

Firm Productivity and Agglomeration Economies: Evidence from Egyptian Data¹

Karim Badr²

Reham Rizk³

Chahir Zaki⁴

Abstract

This paper attempts to shed the light on the nexus between firms' productivity and economies of agglomeration in Egypt. Using a large dataset of firms in 342 firms' four-digit activities in 27 regions (62,108 firms), we introduce three measures of agglomeration which are urbanization or firm diversification measured by the number of firms by governorate, localization and specialization measured by the average productivity by governorate and sector (generating externalities and knowledge spillovers) and finally competition measured by the number of firm operating in the same governorate and the same sector. We find strong evidence for the existence of agglomeration in Egypt after controlling for firm age, location, economic activity and legal status. In the Egyptian context, productivity spillovers gained from agglomeration measures outweighed the negative effects of competition implied by congestion. The latter is chiefly due to the lack of good infrastructure. When regressions are run by firm size, location and activity, our main findings show first that micro and small firms are more likely to benefit from localization and diversification compared to medium and large firms. Service firms benefit more from high level of diversification while manufacturing firms gain more benefits from knowledge spillovers and specialization in Egypt.

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² Financial Sector Economist, World Bank, Cairo, Egypt. Email: kmohamed@worldbank.org

³ Assistant Professor, British University in Egypt, Email: rehamrizk82@gmail.com

⁴ Associate Professor, Cairo University and ERF, Email: chahir.zaki@feps.edu.eg

1. Introduction

Spatial agglomeration has been always the most important driver for industrial growth in developing countries. The linkage between spatial agglomeration of production and firms' productivity have received less attention particularly in the Egyptian contexts. Indeed, agglomeration occurs to benefit the economic agents based on two main perspectives (Rosenthal and Strange, 2004). The first, the localization economies arises from concentration of firms in the same industry. While, the second is urbanization economies which occurs from an increase in the city size that enables cross- fertilization of ideas among diverse economic activities (Jacobs, 1969). Some empirical studies are supporting localization economies more than urbanization economies such (Henderson, 2003; Li, Lu, and Wu, 2012)

There are different arguments focuses on the positive spillover effects of economies of agglomeration (Ohlin 1933; Hoover 1937). According to early work of Marshall (1920), it is better for small and very small firms to cluster because it would benefit to a greater extent from knowledge spillovers, similarity of cultural and psychological attitudes (Cainelli, 2008; Krugman and Venables, 1996). Moreover, facilitate the mobility of skilled workers and other specialized inputs for the firms (Krugman, 1991; Helsley and Strange, 1991). Finally, the regional system of innovation approach and it covers a broader aspects of innovative relations covering the intra-firm as well as the extra-firm relations and process (Cainelli, 2008; Iammarino and McCann, 2006). On the other hand, agglomeration could be associated with diseconomies of scale. Congestion that occurs from a dense firm location could be severe if infrastructure is a bottleneck to economic activities (Hu, Xu and Yashiro, 2015; Lall, Shalizi, and Deichmann, 2004).

Among the studies that relate several urban agglomeration channels to total factor productivity (TFP), Ellison, Glaeser, and Kerr (2010) reveal that all three Marshallian approaches of economies of agglomeration are found to have positive influence, with input-output linkage being extremely important. This is also supported by the work of Baldwin, Brown, and Rigby (2010) that claimed the importance of buyer-supplier networks, labor market matching and local spillovers that enhance the productivity within the firms. Henderson (2003) showed that local information spillover sources have a positive impact on the productivity of high –tech industries but not machinery industries. Several studies find a positive relationship between the overall size of a region and productivity (Shefer 1973, Segal 1976, Sveikauskas 1975) as well as between employment density and productivity (Ciccone and Hall 1996, Ciccone 2002, Brühlhart and Mathys 2008).

Against this literature, this paper contribution is threefold. First, it combines different measures of agglomeration (urbanization or firm diversification measured by the number of firms by governorate, localization and specialization measured by the average productivity by governorate and sector and finally competition measured by the number of firm operating in the

same governorate and the same sector) and examine their relationship with productivity. Second, it takes into consideration heterogeneity implied by economic activities, firm size and firm location. Third, it uses a rich dataset (firms in 342 firms' four-digit activities in 27 regions making a total of 62,108 firms) for a developing country (Egypt) in order to examine the effect of such agglomerations on firms' productivity. The Egyptian is particularly interesting since the industrial sector has been facing several problems affecting its productivity and the government is currently implementing several structural reforms to improve its competitiveness. Hence, an evidence-based study on the importance of clusters and agglomeration is crucial from a policy perspective.

We find strong evidence for the existence of agglomeration in Egypt after controlling for firm age, location, economic activity and legal status. In the Egyptian context, productivity spillovers gained from agglomeration measures outweighed the negative effects of competition implied by congestion. The latter is chiefly due to the lack of good infrastructure. When regressions are run by firm size, location and activity, our main findings show first that micro and small firms are more likely to benefit from localization and diversification compared to medium and large firms. In addition, knowledge spillovers are more likely to benefit firms located outside Cairo. Finally, service firms benefit more from high level of diversification while manufacturing firms gain more benefits from knowledge spillovers and specialization in Egypt. Our results support promoting entrepreneurship through the creation of industrial clusters located outside Cairo to lessen disparities between regions and acquire the full advantage of agglomeration.

The remainder of the paper is organized as follows. Section 2 reviews the literature. Section 3 displays the methodology. Section 4 presents the data and some stylized facts on TFP by firm size, activity, location and the correlation between agglomeration indices and TFP. Section 5 is dedicated to empirical findings. Section 6 robustness checks and section 7 conclusion and policy recommendations.

2. Literature Review

The theoretical underpinnings of agglomeration economies is based on two main hypotheses. Localization hypothesis (specialization), which are externalities occurred from clustering of firms in the same industry (Marshall, 1920). Urbanization or diversification hypothesis refer to urban regions with diversified industries that enables sharing ideas and practices among different economic activities (Jacobs, 1969). Localization economies promotes knowledge spillover and labor pooling due to regional specialization (Saxenian, 1994).

There is a body of literature review that distinguishes between urbanization and localization on several aspects. Localization is associated with several channels of economies of scale. It creates the basis of the intra-industry transmission of knowledge and technology. For instance Jaffe and Henderson (1993) found that patent citations are more likely to be domestic and

came from the same state. Rauch and Casella (2003) argued that knowledge spillover is not confined to technology only but also includes business opportunities and market knowledge. Also, Baldwin et al. (2010) found that knowledge spillovers are highly localized and enhanced firms productivity within industries rather than between them. Spatial concentration gives the rise to pecuniary externalities (Henderson, 1997; Fujita, Krugman and Venables, 1999). For instance, it promotes the emergence of thick labour market, where it is easier to find highly skilled workers and reduced job search (Helsley and Strange, 1991). Moreover, large markets triggered entry in production of intermediate goods that is sufficient to scale economies and allows firms to outsource huge share of their intermediate inputs and gains from specialization (Holmes, 1999; Rodríguez-Clare, 1996). Finally, forward and backward linkages in the production function arise thanks to such agglomerations (Hirschman, 1958). In contrast, concentration of firms could generate congestion especially if infrastructure is a bottleneck to economic activities which increases business costs (Hu et al., 2015). In addition, Broersma and Oosterhaven (2009) concluded that congestion dominated agglomeration externalities and impeded productivity.

