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Agglomeration economies in Vietnam: A firm-level analysis

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ABSTRACT

This study examines the effects of agglomeration economies on firm-level productivity in Vietnam. We develop new measures of localization and urbanization economies using the cluster detection technique proposed by Mori and Smith (2014) and estimate the effects of localization and urbanization economies by firm type—state-owned, private, and foreign-owned. Furthermore, we decompose the effects of agglomeration economies into three sources: inter-industry transaction relationships, knowledge spillovers, and labor pooling. We show that localization economies improve firm-level productivity in Vietnam, with firms in clustered areas having higher productivity. However, such economies do not improve the productivity of state-owned enterprises. We also find that urbanization economies improve productivity only for foreign-owned firms, but do not benefit state-owned and private firms. On the other hand, decomposition of agglomeration economies suggests that transactions are effective only for private firms, while knowledge spillovers and labor pooling are effective for foreign-owned firms.

1. Introduction

Traditional village-based industrial clusters have historically dominated in Vietnam. Recently, however, increased investment by foreign-owned firmsespecially in industrial parks in suburban areashas resulted in the emergence of a different type of industrial cluster in such areas. However, as Ketels, Nguyen, Nguyen, and Hanh (2010) point out, agglomeration economies are still weak in Vietnam. They argue that clusters in Vietnam focus on “a narrow set of activities without the breadth of related and supporting industries” and “linkages are also rarely established beyond the industrial parks’ boundaries.” Thus, the question remains whether clusters in Vietnam function as a source of positive externalities. Moreover, if clusters do not generate positive externalities, it is necessary to identify where the bottlenecks exist.

Vietnam has been experiencing the transition from a centrally-planned to a market-based economy since 1986, when the nation adopted a new economic reform policy called Doi Moi. Since the reform, export-oriented labor-intensive manufacturing sectors, such as apparel and footwear, have developed rapidly thanks to massive inflows of foreign direct investment (FDI). After the Asian economic crisis in 1997, the 1999 Law on Enterprises institutionalized ownership rights and the freedom to do business (Vu-Thanh, 2017). Vietnam’s economic growth was further boosted by trade liberalization, especially after Vietnam signed a bilateral trade agreement with the USA in 2000, followed by accession to the WTO in 2007. This accession unified the Law on Enterprises for private firms and state-owned enterprises (SOEs), and the Law on Investment for foreign-owned firms and SOEs (Vu-Thanh, 2017). As a result, SOEs, foreign-owned firms, and private firms

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started to compete with each other, but in different contexts: SOEs maintain a close relationship with the government, while foreign-owned and private firms are closely linked to the international and domestic markets, respectively. As this study shows, such differences in firm characteristics significantly affect the magnitude and causes of the agglomeration economies.

This study examines the effects of agglomeration economies on firm-level productivity in Vietnam. By using firm-level data, we estimate total factor productivity (TFP). Then, using the procedure proposed by Mori and Smith (2014), we detect the location of industrial clusters and estimate the agglomeration effects on firm-level productivity. Note that the cluster detection procedure proposed by Mori and Smith clearly separates agglomeration effects into localization and urbanization externalities. Then, using data derived from the cluster detection procedure, we construct alternative measures of localization and urbanization externalities and examine how they affect firm productivity.

Simultaneously, these effects are measured for three types of firmsstate-owned enterprises (SOEs), private firms, and foreign-owned firms. Particularly, SOEs need to be treated separately from other types of firms considering that the Vietnamese economy is in transition. As will be shown later, the effects of agglomeration economies on SOEs are significantly different from those on other types of firms.

Finally, we decompose the channels of agglomeration economies at work within clusters. Since Marshall's (1920) seminal study, the importance of agglomeration economies in improving productivity has been widely recognized. As he pointed out, there are three main sources of agglomeration economies: knowledge spillovers, inter-firm transaction relationships, and labor pooling. By using inter-industry relationships in each agglomeration effect (e.g., knowledge transfers, input-output linkages, and sharing types of workers), we build industry-level indices for each agglomeration effect in the cluster and further decompose it.

We find the following results. First, localization economies improve firm-level productivity in Vietnam, with firms in clustered areas exhibiting higher productivity. However, localization does not affect state-owned enterprises. Second, urbanization economies improve productivity only in foreign-owned firms. State-owned and private firms do not benefit from urbanization economies. These results imply that agglomeration economies, especially urbanization economies, may not be fully effective in Vietnam.

When examining the decomposition of the agglomeration effects, we find that agglomeration economies through transactions are effective only for private firms. In contrast, agglomeration economies through knowledge spillovers and labor pooling are effective for foreign-owned firms.

The rest of this article is organized as follows. The next section consists of a literature review. Section 3 describes the data. Section 4 explains our empirical strategy. Section 5 provides our main results. Finally, Section 6 concludes the study.

2. Literature review

Many empirical studies have investigated agglomeration economies. Such studies have, however, focused mainly on market-based countries like the US (e.g., Ciccone & Hall, 1996; Henderson, 2003) and the UK (e.g., Ciccone, 2002), while research on transition economies has been rare. Recently, there has been a growing body of empirical analysis on the effect of agglomeration economies in transition economies, such as China (e.g., Drucker & Feser, 2012; Fu & Hong, 2011; Lin, Li, & Yang, 2011); Ukraine (Vakhitov, 2008), and Vietnam (Ercole, 2013; Howard, Newman, Rand, & Tarp, 2014; Howard, Newman, & Tarp, 2016).

