public use form. We thank Kyiv School of Economics and the Derzhkomstat for assistance in obtaining and using these data.

tangible assets. The capital measure was not available for some branches. We use the intrafirm capital - labor ratio to impute capital levels for each branch within a multiplant company. The branches constituted between three percent of all establishments in 2001 and six percent in 2005. It is also possible that capital-labor ratios are different for "head-quarters" and "production-units" as well as for firms located in rural areas vs. urban locations. Estimates were obtained for both the full sample (reported below) as well as for only single establishment firms. The results and conclusions were remarkably similar and so we conclude that any bias from imputation is small.

The comprehensive description file contains basic data on the firm including links to any mother firm, property type, organizational form type, an industry code, and a territory code. We created an indicator variable "subsidiary" which is one if an entity (a branch or a separate firm) shows some other firm as its "mother company" or a "head office". The structure of management in Ukrainian companies is rather complex. We believe that various vertical relationships can be captured by this variable.

The classification of industries in the Ukraine (KVED) was introduced in 1998-2000 and coincides with European industrial classification NACE rev.1 and International Standard Industry Classification (ISIC) at the level of four digits. For this work, we have chosen the entire set of manufacturing industries first. Comparable to Henderson (2003) we have chosen two industry groups: machinery manufacturing and high-tech industries. These are arrived at by combining a number of three-digit industries. The industries in the machinery group are KVED 291 (Manufacture of machinery for the production and use of mechanical power, except aircraft, vehicle and cycle engines), 292 (Manufacture of other general purpose machinery), 294 (Manufacture of machine tools), and 295 (Manufacture of other special purpose machinery). The high-tech industries are KVED 296 (Manufacture of weapons and ammunition), 300 (Manufacture of office machinery and computers), 321 (Manufacture of electronic valves and tubes and other electronic components), 331 (Manufacture of medical and surgical equipment and orthopedic appliances), and 353 (Manufacture of aircraft and spacecraft). While no perfect cross walk between these industries and the ones used in other work exists, we have carefully tried to match definitions, to facilitate comparison.

The territory classification in the Ukraine reflects the rules of administrative subordination. The entire country is split into twenty four oblasts (which are comparable to small US states), one autonomous Republic of Crimea and two cities with special status: Kyiv, which is the national capital, and Sevastopol in Crimea. These units constitute the first, upper level of the administrative division of the country. Each oblast is further split into a number of rural raions (similar to US counties) subordinated to the oblast capital city. Big raion capitals and sometimes other large cities within raions are also governed from the oblast capital city and have a status of cities with oblast administrative subordination. This status is assigned based on the population of the city (which should be at least fifty thousand people), and the level of the industrial and cultural development. The number of such cities ranges from one per oblast in the predominantly rural Western part of Ukraine to twenty eight in the heavily industrialized Donetsk oblast in the East. Rural raions and cities of oblast administrative subordination constitute the second, medium level of the administrative division. We perform our analysis at this level. There are 490 rural raions, 177 cities of the oblast subordination and two cities of the national subordination, which totals to

669 territorial units. Hereafter we will refer to them as "raions."

To achieve greater compatibility with Western studies, we created an analog of Metropolitan Statistical Areas for the Ukraine. Since commuting patterns normally used for defining MSA's are not readily available for Ukrainian raions, we used a simplified approach. We took neighboring raions within sixty kilometers from cities with a population of over fifty-thousand people in a hierarchical order. If a raion is within sixty kilometers of several cities, it is "assigned" to the city with the greatest population. The population counts are taken from the 2001 Population Census, and the matrix of distances is based on air distances between the administrative centers of each raion. From private conversations with representatives of Ukrainian Association of Employers, sixty kilometers is the maximum transportation distance for working commuters. We believe that this approach is a good measure of MSA's in the Ukraine given current data availability. Thus, we constructed fifty-six "quasi-metropolitan" (QMSA) areas for Ukraine covering 537 raions and cities (about eighty percent of all administrative units). About ninety five percent of firms from our database are located in one of these QMSA's. See Figure 1 for the map of QMSA areas in Ukraine. We also experimented with a fifty-kilometer transportation threshold, which resulted in 465 areas covered by sixty one QMSA's, but it did not significantly affect our results. For the analysis of agglomeration economies and attenuation of agglomeration effects we used only establishments located in QMSA's.