With respect to urbanization hypothesis, (Jacobs, 1984) argued that large cities are characterized by diversity of industries that bring benefits to all firms located in the region. Duranton and Puga (2004) offered three mechanisms for explaining urban increasing returns; sharing, matching and learning. Sharing enables firms to increase their gains from an accessible variety of inputs and deeper division of workers that can be sustained from large production and sharing risks. Moreover, for matching, agglomeration improves the expected quality of matching between agents and reduce the hold-up problems. Finally, learning enables firms to benefit from creation, accumulation and transmission of knowledge. Moreover, Andersson, Burgess, and Lane, (2007) argued that thicker labor market along with complementarity in production contributed to urban premium. However, empirical evidence showed contradicting conclusions. Henderson (1997) found that diversity and narrower specialization of worker improved firm growth. Moreover, Glaeser, Kallal, Scheinkman and Shleifer (1992) found that sectoral diversity and competition improved firms employment in USA. In contrast, diversity is found to have a negative impact on most industries except services, while deeper specialization reduces employment growth (Combes, 2000).

Another strand of literature examines agglomeration hypothesis based on theories related to firms and their market size (Rizov, Oskam, and Walsh, 2012). *Co-location* to large markets could induce agglomeration effects through lower transportation cost and labor mobility (Krugman, 1991; Krugman and Venables, 1996). Furthermore, clustering near large firms provides opportunities to benefit from not only technology spillovers but also management practices and huge variety of intermediate inputs (Hu, Xu, and Yashiro, 2015). For instance, Greenstone, Hornbeck and Moretti (2010) found that productivity spillover is found to be higher with firms sharing the same pool of labor and technology with new firms in USA. Li et al., (2012) argued that Chinese firms are more likely to upgrade if it is located near large firms. Moreover, *market access*

as result of exports and trade liberalization could create export externalities to agglomerated firms through shared infrastructure and input-output linkages. For instance, Saito, Gopinath, and Wu (2011) found that agglomeration increased among high productivity firms. Sjöberg and Sjöholm, (2002) observed that firms engaged in international trade are comparably clustered in Indonesia. In contrast, proximity to foreign markets could make the domestic market less attractive which might work against regional agglomeration (Damijan and Konings, 2011). Finally, sectoral competition is other agglomeration externalities that could be a source of productivity gains (Porter, 1990). In contrast, severe competition lowers firms productivity through raising input prices and lowering product prices (Lall et al., 2004).

The empirical evidence on the relationship between productivity and different agglomeration types was inconclusive. For instance, Choi and Choi, 2017 showed that concentration of firms within the same industry contributes to both employment and productivity growth , while, little evidence is found for urbanization in South Korea. Moreover, employment density and localization resulted in raising labor productivity, but diversity and competition are found to have negative effects in Netherlands (Groot, de Groot, and Smit, 2014). Howell (2017) found that Marshallian theory of agglomeration matters in China as technology proximity reduced the cost of moving people, ideas and goods. Ciccone and Hall (1996) found that productivity increased when firms with similar activities are clustering together using USA data. Using different methodology, Melo, Graham, Levinson, and Aarabi (2017) found that employment density have stronger impact on productivity compared with shared infrastructure in USA. In addition, Andersson and Lööf (2011) concluded that urbanization favored firms' growth. As per developing countries, few studies examined the agglomeration-productivity nexus in these economies. Siba, Soderbom, Bigsten, and Gebreeyesus (2012) concluded that Ethiopian firms are more likely to be productive if they produce similar products to other firms in the cluster. Fafchamps and Hamine (2017) showed strong and large magnitude for specialization and found no clear-cut for diversity argument in Morocco.

Against this literature, this paper contribution is threefold. First, it combines different measures of agglomeration and examine their relationship with productivity. Second, it takes into consideration heterogeneity implied by economic activities, firm size and firm location. Third, it uses a rich dataset for a developing country (Egypt) in order to examine the effect of such agglomerations on firms' productivity.

3. Methodology

3.1. Estimating the Production Function

The analysis is done in three stages: The first is estimating TFP, and then using the predicted TFP as a dependent variable with other explanatory variables. TFP is estimated using a log linear Cobb-Douglas production function with constant returns to scale as follows:

$$Y_{ikg} = A_{ikg} L_{ikg}^{\alpha} K_{ikg}^{\beta} \quad (1)$$

where Y is value-added, K is capital, L is labor, A is technology efficiency parameter, i denotes individual plant, k denotes sector and g governorate. By log-linearizing equation (1), we obtain an estimable equation as follows:

$$\log Y_{ikg} = \log A_{ikg} + \alpha \log L_{ikg} + \beta \log K_{ikg} + \varepsilon_{ikg} \quad (2)$$

where ε is the residual (TFP).

We estimate the TFP as follows:

$$TFP_{ikg} = \log A_{ikg} = \log Y_{ikg} - \log \hat{Y}_{ikg} \quad (3)$$

with $\log \hat{Y}_{ikg}$ the estimated value-added.

3.2. Computing Agglomeration Indices

The paper makes use of large dataset of firms in 342 firms' four-digit activities in 27 regions (62,108 firms). Following Howard et al. (2014), we use several indices to measures the economies of agglomeration.

First, to measure urbanization or diversification economies (Jacobs J. , 1969), we define the size of the cluster as the number of firms located in the cluster which is a governorate in our case (*firm gov.*). Indeed, we follow Henderson (2003) in counting the number of firms in each governorate rather than focusing on employment. In his seminal work, he showed that the sources of agglomeration externalities are individual firms rather than individual employees (similar to Fujita and Ogawa, 1982). Therefore, firms will be attracted to areas where there is more economic activity.

Second, localization economies or specialization associated with agglomeration are measured by the average productivity of activity and governorate (Marshall, 1920): for firm i , we

calculate the average productivity of all other firms in area g in sector k , excluding firm i (*Avg. TFP Gov.*) to avoid endogeneity. Indeed, if knowledge and technology spillovers are more likely to occur, average productivity of other firms in the same cluster will have an impact on firm productivity when more productive firms are in close proximity. Moreover, having some champions in the cluster might be a proxy for the average productivity in a particular sector and a particular governorate. This is why construct another variable $Ln(Num\ 90)$ that measures the number of firms per sector and per governorate whose sales are greater or equal than the 90th percentile.

Third, to measure competition, we compute the number of firms in the same cluster (or governorate) that are operating in the same sector (measured at the 4-digit level) (*firm gov. sec.*). The higher the proportion of firms in the cluster in the same sector, the greater the competition. Hence, in order to survive, firms must be highly productive. We also control for possible cross-effects between them. We interact agglomeration variables with both Marshall-type and Jacobs-type of knowledge spillovers to account for possible amplification of within-and cross-industry agglomeration effects when region and industries are more exposed to foreign market access.

3.3. Examining Productivity and Agglomeration

To reiterate, the aim of our paper is to investigate the extent to which agglomeration variables have an impact on firm level productivity. This part will assess the impact of Marshallian externalities, Jacobs's externalities and competition. The type of externality could be indicative to the structure of the market (monopoly or competition). Hence, our third step is to use this estimated TFP to examine which agglomeration variable matters most as follows:

$$TFP_{ikg} = \alpha_0 + \alpha_1 \ln(age_{ikg}) + \alpha_2 Priv_{ikg} + \alpha_3 Leg_{ikg} + \alpha_4 Num.Firm_{kg} + \alpha_5 Num.Fim_g + \alpha_6 Avg.Prod_{kg} + \mu_k + \eta_{ikg} \quad (4)$$

where $\ln(age_{ikg})$ is the age of firm i operating in sector k and governorate g , $Priv$ is a dummy variable that takes the value of 1 if the firm is privately owned and zero otherwise, Leg measures the legal status of the firm. As per agglomeration variables, we include the number of firms by sector and governorate to measure competition $Num.Firm_{kg}$, the number of firms by governorate to measure urbanization/diversification (Jacob's externalities) $Num.Fim_g$ and the average productivity by governorate and activity $Avg.Prod_{kg}$ to measure specialization/localization externalities (Marshall's externalities). μ_k are sector dummies (at the 2-digit level) and η_{ikg} is the discrepancy term.

Furthermore, we extend our analysis in three ways. First, to capture location specific results, we run the regression by location for both the core (Cairo) and the periphery (other governorates). Second, to examine the differential impact of agglomeration economies on TFP of

different firms, we run regressions for micro (less than 5 employees), small (from 5 to 19), medium (from 20 to 99) and large (greater than 100) firms. Finally, we run regressions for both the manufacturing and services sector as the former is likely to be more affected by agglomeration economies than the latter (Krugman, 1991).

For the sake of robustness checks we run this regression using a TFP estimated using a translog function. We also control for the endogenous relationship between TFP and agglomeration measures.

4. Descriptive Statistics

This section will show some descriptive statistics that serve as an introduction to more thorough quantitative analysis. The section, first, describes aggregate measures of firm productivity, Jacob and Marshall externalities indices, as well as, the correlations between them. Second, the section will present some stylized facts by firm size, location and sector for these variables.

4.1. Aggregate Indices

Firm productivity is heterogeneous among governorates in Egypt (Figure 1). The governorates that enjoyed higher than average productivity are either metropolitans (Cairo, Giza, Alexandria and Suez) or highly populated governorates in Lower Egypt (Al-Sharkeya, Al-Beheira and Al-Gharbeya). Al-Dakahleya is another highly populated governorate in Lower Egypt that enjoys relatively high firm productivity, yet lower than the country average. These governorates also exhibit relatively lower poverty rates, higher living standards, and easier connection to markets compared to the rest of Egypt. All governorates in Upper Egypt (with exception of Giza) show lower productivity levels for their firms, which coincides with high poverty levels, lower welfare and difficult connectivity to markets. Furthermore, productivity is also surprisingly high in three frontier governorates; namely Matrouh, North and South Sinai (for the latter, mainly thanks to tourism).

[Figure 1 about here]

Most of the governorates have diverse industries (Figure 2), where few have positive externalities from industry specialization (Figure 3). Governorates with high Marshall specialization index, compared to the average, also enjoy higher productivity and relatively higher living standards (Cairo, Giza, Alexandria and Al-Kalyoubia).

[Figures 2-3 about here]

Higher productivity is correlated with high specialization index, measured by Marshallian Intra-Industry index (Figure 4) and with urbanization (Figure 5) and business clusters (Figure 6). Indeed, simple regressions show that 10% increase specialization index increases TFP by 6%, confirming a preliminary evidence that spillovers from specialization and business clusters enhance productivity, hence support the economies of agglomeration hypothesis in Egypt.

[Figures 4-6 about here]

4.2. Core vs. Periphery

Firms in the core have higher productivity, older in age and have higher specialization and diversification spillovers compared to peripheries (Table 1). Firm productivity in Cairo (the core) is significantly higher than the rest of the governorate. Furthermore, firms in Cairo are older in age. The core is also characterized by a tougher competition compared to the rest of the country. Furthermore, spillovers from diversification and specialization (measured by the average productivity) are higher in Cairo compared to the rest of Egypt.

[Table 1 about here]

4.3. Firm Size and Agglomeration Economies

Firm size is inversely related to productivity. Table 2 shows that smaller firms have higher productivity than larger ones. The data also shows that firm age increases with firm size, yet the differences are not remarkable. Larger firms have higher spillovers from diversification measured by the number of firms by governorate, while competition measured by the number of firms by sector and by sector is higher for micro and small firms than medium and large ones. By contrast, externalities related to average productivity by governorate and by sector is higher for large and medium firms than for micro and small ones. This can be explained by the externalities related to the presence of high growth firms in particular sectors.

[Table 2 about here]

4.4. Economic Activity

Productivity and spillovers vary widely among sectors (Table 3). Productivity by sector is heterogenous, where mining enjoys the highest TFP, followed by agriculture, then manufacturing and services. However, the latter two sectors have the highest spillover from diversification and specialization compared to the former ones. Additionally, competition is higher for manufacturing and services compared to the other two sectors.

[Table 3 about here]

5. Empirical Findings

Before reporting the estimates of different agglomeration measures in Tables (4-13), we estimated the production function using Cobb-Douglas and Trans-log approach by clustering the errors at the governorate level. A number of covariates representing firm characteristics such as age, firm ownership and legal status is added. All regressions included 4-digit sector dummies.

5.1. Aggregate regressions

Tables 4 and 5 show the results of aggregate regressions⁵. As the most basic setting, column (1) shows the results where only firm's legal status, ownership and age are included. Table 4 shows that firms private-ownership contributes positively to productivity compared to any other ownership structure. Firm age is also positively associated with a higher productivity. This result holds for trans-log total factor productivity as it is shown in Table 5. As we added the number of firms located in the region (firm gov.) "Urbanization externalities" in column 2, as expected, diversification or urbanization is found to have a positive impact on firm productivity and the result holds for all specification and productivity measures. In consistency with the theory, firms tend to be more productive in clusters where there are a larger number of firms. In column (3), we include the proportion of firms in the governorate that are in the same 4-digit economic activity as a proxy for competition. We find that competition spurs productivity (Schiffbauer and Ospina, 2010).

As revealed in columns (4-5), our externality variable is found to be positive and significant either measured by average productivity of the cluster excluding the individual firm in question or the highest growth firms. In column (6) to (9), we include the three measures simultaneously and their interactions. In column (7), we introduce the number of firms in the same sector in the same cluster whose sales are greater than or equal the 90th percentile as a measure of productivity. We find that firm's productivity increases when located in the same sector in the same cluster near

⁵ TFP is estimated using a log linear Cobb-Douglas production function with constant returns to scale. We also use Translog and find similar results in all cases.

high growth firms pointing out the importance of knowledge spillovers. However, competition variable turns to be negative. This is due to severe congestion with deficient infrastructure as it was shown in the literature.

Finally, column (8) and (9) add interactions between different measures of agglomeration. While all interactions are insignificant (and hence they will be removed from the rest of the regressions), urbanization or diversification index and specialization one (whether average productivity or high growth firms) are still positive and significant. Table 5 confirms these findings with a translog TFP estimation.

Therefore, in a nutshell, we found that agglomerations measured by specialization (the average productivity by sector and governorate) and diversification (the number of firms by governorate) boost productivity, whereas competition (the number of firms by governorate and by sector) has a detrimental effect on it due to congestion and the lack of a developed infrastructure.

[Tables 4-5 about here]

Next, for a better understanding of the agglomeration-productivity nexus in Egypt, we analyze differences in firm productivity controlling for different categories; firm size (micro, small, medium and large), location (core-periphery) and economic activity (agriculture, mining, manufacturing and services).

5.2. Heterogenous Effects by Firm Size

Table 6 presents the results by firm size: micro, small, medium and large firms. While firm's age is positively associated with TFP only for micro firms, we find strong evidence to suggest that private ownership contributes positively to productivity of all firms' regardless their size and TFP measures.

As per our measures of agglomeration, it is interesting to note that urbanization externalities are strong for all types of firms regardless their size and TFP specifications as revealed in Tables (6-7). Urbanization or diversification is highly beneficial for small and medium sized firms compared to both large and micro firms. Indeed, small and medium firms have no resources to invest in R and D and being located in clusters that are characterized by a high density of various economic activities, they can learn more from large firms without incurring any costs (*Damijan and Konings, 2011*). In addition, localization or specialization is found to have positive a significant impact on firm's productivity regardless their size and TFP specification. Yet, it is important to note that this pattern holds for micro and small firms and vanishes for medium and large when we measure externality by the number of high growth firms. This suggests that micro and small firms experienced higher positive productivity spillovers compared to other firm's size when they are close to high growth firms. Finally, competition is found to have a significant and

negative impact on all firms size productivity except large firms where it is insignificant (Fafchamps and Hamine, 2017). The results suggest hence that both urbanization/diversification and specialization matter for micro and small firms' productivity as well as private ownership, whereas competition is detrimental due to congestion effects and deficient infrastructure. Similar results are obtained with a translog specification as it is shown in Table 7.