Figure 1 should be around here

We used the data from the State Property Fund (SPF) database and Balance Sheet Statements to construct two control indicator variables, "primarily domestic-owned" and "primarily foreign-owned." Brown et al. (2006)

used this pair of variables to examine the productivity effects of privatization. Matching the SPF to the State Registry and Balance Sheet Statements was performed and double checked using measures of total value (statutory fund) common to both data sets. If the private share in a given year was below one half such firms were marked as state-owned. All other firms were marked as majority private. Foreign ownership shares were obtained from the Foreign Direct Investment dataset provided by Derzhkomstat. Those firms majority owned by foreign interests were then coded as "primarily foreign-owned."

Table 1 provides means for the entire sample and by ownership status We note that firms owned by private-domestic-owned interests are the overwhelming majority of both samples comprising 92.5% of the machinery sample and 88.2% of the high-tech sample. In both industries, the state-owned firms are large compared to the private-domestic-owned (as measured by employment, capital or output). In the Machinery sample, the foreign owned firms are also much larger than the private-domestic-owned. They have lower capitalization but higher employment and output than the state-owned firms. In the high tech sample, the foreign owned firms have similar employment levels to the private owned, but notably higher capitalization and output. Foreign-owned firms are still markedly smaller than the state-owned firms in the High Tech sector.

Table 1 should be around here

3. Model and Estimation

Following Eberts and McMillen (1999), we begin with a simple production model:

$$y_i = g(A_i)f(x_i),$$

where y_i is a firm $i's$ output, $g(A_i)$ is the agglomeration component, and x_i is a set of production factors. Rosenthal and Strange (2004) consider the agglomeration component in greater detail arguing that all types of relationships between firms should be accounted for. They propose the following "benchmark" model of the total effects from agglomeration economies the firm i is exposed to:

$$A_i = \sum_{k \in K} s(x_i, x_k)\theta(d_i k^G, d_i k^I, d_i k^T). \tag{1}$$

The first component, $s(x_i, x_k)$ models all relationships between the firm i and another firm k, $k \in K$, where K is a set of all reference firms in the economy. Rosenthal and Strange (2004) claim that the strength of the relationship and its possible effect on the firm's productivity attenuates with the distance. The second component of the model measures this attenuation speed, where distances between firms i and k are measured in the geographic ($d_i k^G$), industrial ($d_i k^I$), and temporal ($d_i k^T$) "dimensions." The authors argue that intensity of relationships in either dimension directly affects spillovers between firms and their productivity.

Based on data availability, different authors took a number of approaches to estimate agglomeration economies in operationalizing equation 1. Early studies estimated production functions for different industries separately based on data aggregated at the level of Metropolitan Statistical Areas (see Quigley, 1998, for a review). Authors such as Sveikauskas (1975), Segal (1976), Moomaw (1981), Nakamura (1985), Henderson (1986) and Moomaw (1983) used various specifications and levels of aggregation. However, aggregation of the data at the level of two-digit industry groups and non-availability of key variables failed to lead to robust conclusions, but nonetheless have suggested that agglomeration economies might have an effect on firms' productivity. In recent years, firm level data has become increasingly available. Glaeser et al. (1992), Henderson (1995), Rosenthal and Strange (2003) and Henderson (2003) all use less aggregated firm and establishment data. While the debate about the level and extent of agglomeration economies is still unsettled, the firm level approach and specification of Henderson (2003) has gained credence as the most appropriate. A standard log-log production function for a given establishment i in the area m, industry s, at time t is:

$$\ln(y_{it}) = \alpha \ln \mathbf{X}_{it} + \beta \ln \mathbf{E}_{it} + \gamma_1 \mathbf{I}_{it} + \gamma_2 \ln \mathbf{E}_{it} \cdot \mathbf{I}_{it} + \delta_m + \phi_t \times \eta_s + \epsilon_{itsm}. \quad (2)$$

where X_{it} is a vector of a firm's production inputs, E_{it} is a vector of agglomeration variables, I_{it} is a vector of institutional variables, δ_m is a QMSA fixed-effect, ϕ_t is a time fixed effect, η_s is an industry fixed effect (sub industries as described above), and ϵ_{itsm} is the error term. Henderson (2003) shows that this estimation approach yields the most stable results.

We have chosen four agglomeration measures in our preferred specifications: plant counts and employment in the same broad industry group (machinery or high-tech) and the same raion, and plant counts and employment in the same three-digit industry group (KVED-3) and QMSA. The first group of agglomeration variables measures relationships among firms in the "wide" industrial space, but emphasizes geographic proximity, whereas the second group measures "industrial" proximity, but expands geographic distances between firms.