[Tables 6 and 7 about here]

5.3. Agglomeration Economies: Core vs. Periphery

On disaggregating by location in Tables 8 and 9 (with Cobb-Douglas and translog), the effect of age and private ownership is still positive and significant. Regarding our agglomeration measures, productivity spillovers are found to matter only for firms located near high growth firms outside Cairo. This sheds the light on the importance of colocation with high growth firms outside Cairo as it generates significant agglomeration economies. When externalities are measured with average productivity, we found a positive and statistically significant effect on firms TFP. By contrast, and as it was mentioned before, competition between firms in the same governorate and the same sector is found to be detrimental to the firms' performance for firms only for those located outside Cairo. This is in line with the lack of infrastructure in governorates other than Cairo. Indeed, such a lack leads to more congestion which negatively affects firms productivity.

[Tables 8-9 about here]

5.4. Agglomeration Economies and Economic Activities

Finally, we analyze TFP by economic activity as it is shown in Tables (10-11). We found that diversification (number of firms by governorates) does not follow a unique pattern using different specification of TFP. In fact, we find that while mining and manufacturing firms are negatively affected by the number of firms by governorates, firms in the services sector are positively affected. Yet, when we control for the high growth firms located in the cluster, manufacturing and services firms tend to benefit more from diversification whereas mining firms do not. As per our translog estimation as it is shown in Table (11), urbanization agglomeration is stronger for both manufacturing and services firms. At the same time, the average productivity by sector and governorate has strong productivity effects on manufacturing firms compared to services and mining for different TFP measures (Henderson, 2003). Indeed, co-agglomeration of similar economic sectors can help only manufacturing firms to benefit from input-output linkages and labor pooling (Baldwin et al., 2010; Ellison et al., 2010). Competition between firms with similar economic sectors in the same cluster is found to improve productivity in agriculture firms, while decreasing productivity for mining, manufacturing and services firms. These results also hold using the trans-log measure of TFP and attributed to severe congestion (Hu et al., 2015).

Firm age is positively associated with productivity regardless industry type but negative for manufacturing. One reason is that manufacturing sector requires more innovation and investment in both labor and capital to sustain productivity increase. This is why younger firms are more likely to innovate and hence to have a higher TFP than older firms. At the same time, private ownership of firm is found to improve firm productivity but vanishes for agriculture firms. This pattern is consistent with results of trans-log TFP as shown in Table 11. We observe that service firms benefit more from high level of urbanization while manufacturing firms gain more from localization in Egypt. The rationale behind could be that the embedded knowledge in service firms are less tangible and benefit more from labor pooling while on the contrary, manufacturing firms require more investment in RandD and benefit more from knowledge spillovers and specialization (Ehrl, 2013; Rizov et al., 2012).

[Tables 10-11 about here]

6. Robustness checks

One common problem is endogeneity where an unobserved variable is correlated with the independent variable (agglomeration), rendering the OLS estimation to be inconsistent and biased. In other words, the issue of endogeneity could arise if there is an unobservable variable that impacts the decision of firms with certain level of productivity to reside in highly agglomerate regions. To correct for endogeneity, we used 2 two-stage least squares (2SLS) technique where the shares of population in governorates are used as an instrumental variable for firm agglomeration.

Regressions using population as instruments are included in Tables 12 and 13. In both tables, columns (1)-(4) use population as an instrument for each agglomeration measure taken individually ($\ln(\text{Firm sec. gov.})$, $\ln(\text{Num. 90})$, Avg. TFP and $\ln(\text{Firm gov.})$ respectively). Column (5) uses urbanization $\ln(\text{Firm gov.})$, competition $\ln(\text{Firm sec. gov.})$ and population share as instruments for Avg. TFP . The rationale behind is that productivity gains are the result of having a more diversified governorate with a tougher competition. Finally, columns (6) and (7) use governorate dummies as instruments for the three measures of agglomerations (which are considered thus endogenous). When each dimension is taken into consideration individually, even after controlling for endogeneity, agglomeration measures are positive and statistically significant showing that the latter does matter for productivity gains. When the three dimensions are introduced simultaneously, specialization/localization economies associated with agglomeration (whether measured by the average productivity of activity and governorate or by the number of firms per sector and per governorate whose sales are greater or equal than the 90th percentile) is the only significant variable that exerts a positive and significant effect on TFP.

[Tables 12-13 about here]

7. Conclusion and Policy Recommendations

This paper contribution is threefold. First, it combines different measures of agglomeration (urbanization or firm diversification measured by the number of firms by governorate, localization and specialization measured by the average productivity by governorate and sector and finally competition measured by the number of firms operating in the same governorate and the same sector) and examine their relationship with productivity. Second, it takes into consideration heterogeneity implied by economic activities, firm size and firm location. Third, it uses a rich dataset (firms in 342 firms' four-digit activities in 27 regions making a total of 62,108 firms) for a developing country (Egypt) in order to examine the effect of such agglomerations on firms' productivity. The Egyptian is particularly interesting since the industrial sector has been facing several problems affecting its productivity and the government is currently implementing several structural reforms to improve its competitiveness. Hence, an evidence-based study on the importance of clusters and agglomeration is crucial from a policy perspective.

Overall, we find strong evidence for the existence of agglomeration in Egypt after controlling for firm age, location, economic activity and legal status. Similar to others work, (Howard, Newman, Rand, and Tarp, 2014), in the Egyptian context, productivity spillovers gained from agglomeration measures outweighed the negative effects of competition implied by congestion. The latter is chiefly due to the lack of good infrastructure. When regressions are run by firm size, location and activity, our main findings show first that micro and small firms are more likely to benefit from localization and diversification compared to medium and large firms. In addition, knowledge spillovers are more likely to benefit firms located outside Cairo. Finally, service firms benefit more from high level of diversification while manufacturing firms gain more benefits from knowledge spillovers and specialization in Egypt.

The study highlights the importance of investing in business cluster development to enhance productivity through utilizing economies of agglomeration. One policy recommendation could be developing specialized business cluster based on each governorate's comparative advantage. Furthermore, these clusters should have the appropriate hybrid of different firm sizes. As highlighted in this research, smaller firms tend to have higher productivity. Furthermore, micro, small and medium firms benefit from specialization and diversification spillovers resulting from agglomeration.

From a policy perspective, first, facilitating mobility of factors of production (labor and capital) is integral to promote economies of agglomeration and consequently boosting firm productivity. Enhanced transportation and access to markets close to business clusters locations could be one policy advice to the government.

Second, further development to the existing business clusters is needed. Government efforts should be focused on supporting the existing business clusters, expanding the supply chain, and linking it to markets (internal and external). Rigorous efforts are needed to expand and enhance the existing clusters, develop further the supply chain of feeding industries, and fostering specialization. It is recommended to establish specialized industrial zones for promising business clusters that have high growth potentials.

Third, it is advisable that the government invest in human capital through providing vocational educations and training centers that is related to the business clusters. These human capital centers would be in the proximity of the business clusters. A tripartite arrangement among the ministry of trade and industry, the ministry of higher education and the private sector could be useful in setting vocational education and training programs for labor working in these industries.

Forth, enhancing access to finance for firms in these business clusters is important to ensure sustainability and growth. Access to finance is one of the obstacles facing firms in Egypt in general. However, the government and the banking sector are encouraged to enhance access to finance for firms in these clusters and develop customized financial product that could help in financing the working capital needs and increasing investments.

Fifth, the government is advised to ensure proper infrastructure is well connected to the business clusters all over Egypt. Electricity, water, sanitation and waste disposal systems are important factors to attract business and to develop the clusters.

Sixth, on the sectoral side, manufacturing will benefit most from specialization. Hence, promoting business clusters in manufacturing and creating a value chain that will greatly enhance productivity of the sector and promote forward and backward linkages. On the other hand, services will benefit most from spillovers resulting from diversification.

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Table 1. Indices by Core-Periphery

	Not Cairo	Cairo	Total
TFP	-0.02	0.24	0.06
Ln(Age)	2.09	2.21	2.13
Private	0.99	0.99	0.99
Firm Gov.	2486.10	7988.65	4138.07
Firm Gov. Sec.	69.07	169.91	99.34
Avg. TFP Gov.	-0.02	0.23	0.06

Source: Constructed by the authors using the Economic Census data.

Table 2. Indices by Firm Size

	Micro	Small	Medium	Large	Total
TFP	0.11	0.00	-0.25	0.01	0.06
Ln(Age)	1.91	2.43	2.85	2.91	2.13
Firm Gov.	3655.46	4921.96	5395.78	5741.68	4138.07
Firm Gov. Sec.	100.01	106.26	85.02	66.94	99.34
Avg. TFP Gov.	0.03	0.10	0.13	0.19	0.06

Source: Constructed by the authors using the Economic Census data.

Table 3. Indices by Economic Activity

	Agriculture	Mining	Manufacturing	Services	Total
TFP	0.25	0.83	0.06	0.05	0.06
Ln(Age)	2.22	1.61	2.34	2.07	2.13
Firm Gov.	2789.54	2873.62	4147.25	4165.53	4138.07
Firm Gov. Sec.	21.08	41.38	64.54	110.34	99.34
Avg. TFP Gov.	0.02	-0.06	0.05	0.06	0.06

Source: Constructed by the authors using the Economic Census data.

Table 4. Aggregate Results with Cobb-Douglas TFP

	TFP (1)	TFP (2)	TFP (3)	TFP (4)	TFP (5)	TFP (6)	TFP (7)	TFP (8)	TFP (9)
Ln(Age)	0.0720*** (0.00442)	0.0679*** (0.00441)	0.0713*** (0.00442)	0.0678*** (0.00432)	0.0715*** (0.00442)	0.0687*** (0.00432)	0.0676*** (0.00441)	0.0687*** (0.00432)	0.0676*** (0.00441)
Private	0.915*** (0.0783)	0.902*** (0.0779)	0.897*** (0.0783)	0.867*** (0.0764)	0.917*** (0.0782)	0.891*** (0.0764)	0.927*** (0.0779)	0.891*** (0.0764)	0.927*** (0.0781)
Ln(Firm gov.)		0.129*** (0.00573)				-0.00378 (0.00782)	0.162*** (0.00724)	0.0106 (0.0212)	0.0662*** (0.0188)
Ln(Firm sec. gov.)			0.0309*** (0.00432)			-0.0455*** (0.00530)	-0.0466*** (0.00549)	-0.0274 (0.0439)	-0.247*** (0.0359)
Avg. TFP. Gov.				0.857*** (0.0157)		0.916*** (0.0183)		1.066*** (0.230)	
Ln(Firm sec. gov.)*Avg. TFP.								-0.00274 (0.0167)	
Ln(Firm gov.)*Avg. TFP.								-0.0193 (0.0318)	
Ln(Firm gov.)*Ln(Firm sec. gov.)								-0.00218 (0.00546)	0.0247*** (0.00437)
Ln(Num. 90)					0.0301*** (0.00447)		0.0136*** (0.00465)		0.0736 (0.0479)
Ln(Firm sec. gov.)*Ln(Num. 90)									-0.00524 (0.00649)
Ln(Firm gov.)*Ln(Num. 90)									-0.00338 (0.00508)
Constant	-0.541*** (0.0773)	-1.607*** (0.0904)	-0.647*** (0.0786)	-0.641*** (0.0755)	-0.561*** (0.0773)	-0.461*** (0.0938)	-1.735*** (0.0923)	-0.574*** (0.182)	-0.967*** (0.166)
Legal Form	YES	YES	YES	YES	YES	YES	YES	YES	YES
Act. Dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES
Observations	60,056	60,056	60,056	60,056	60,056	60,056	60,056	60,056	60,056
R-squared	0.223	0.230	0.224	0.260	0.224	0.262	0.231	0.262	0.231

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 5. Aggregate Results with Translog TFP

	TFP	TFP	TFP	TFP	TFP	TFP	TFP
Ln(Age)	0.0657*** (0.00445)	0.0614*** (0.00444)	0.0648*** (0.00445)	0.0654*** (0.00434)	0.0653*** (0.00445)	0.0627*** (0.00434)	0.0612*** (0.00444)
Private	1.137*** (0.0788)	1.123*** (0.0784)	1.114*** (0.0788)	1.112*** (0.0768)	1.138*** (0.0788)	1.125*** (0.0767)	1.142*** (0.0785)
Ln(Firm gov.)		0.135*** (0.00577)				0.113*** (0.00715)	0.161*** (0.00729)
Ln(Firm sec. gov.)			0.0394*** (0.00435)			-0.0404*** (0.00532)	-0.0362*** (0.00553)
Avg. TFP.				13.76*** (0.245)		13.17*** (0.249)	
Ln(Num. 90)					0.0273*** (0.00450)		0.00806* (0.00468)
Constant	-1.103*** (0.0778)	-2.216*** (0.0910)	-1.237*** (0.0792)	-1.106*** (0.0759)	-1.120*** (0.0778)	-1.907*** (0.0910)	-2.320*** (0.0929)
Legal Form	YES	YES	YES	YES	YES	YES	YES
Act. Dummies	YES	YES	YES	YES	YES	YES	YES
Observations	60,056	60,056	60,056	60,056	60,056	60,056	60,056
R-squared	0.207	0.214	0.208	0.247	0.208	0.250	0.215

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 6. Results with Cobb-Douglas TFP by firm size

	Micro TFP	Small TFP	Medium TFP	Large TFP	Micro TFP	Small TFP	Medium TFP	Large TFP
Ln(Age)	0.101*** (0.00449)	0.00196 (0.0109)	0.00643 (0.0267)	-0.0473 (0.0464)	0.101*** (0.00465)	-0.00519 (0.0110)	0.00981 (0.0267)	-0.0557 (0.0467)
Private	0.818 (0.516)	1.582*** (0.320)	0.476** (0.233)	0.513*** (0.125)	0.903* (0.534)	1.604*** (0.322)	0.493** (0.234)	0.534*** (0.126)
Ln(Firm gov.)	-0.0535*** (0.00852)	0.0774*** (0.0189)	0.124*** (0.0416)	0.0824 (0.0592)	0.129*** (0.00814)	0.201*** (0.0171)	0.202*** (0.0357)	0.188*** (0.0545)
Ln(Firm sec. gov.)	-0.0334*** (0.00614)	-0.0690*** (0.0123)	-0.0889*** (0.0232)	0.00314 (0.0364)	-0.0347*** (0.00637)	-0.0867*** (0.0128)	-0.0972*** (0.0248)	0.0220 (0.0423)
Avg. TFP.	1.004*** (0.0186)	0.736*** (0.0465)	0.410*** (0.117)	0.709*** (0.164)				
Ln(Num. 90)					0.0107* (0.00596)	0.0554*** (0.00885)	0.0325 (0.0224)	-0.00238 (0.0437)
Constant	0.720 (0.516)	-1.425*** (0.346)	-1.223*** (0.393)	-0.995** (0.483)	-0.769 (0.534)	-2.318*** (0.343)	-1.824*** (0.355)	-1.797*** (0.450)
Legal Form	YES	YES	YES	YES	YES	YES	YES	YES
Act. Dummies	YES	YES	YES	YES	YES	YES	YES	YES
Observations	40,838	13,280	4,410	1,528	40,838	13,280	4,410	1,528
R-squared	0.165	0.398	0.419	0.336	0.105	0.388	0.418	0.327