Given that every group is composed of several three-digit industries, we also experimented with industry fixed-effects. The group of machinery firms is relatively more homogeneous (it is composed by three-digit industries from the same two-digit industry sector), and we did not expect coefficients to differ significantly for industry fixed-effect specification. The high-tech group, on the contrary, is heterogeneous both in terms of industry composition (three-digit industries constituting the group belong to different two-digit industrial sectors), and, possibly, product mix or business processes. If there were any additional relationships between these three-digit industries, it would be possible that coefficients in the industry fixed effect specification would reveal them by behaving differently. We estimated specifications both with and without industry fixed effects and found no significant difference in our coefficients of interest. Since we could not obtain the inflation estimates for separate sectors, we decided to include industry - year cross terms rather than separate annual and industry dummies.

4. Empirical Results

The estimation results are presented in Table 2 for the machinery sample, and in Table 3 for the high tech sample. Production factor elasticities are consistent with those estimated in other agglomeration studies, as well as with productivity studies in transition economies. The coefficients have expected signs and are strongly significant. Henderson (2003) reported capital elasticities in the range of 0.03 to 0.07 in machinery and 0.05 to 0.08 in the high-tech industry groups. Using Ukrainian data, Brown et al. (2006) (unpublished appendix) estimated capital elasticities of 0.094 in “machinery and equipment" and 0.044 in the "electrical and optical equipment" sector, which are similar to machinery and high-tech industry groups in our study, respectively. We estimated capital elasticities in the range of 0.08 to 0.088 for machinery and 0.108 to 0.121 for high-tech. In general, the relationship between the industry groups resembles that of Henderson's. Our labor elasticities are about 0.94 in machinery and between 0.96 and 0.99 in high-tech. Brown et al. (2006) used a similar dataset and also lacked material cost data; they report labor elasticities slightly above one in both industry groups. Henderson's coefficients on labor are half as large compared to ours, but he was able to include the material costs which sapped a portion of the effect. In general, it is likely that our labor coefficients may include the effects of other omitted factor variables, such as material costs. The sum of our production factor elasticities (capital and labor) slightly exceeds one both for machinery and high-tech, indicating increasing or close to constant returns to scale. We tested the hypothesis that $\alpha_K + \alpha_L = 1$ and failed to reject it in all equations. While Henderson (2003) reports the sum of factor coefficients to be slightly below one, the returns to scale in our work are similar to those found by Brown et al. (2006) with the Ukrainian data.

Tables 2 and 3 should be around here

The coefficient on the subsidiary status is always negative and strongly significant. A possible cause for the negative effect is the fact that subsidiaries as parts of broader intrafirm networks are located in the places determined by their mother companies or headquarters and do not always follow the reasoning of an independent profit-maximizing firm. We ran separate estimations for subsidiaries and non-affiliated ("independent") firms. For independent firms, there were no noticeable changes both in the factor elasticities and agglomeration coefficients. For affiliated firms, the capital elasticity fell sharply to below 0.01 or even negative and in most estimation equations turned statistically insignificant, whereas the labor elasticity increased to above one. The agglomeration coefficients in most specifications have turned insignificant and sometimes changed their sign to negative. The rise of the standard errors was especially pronounced in the high tech sample. One of possible reasons for this may be a relatively low number of observations in the subsidiary subsample (about eleven percent in both industry groups on average), which could inflate the standard errors.

In specifications when agglomeration variables were measured at the level of three-digit industries in the QMSA, we included the "urban" variable to mark observations located in cities or towns within the QMSAs. The coefficient on this variable was positive and strongly significant both in machinery and high-tech samples indicating higher productivity of firms in urban areas. This result generally follows both theoretical and empirical findings: productivity in cities tends to be higher. It is possible that this variable partially measures the urbanization economies effects. However, inclusion or omission of this variable does not affect the value and the significance of the local agglomeration effects.

Columns one and two in Tables 2 and 3 display a specification similar to that of Henderson (2003). With the exception of the high tech industries using the sub-industry and QMSA measures, we find evidence for localization economies. We note that for both industries, the KV3-QMSA measures of agglomeration are smaller. We suspect this may be due to the larger size of QMSA's and too fine a measure of industry. As a baseline these results suggest that there are localization economies measured in both areas. The coefficients are larger for the hi-tech when using the industry group and raion measure. While the coefficients for KV3-QMSA measures are negative for the high-tech industry, this may simply indicate that high-tech firms need to be in very proximity in order to gain from localization. Our results support Henderson's (2003) conclusion that it is the number of plants rather than employment in the same industry that provides localization effects. It has been suggested that knowledge spillovers occur between entrepreneurs (firm owners) or managers rather than between employees of the firms. We will further develop this idea when we discuss the ownership effects.