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 7. Aggregate Results with Translog TFP by firm size

	Micro TFP	Small TFP	Medium TFP	Large TFP	Micro TFP	Small TFP	Medium TFP	Large TFP
Ln(Age)	0.102*** (0.00451)	-0.0137 (0.0108)	0.00970 (0.0264)	-0.0343 (0.0473)	0.102*** (0.00465)	-0.0210* (0.0110)	0.00999 (0.0265)	-0.0351 (0.0473)
Private	0.869* (0.517)	1.462*** (0.316)	0.255 (0.231)	0.385*** (0.128)	0.954* (0.533)	1.489*** (0.321)	0.264 (0.232)	0.387*** (0.128)
Ln(Firm gov.)	0.0803*** (0.00789)	0.166*** (0.0168)	0.163*** (0.0362)	0.149*** (0.0554)	0.129*** (0.00814)	0.207*** (0.0170)	0.191*** (0.0354)	0.151*** (0.0552)
Ln(Firm sec. gov.)	-0.0301*** (0.00615)	-0.0694*** (0.0122)	-0.0613*** (0.0230)	0.0706* (0.0370)	-0.0345*** (0.00637)	-0.0776*** (0.0127)	-0.0748*** (0.0246)	0.0796* (0.0429)
Avg. TFP.	15.56*** (0.305)	10.17*** (0.478)	3.102*** (0.962)	1.972 (3.196)				
Ln(Num. 90)					0.0117** (0.00595)	0.0565*** (0.00882)	0.0263 (0.0222)	-0.0170 (0.0443)
Constant	-0.465 (0.517)	-1.950*** (0.337)	-1.669*** (0.360)	-2.408*** (0.459)	-0.824 (0.533)	-2.331*** (0.342)	-1.918*** (0.352)	-2.436*** (0.456)
Legal Form	YES	YES	YES	YES	YES	YES	YES	YES
Act. Dummies	YES	YES	YES	YES	YES	YES	YES	YES
Observations	40,838	13,280	4,410	1,528	40,838	13,280	4,410	1,528

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 8. Results with Cobb-Douglas TFP by Location

	Cairo TFP	Not Cairo TFP	Cairo TFP	Not Cairo TFP
Ln(Age)	0.0206** (0.00860)	0.0853*** (0.00511)	0.0235*** (0.00859)	0.0854*** (0.00496)
Private	0.948*** (0.123)	0.887*** (0.104)	0.932*** (0.123)	0.822*** (0.101)
Ln(Firm gov.)	0.193*** (0.0190)	0.147*** (0.0102)	-0.0259 (0.0349)	0.0156 (0.0102)
Ln(Firm sec. gov.)	-0.00698 (0.0114)	-0.0613*** (0.00650)	-0.00539 (0.0106)	-0.0616*** (0.00625)
Ln(Num. 90)	-0.00265 (0.0133)	0.0241*** (0.00660)		
Avg. TFP.			0.885*** (0.118)	0.924*** (0.0179)
Constant	-2.069*** (0.197)	-1.589*** (0.123)	-0.342 (0.303)	-0.557*** (0.121)
Legal Form	YES	YES	YES	YES
Act. Dummies	YES	YES	YES	YES
Observations	17,840	42,216	17,840	42,216
R-squared	0.161	0.264	0.164	0.308

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 9. Results with Translog TFP by Location

	Cairo TFP	Not Cairo TFP	Cairo TFP	Not Cairo TFP
Ln(Age)	0.00968 (0.00871)	0.0813*** (0.00513)	0.0121 (0.00857)	0.0821*** (0.00500)
Private	1.268*** (0.125)	0.989*** (0.104)	1.268*** (0.123)	0.952*** (0.101)
Ln(Firm gov.)	0.203*** (0.0193)	0.145*** (0.0102)	0.152*** (0.0191)	0.0931*** (0.00999)
Ln(Firm sec. gov.)	0.00798 (0.0116)	-0.0522*** (0.00653)	-0.0733*** (0.0112)	-0.0402*** (0.00631)
Ln(Num. 90)	-0.00185 (0.0135)	0.0157** (0.00663)		
Avg. TFP.			22.49*** (0.954)	12.57*** (0.266)
Constant	-2.870*** (0.199)	-2.035*** (0.124)	-2.178*** (0.198)	-1.634*** (0.121)
Legal Form	YES	YES	YES	YES
Act. Dummies	YES	YES	YES	YES
Observations	17,840	42,216	17,840	42,216
R-squared	0.149	0.249	0.175	0.287

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 10. Sectoral Results with Cobb-Douglas TFP

	Agr. TFP	Mining TFP	Manuf TFP	Ser. TFP	Agr. TFP	Mining TFP	Manuf TFP	Ser. TFP
Ln(Age)	0.100** (0.0473)	0.126** (0.0581)	-0.0160** (0.00788)	0.118*** (0.00513)	0.102** (0.0471)	-0.0191 (0.0626)	-0.0209*** (0.00803)	0.118*** (0.00523)
Private	0.475 (0.391)	2.678*** (0.448)	0.266*** (0.0921)	1.423*** (0.129)	0.528 (0.389)	2.563*** (0.443)	0.280*** (0.0939)	1.471*** (0.132)
Ln(Firm gov.)	-0.00564 (0.0879)	-0.397*** (0.0985)	-0.0640*** (0.0150)	0.0189** (0.00847)	-0.00154 (0.0878)	-0.279*** (0.0829)	0.132*** (0.0130)	0.181*** (0.00776)
Ln(Firm sec. gov.)	0.0818* (0.0470)	-0.299*** (0.0594)	-0.0223*** (0.00672)	-0.0393*** (0.00466)	0.0904* (0.0466)	-0.500*** (0.0767)	-0.0383*** (0.00787)	-0.0392*** (0.00476)
Avg. TFP.	0.247 (0.201)	0.616** (0.247)	0.964*** (0.0424)	0.917*** (0.0212)				
Ln(Num. 90)					0.150 (0.132)	0.153*** (0.0381)	0.0142*** (0.00501)	0.0197 (0.0211)
Constant	-0.615 (0.762)	2.090** (0.915)	0.383** (0.149)	-1.642*** (0.144)	-0.730 (0.755)	1.936** (0.848)	-1.118*** (0.141)	-2.937*** (0.143)
Legal Form	YES	YES	YES	YES	YES	YES	YES	YES
Observations	673	402	12,721	46,260	673	402	12,721	46,260
R-squared	0.048	0.464	0.061	0.232	0.048	0.478	0.023	0.201

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 11. Sectoral Results with Translog TFP

	Agr. TFP	Mining TFP	Manuf TFP	Ser. TFP	Agr. TFP	Mining TFP	Manuf TFP	Ser. TFP
Ln(Age)	0.0913** (0.0452)	-0.0424 (0.0630)	-0.0165** (0.00795)	0.0937*** (0.00503)	0.0937** (0.0472)	-0.0537 (0.0622)	-0.0294*** (0.00812)	0.111*** (0.00524)
Private	0.0706 (0.373)	2.453*** (0.443)	0.206** (0.0927)	1.912*** (0.126)	0.0871 (0.390)	2.502*** (0.439)	0.180* (0.0950)	1.998*** (0.132)
Ln(Firm gov.)	0.00268 (0.0842)	-0.146 (0.0952)	0.116*** (0.0120)	0.0974*** (0.00753)	0.00914 (0.0880)	-0.249*** (0.0823)	0.140*** (0.0132)	0.176*** (0.00778)
Ln(Firm sec. gov.)	0.00904 (0.0462)	-0.343*** (0.0963)	-0.00552 (0.00676)	-0.0383*** (0.00456)	0.103** (0.0467)	-0.312*** (0.0762)	-0.00766 (0.00796)	-0.0320*** (0.00477)
Avg. TFP.	67.05*** (8.606)	13.38** (6.599)	25.94*** (1.039)	13.65*** (0.211)				
Ln(Num. 90)					0.0847 (0.132)	0.0959** (0.0379)	0.00589 (0.00507)	0.00662 (0.0212)
Constant	-0.230 (0.725)	0.450 (0.828)	-1.100*** (0.131)	-2.677*** (0.138)	-0.420 (0.757)	1.125 (0.842)	-1.243*** (0.142)	-3.452*** (0.143)
Legal Form	YES	YES	YES	YES	YES	YES	YES	YES
Observations	673	402	12,721	46,260	673	402	12,721	46,260
R-squared	0.139	0.294	0.093	0.256	0.060	0.298	0.049	0.188