Columns five through eight of Tables 2 and 3 present the primary results. In this specification we include the two ownership variables representing the three categories. Introduction of the ownership variables has slightly increased the factor elasticities. As in Brown et al. (2006) the coefficients by the ownership variables (DO and FO) are statistically significant and positive. Productivity of domestically owned private firms is distinctly greater compared to the state firms, whereas for the primarily foreign firms, the effect further increases approximately twofold in both industry groups. As a result of introducing the cross terms, the total effect of agglomeration variables is now decomposed into the effect on the state firms (measured by the direct coefficient), and the effect for private-domestic-owned and foreign-owned firms (measured by the sum of the direct coefficient and the respective interaction term). The large standard errors suggest that we are pushing the data quite hard here. This is understandable given the fixed effects terms included in the specification (specifically time and region).

Turning first to the machinery manufacturing sample (Table 2), we note that the magnitude of the coefficient on the employment agglomeration measure (columns 5 and 7) has only fallen slightly. The interaction between the employment agglomeration measure and private-domestic-owned is very small, suggesting that agglomeration effects in manufacturing are accrued by both state-owned and private-domestic-owned firms. The coefficient on the interaction between the employment agglomeration measure and private-foreign-owned is quite large, although insignificant. When we turn to the plant agglomeration measure (columns 6 and 8), preferred by Henderson (2003), we find a similar but stronger pattern. The coefficient on the direct effect (measuring agglomeration effects for state-owned firms) has a more pronounced decline. It is still positive however. The interaction between the plant measure and private-domestic-owned ownership is also positive. Although it is modest, it does suggest that firms under private ownership may be better able to elicit these agglomeration economies. The coefficient on the interaction between foreign-owned and the plant agglomeration measure is large and significant for the industry group-raion measure. The results for machinery manufacturing are weak, but indicate that while all firms may gain some agglomeration economies, privately-owned firms, and especially foreign-owned firms gain the most.

The pattern is repeated, and stronger, for the group-raion measures (columns 5 and 6) in the high tech industry (Table 3). The direct effect, now measuring agglomeration for state-owned industries, has fallen by more than half for both the plant and employment measures. The coefficient on the interaction between domestically owned and both the employment (column 5) and plant (column 6) measures of agglomeration is quite large and significant. The coefficient on the interaction between the agglomeration measures and foreign ownership is also large although not statistically significant. The pattern is most pronounced using the plant measure, similar to what was found in the machinery industry. In columns 7 and 8 of Table 3, the relative pattern is preserved, but the initial estimates on the agglomeration, like those in columns 3 and 4, are negative. As we argue above, this may simply indicate that the KV3-QMSA measure is either too broad geographically or two narrow for the industry. The relative pattern is the same though, with private firms, and especially foreign owned firms, gaining the most. The effects are the most pronounced for the plant level measure of agglomeration. The results for the high-tech firms are stronger. Agglomeration economies appear to occur within the broad industry but at a small geography for all firms. However, privately owned firms, and especially foreign owned firms appear to be able to extract more productivity out of agglomeration effects than do the state-owned firms. This is consistent with higher productivity in general for private- and foreign-owned firms.

Even though "cherry-picking" for the foreign firms could have taken place (in a sense that foreign owners may have initially chosen the most productive assets when considered opening their businesses in the Ukraine), we still may conclude that they managed to choose the most productive locations and enjoy the agglomeration effects to the largest extent. Our results also suggest that ownership or firm management is a more important channel of agglomeration than employment, since it is the number of firms in vicinity that brings about greater increases in plant productivity. Another observation is the difference in statistical significance of the results at the three-digit industries in the QMSAs between machinery and high-tech. It is possible that geographic distances between firms in machinery play a greater role in accruing the agglomeration effects than distances in the industrial space, and therefore effects at this level of aggregation are insignificant. In the high-tech industry group, on the contrary, we observe lower standard errors for agglomeration coefficients and greater significance. One possible explanation is the difference in the number of firms between the groups. Since the high-tech sample is only a third the size of the machinery sample, increasing the number of high-tech firms in the neighborhood, even widely defined (such as QMSA), still affects firms' productivity. Greater heterogeneity of the high-tech sample may also add to the effect. The number of firms in the same three digit industry in the area is relatively small, and an additional firm plays a greater role for productivity than in the machinery industry.

In addition to the results presented here, we have estimated models year by year and included lagged impacts of agglomeration. The results (available from the authors upon request) demonstrate that the main conclusions of Tables 2 and 3 are quite robust to these changes in specification.

5. Conclusion

We find evidence for the existence of agglomeration economies in the Ukraine and that the ability of firms to fully make use of external spill overs is linked to the type of ownership: privately owned firms get higher returns to the same levels of agglomeration than do state-owned firms and foreign owned firms may gain the highest returns. These finding have important implications for understanding why agglomeration economies exists. Henderson (2003), who found that the number of plants gave stronger agglomeration results than total employment, concluded that this may indicate that agglomeration occurs at the management level, rather than the rank and file employment level. Our results further strengthen this claim, as we find a similar pattern between employment and plant measures, but more importantly find that the type of ownership matters. This suggests that in Western studies it may be important to distinguish between different types of management or ownership. It also suggests that unlike externalities in other cases, the recipients of the agglomeration externality may need to take some proactive measures to make full use of it. This has important implications for policy and for firm management. Simply locating in proximity to other similar firms may not be enough. Policy makers need to understand that while attracting an industry to an area may potentially result in agglomeration effects, the effects may not be fully realized if the firms have inexperienced management.

This raises a number of important research questions which were beyond the scope of this paper. One important question is whether the management of the firms in the agglomeration measure matters. It is quite possible that agglomeration externalities require some cooperation between firms. It may be that where state-owned firms all located near each other, a single foreign owned firm could not gain as much if it were located there as if it were located with other privately owned firms. This is a difficult exercise and given the small data set used here and the already large standard errors, it is not possible to measure this effect. However, in larger data sets this may be possible. Another important question is why agglomeration effects differ across industries or across countries. We find some evidence for agglomeration effects in machinery manufacturing; evidence not found by Henderson (2003). This may indicate that different manufacturing processes may play a crucial role in agglomeration economies. Finally, if the agglomeration externalities are due to certain types of workers (possibly upper management) interacting, it may be possible to measure this using different types of worker classifications. Again the data here do not allow this, but future work might consider this possibility.

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Tables

Table 1: Variables description

		Full sample	State owned	Private domestic	Private foreign
Machinery	Employment	113.2	397.4	89.3	456.8
	Capital	2818.3	13918.9	1985.4	10987.6
	Output	4357.1	10588.5	3514.8	27852.6
	Urban	0.9	0.9	0.9	0.9
	Subsidiary	0.1	0.6	0.1	0.2
	Former state	0.2	1	0.1	0.2
	Obs.	13,028	729	12,060	239
High Tech	Employment	119.4	657.4	61.6	62.7
	Capital	3284.5	19589.7	1463.9	4405.4
	Output	5739	21003.8	4037.6	6666
	Urban	1	1	1	0.9
	Subsidiary	0.1	0.5	0.1	0.1
	Former state	0.1	1	0.1	0.1
	Obs.	3,949	383	3,482	84