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 12. Instrumenting Agglomeration – Cobb-Douglas TFP

	(1) TFP	(2) TFP	(3) TFP	(4) TFP	(5) TFP	(6) TFP	(7) TFP
Ln(Age)	0.0691*** (0.00444)	0.0668*** (0.00461)	0.0687*** (0.00432)	0.0686*** (0.00441)	0.0685*** (0.00432)	0.0684*** (0.00433)	0.0671*** (0.00458)
Private	0.839*** (0.0786)	0.935*** (0.0814)	0.877*** (0.0764)	0.904*** (0.0779)	0.875*** (0.0764)	0.923*** (0.0860)	0.857*** (0.0910)
Ln(Firm sec. gov.)	0.130*** (0.00770)					-0.110 (0.0788)	0.133 (0.0836)
Ln(Num. 90)		0.347*** (0.0213)					0.251*** (0.0248)
Avg. TFP.			0.676*** (0.0389)		0.709*** (0.0283)	0.926*** (0.0183)	
Ln(Firm gov.)				0.105*** (0.00617)		0.0469 (0.0638)	-0.0548 (0.0673)
Constant	-0.689*** (0.0887)	-0.514*** (0.0905)	-0.462*** (0.0848)	-1.257*** (0.0997)	-0.465*** (0.0848)	-0.623* (0.356)	-0.330 (0.376)
Legal Form	YES	YES	YES	YES	YES	YES	YES
Act. Dummies	YES	YES	YES	YES	YES	YES	YES
Observations	60,056	60,056	60,056	60,056	60,056	60,056	60,056
R-squared	0.217	0.159	0.259	0.230	0.259	0.260	0.175

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: Columns (1)-(4) use population as an instrument for the agglomeration measure taken into account (*Ln(Firm sec. gov.)*, *Ln(Num. 90)*, *Avg. TFP* and *Ln(Firm gov.)* respectively). Column (5) uses urbanization *Ln(Firm gov.)*, competition *Ln(Firm sec. gov.)* and population share as instruments for *Avg. TFP*. The rationale behind is that productivity gains are chiefly explained by competition and urbanization. Finally, columns (6) and (7) use governorate dummies as instruments for the three measures of agglomerations (which are considered thus endogenous).

Table 13. Instrumenting Agglomeration – Translog TFP

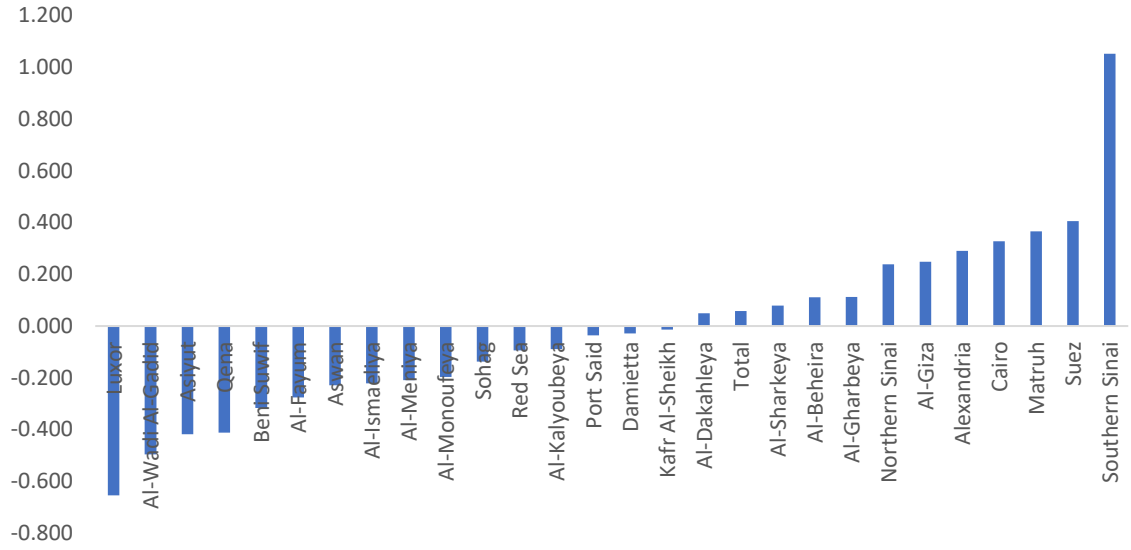
	(1) TFP	(2) TFP	(3) TFP	(4) TFP	(5) TFP	(6) TFP	(7) TFP
Ln(Age)	0.0627*** (0.00447)	0.0603*** (0.00466)	0.0649*** (0.00463)	0.0622*** (0.00444)	0.0651*** (0.00448)	0.0649*** (0.00450)	0.0608*** (0.00460)
Private	1.058*** (0.0791)	1.158*** (0.0822)	1.072*** (0.0820)	1.126*** (0.0784)	1.085*** (0.0793)	0.998*** (0.0893)	1.064*** (0.0915)
Ln(Firm sec. gov.)	0.135*** (0.00775)					0.179** (0.0816)	0.158* (0.0840)
Ln(Num. 90)		0.359*** (0.0215)					0.229*** (0.0249)
Avg. TFP.			36.21*** (2.161)		29.24*** (1.189)	25.73*** (0.545)	
Ln(Firm gov.)				0.109*** (0.00621)		-0.115* (0.0662)	-0.0625 (0.0677)
Constant	-1.276*** (0.0892)	-1.095*** (0.0914)	-1.039*** (0.0910)	-1.864*** (0.100)	-1.029*** (0.0879)	-0.481 (0.370)	-0.891** (0.378)
Legal Form	YES	YES	YES	YES	YES	YES	YES
Act. Dummies	YES	YES	YES	YES	YES	YES	YES
Observations	60,056	60,056	60,056	60,056	60,056	60,056	60,056
R-squared	0.202	0.136	0.141	0.214	0.197	0.196	0.161

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

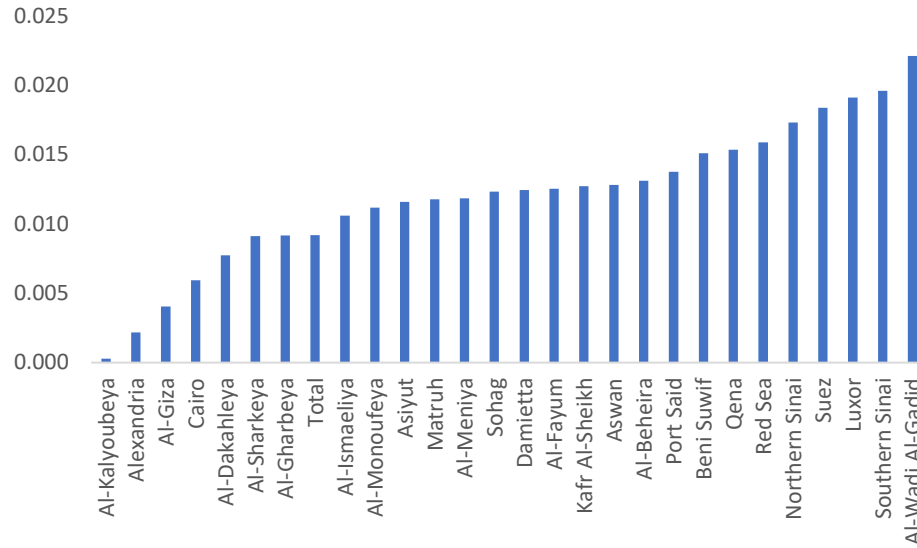
Note: Columns (1)-(4) use population as an instrument for the agglomeration measure taken into account (*Ln(Firm sec. gov.)*, *Ln(Num. 90)*, *Avg. TFP* and *Ln(Firm gov.)* respectively). Column (5) uses urbanization *Ln(Firm gov.)*, competition *Ln(Firm sec. gov.)* and population share as instruments for *Avg. TFP*. The rationale behind is that productivity gains are chiefly explained by competition and urbanization. Finally, columns (6) and (7) use governorate dummies as instruments for the three measures of agglomerations (which are considered thus endogenous).