Table 2: Main Production Function Results for Machinery Sample

	Localization effects				Localization and ownership effects			
	Group-Raion		**KV3 - QMSA**		**Group-Raion**		**KV3 - QMSA**	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ln(Capital)	0.072^a	0.071^a	0.066^a	0.066^a	0.077^a	0.076^a	0.071^a	0.071^a
	(0.017)	(0.017)	(0.017)	(0.017)	(0.015)	(0.016)	(0.016)	(0.016)
ln(Labor)	0.938^a	0.938^a	0.945^a	0.944^a	0.945^a	0.945^a	0.951^a	0.950^a
	(0.026)	(0.026)	(0.025)	(0.025)	(0.025)	(0.024)	(0.024)	(0.024)
Primarily domestic (DO)					0.683^a	0.594^a	0.699^a	0.601^a
					(0.089)	(0.111)	(0.084)	(0.203)
Primarily foreign (FO)					1.272^a	0.687^b	1.339^a	0.806^c
					(0.170)	(0.331)	(0.182)	(0.459)
Local empl. effect	0.074^a		0.041^b		0.074^c		0.036	
	(0.017)		(0.017)		(0.042)		(0.051)	
Empl. + DO cross-effect					-0.007		0.011	
					(0.035)		(0.044)	
Empl. + FO cross-effect					0.087		0.099	
					(0.073)		(0.084)	
Local plants effect		0.093^a		0.073		0.06		0.058
		(0.024)		(0.044)		(0.053)		(0.091)
Plants + DO cross-effect						0.024		0.03
						(0.041)		(0.064)
Plants + FO cross-effect						0.164^c		0.162
						(0.090)		(0.123)
Subsidiary	-0.481^a	-0.475^a	-0.481^a	-0.480^a	-0.346^a	-0.343^a	-0.339^a	-0.337^a
	(0.058)	(0.056)	(0.064)	(0.064)	(0.051)	(0.050)	(0.054)	(0.055)
Urban			0.292^a	0.293^a			0.292^a	0.291^a
			(0.073)	(0.073)			(0.073)	(0.073)
Constant	2.727^a	2.457^a	2.497^a	2.298^a	2.022^a	1.867^a	1.765^a	1.625^a
	(0.069)	(0.114)	(0.088)	(0.169)	(0.099)	(0.150)	(0.112)	(0.321)
Industry*Time f.e.	yes	yes	yes	yes	yes	yes	yes	Yes
Number of MSA60	56	56	56	56	56	56	56	56
N	13028	13028	13352	13352	13028	13028	13352	13352
R-squared	0.63	0.63	0.63	0.63	0.64	0.64	0.64	0.64

Standard errors in parentheses
$^a p < 0.01$, $^b p < 0.05$, $^c p < 0.1$

Table 3: Main Production Function Results for High Tech Sample

	Localization effects				Localization and ownership effects			
	Group-Raion		**KV3 - QMSA**		**Group-Raion**		**KV3 - QMSA**	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ln(Capital)	0.117^a	0.116^a	0.108^a	0.109^a	0.124^a	0.122^a	0.115^a	0.114^a
	(0.036)	(0.036)	(0.039)	(0.039)	(0.035)	(0.035)	(0.039)	(0.039)
ln(Labor)	0.963^a	0.961^a	0.964^a	0.963^a	0.997^a	0.996^a	0.993^a	0.993^a
	(0.037)	(0.036)	(0.043)	(0.043)	(0.028)	(0.028)	(0.036)	(0.035)
Primarily domestic (DO)					0.541^a	0.218	0.587^a	0.179
					(0.188)	(0.234)	(0.211)	(0.239)
Primarily foreign (FO)					1.020^a	0.496	1.100^a	0.514
					(0.326)	(0.696)	(0.208)	(0.588)
Local empl. effect	0.117^a		-0.044^b		0.043		-0.077^c	
	(0.015)		(0.021)		(0.032)		(0.040)	
Empl. + DO cross-effect					0.081^b		0.035	
					(0.035)		(0.038)	
Empl. + FO cross-effect					0.101		0.036	
					(0.130)		(0.139)	
Local plants effect		0.168^a		-0.086		0.07		-0.223^b
		(0.032)		(0.061)		(0.048)		(0.089)
Plants + DO cross-effect						0.107^a		0.151^a
						(0.038)		(0.051)
Plants + FO cross-effect						0.162		0.204
						(0.129)		(0.138)
Subsidiary	-0.485^a	-0.486^a	-0.466^a	-0.466^a	-0.353^b	-0.357^b	-0.344^b	-0.342^b
	(0.110)	(0.109)	(0.117)	(0.116)	(0.139)	(0.137)	(0.155)	(0.150)
Urban			0.545^a	0.548^a			0.552^a	0.556^a
			(0.114)	(0.113)			(0.108)	(0.108)
Constant	2.366^a	1.962^a	2.067^a	2.107^a	1.781^a	1.618^a	1.461^a	1.792^a
	(0.263)	(0.282)	(0.273)	(0.279)	(0.378)	(0.343)	(0.365)	(0.381)
Industry*Time f.e.	yes	yes	yes	yes	yes	yes	yes	Yes
Number of MSA60	48	48	48	48	48	48	48	48
N	3949	3949	4036	4036	3949	3949	4036	4036
R-squared	0.61	0.62	0.57	0.56	0.62	0.63	0.58	0.57

Standard errors in parentheses
$^a p < 0.01$, $^b p < 0.05$, $^c p < 0.1$

Figure 1: Quasi Metropolitan Statistical Areas (QMSA) based on 60 km (about 37 Miles) commuting transportation distance.