Figure 1. TFP by Governorate



Source: Constructed by the authors using the Economic Census data

Figure 2. Jacobs Externalities Index by Governorate

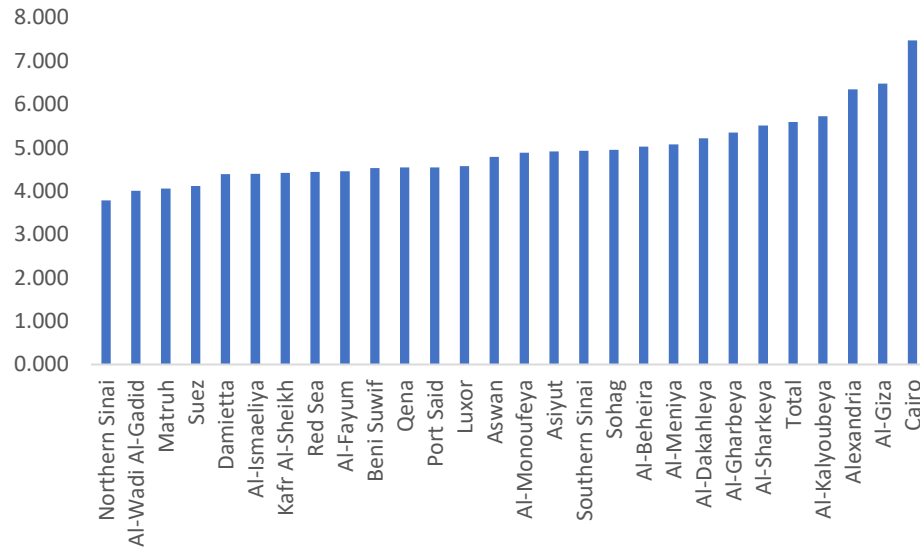


Source: Constructed by the authors using the Economic Census data.

Note: Jacobs externalities are measured by Hirschmann-Herfindhal index $invH_N = 1/\sum_{i \in k} s_{ikg}^2$

Where s is the share of firm i in sector k and region g.

Figure 3. Marshallian Intra-Industry Index by Governorate

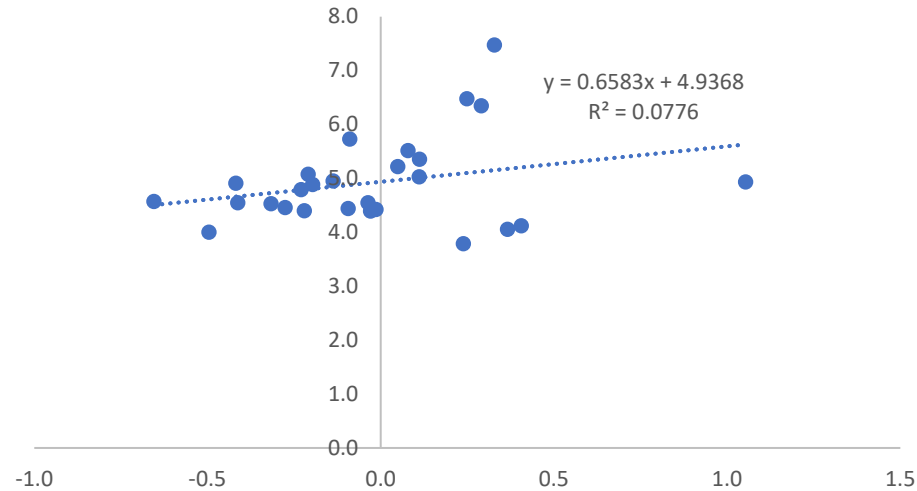


Source: Constructed by the authors using the Economic Census data.

Note: Marshallian externalities are measured by the intra-industry index

$IIS = \langle \sum_{i \in k} E_{ikg} - E_{ikg} + 1 \rangle$ where E is measured by employment for firm i in sector k and region g .

Figure 4. Correlation between TFP and the Marshallian Intra-Industry Index

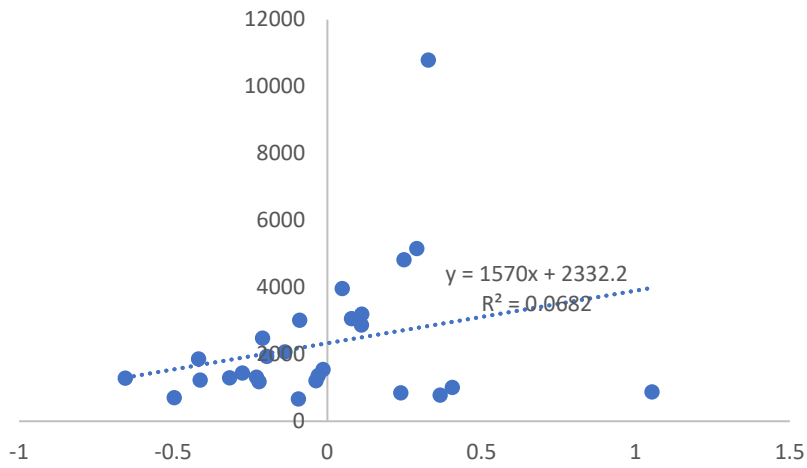


Source: Constructed by the authors using the Economic Census data.

Note: Marshallian externalities are measured by the intra-industry index

$IIS_{ijr} = \langle \sum_{i \in jr} E_{ijr} - E_{ijr} + 1 \rangle$

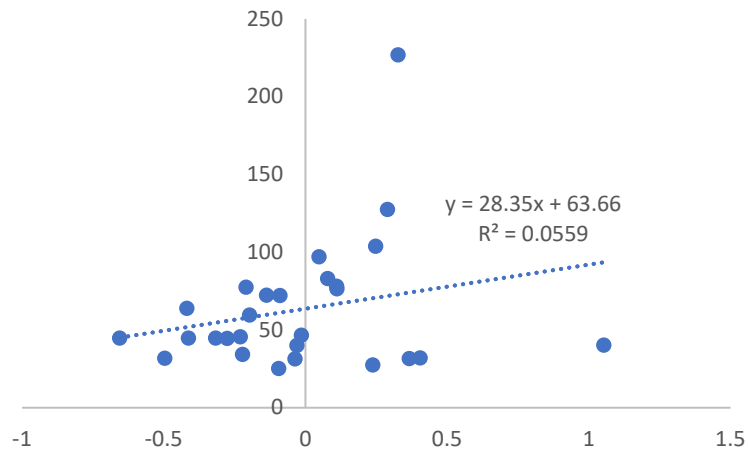
Figure 5. Correlation between TFP and Cluster Size



Source: Constructed by the authors using the Economic Census data.

Note: The cluster size is measured by the number of firms by governorate.

Figure 6. Correlation between TFP and Competition



Source: Constructed by the authors using the Economic Census data.

Note: Competition is measured by the number of firms by governorate and by sector.