Despite the increasing importance of an industrial cluster policy for Vietnam (Ketels et al., 2010), studies on spatial agglomeration in Vietnam are still rare. In one such study, Ercole (2013) investigates agglomeration in Vietnam, finding that only a few regions are participating in the country's rapid economic growth, with economic activities highly concentrated in Ho Chi Minh City. Further, low-tech industries are more agglomerated than medium-high and high technology industries. In another study, Howard et al. (2016) identify the determinants of agglomeration in Vietnam by applying the approach of Ellison, Glaeser, and Kerr (2010). They find no robust determinants, with identified determinants varying with the choice of the agglomeration measure. This may be due to weak agglomeration in Vietnam. The research work most closely related to our study is Howard et al. (2014), who use total number of firms in a commune of Vietnam as the index for urbanization externalities and show that cluster size positively affects the productivity of private firms, SOEs, and foreign-owned firms. In work pertaining to China rather than Vietnam, Fu and Hong (2011) show that the productivity of SOEs is not affected by urbanization economies, which is similar to a result obtained in our study on Vietnam.

Our contribution to the existing literature is twofold. First, Howard et al. (2014) use the average productivity of firms (other than own firm) in a commune as an indicator of localization externalities. However, this does not capture the localization or concentration of manufacturing activities in specific regions. In contrast, we introduce a new localization index using the cluster detection procedure proposed by Mori and Smith. Our index captures the localization of manufacturing activities as illustrated by New Economic Geography (Fujita, Krugman, & Venables, 1999).

Our second contribution is the development of a new index of urbanization externalities, which reflects the number of clustered industries in each district. This index represents an advance over existing measures. First, as pointed out by Beaudry and Schiffauerova (2009), the aggregate number of economic agents, defined as firms, plants, or employees, which is the measure used in Vakhitov (2008) and Howard et al. (2014), does not capture the diversity of activities. Second, the Herfindahl index, which is the measure used in Fu and Hong (2011), captures the diversity of industrial activities but does not account for the absolute size of each industry. In summary, the former captures only the size effect, while the latter accounts only for diversity. We devise a new index that captures both the size and the diversity of clusters.

3. Data

We use data from the fourth Establishment Census (2012) conducted by the General Statistics Office (GSO) of Vietnam. The census covers all economic entities, including enterprises (state-owned, private, and foreign-owned). The census was conducted among enterprises on April 1, 2012 (with a reference date of December 31, 2011), and among non-farm individual businesses on July 1, 2012 (with a reference date of July 1, 2012). The country had 341,600 enterprises as of December 31, 2011 and 4.63 million non-farm individual business establishments as of July 1, 2012.[1] The data we use in this study include location (district level),[2] ownership type (state-owned, private, foreign-owned), establishment code, industrial classification under Vietnam's Standard Industrial Classification (VSIC), number of workers, capital, and value added. We restrict the sample to manufacturing firms only.

To capture the three sources of agglomeration economies in inter-industry relationships, we use the following measures. To capture inter-industry transaction relationships, we use the 2012 input-output table provided by the GSO. The input-output table consists of an inter-industry transaction matrix with 164 $\times$ 164 sectors. By using the concordance provided by the GSO, we convert the matrix to the four-digit International Standards of Industrial Classification (ISIC). For the inter-industry knowledge spillovers measure, we use the results from a questionnaire survey included in the Establishment Census. This survey shows technology transfer from suppliers to enterprises and vice versa. Finally, for the labor pooling measure, we use the 2012 Vietnamese Household Living Standard survey, which provides information regarding the number of workers in each occupation of each industry.

4. Methodology

The purpose of this study is to estimate the effects of agglomeration on productivity. This section explains how to construct the measures of agglomeration and productivity and how to estimate the effects of agglomeration on productivity.

4.1. Measure of agglomeration

We apply the Mori and Smith (2014) methodology to identify the location of clusters for an industry; these clusters consist of combinations of contiguous districts. More precisely, we detect a cluster scheme $\mathbb{C}^*$ that maximizes the Bayesian information criterion (BIC) among each candidate cluster scheme $\mathbb{C}$ which includes one or more disjoint clusters, C_j, for j $= 1, \ldots, k_{\mathbb{C}}$,

$$BIC_{\mathbb{C}} = L_{\mathbb{C}}(\hat{P}_{\mathbb{C}}, |x) - \frac{k_{\mathbb{C}}}{2}\ln n, \quad (1)$$

where $L_{\mathbb{C}}(\hat{P}_{\mathbb{C}}, |x) = \sum_{j=1}^{k_{\mathbb{C}}} n_j(x) ln\hat{p}_{\mathbb{C}}(j) + \sum_{j=1}^{k_{\mathbb{C}}} \sum_{r \in C_j} n_r ln\frac{a_r}{a_{C_j}}$.[3] BIC increases with the log-likelihood of $\hat{P}_{\mathbb{C}}$ —the location probability of cluster scheme $\mathbb{C}$ —given an observed location pattern x; BIC decreases with the penalty term represented by $k_{\mathbb{C}}$, which expresses the number of clusters in the cluster scheme $\mathbb{C}$, and n, which expresses the number of establishments in all districts. The location probability of the cluster scheme $\mathbb{C}$for cluster j $= 1, \ldots, k_{\mathbb{C}}$, $p_{\mathbb{C}}(j)$ can be rewritten as $\hat{p}_{\mathbb{C}}(j) = n_j(x)/n$, where $n_j(x)$expresses the sum of the number of establishments in cluster $j = 1, \ldots, k_{\mathbb{C}}$. In the above log-likelihood functions, $n_j(x)$and n_r are related through a sequence of independent location decisions by individual establishments. Because each district is included as part of a certain cluster C_j or the residual set of non-cluster areas, the right-hand side of the log-likelihood function of the location probabilities (i.e. the probability that a randomly sampled establishment is located in a district within a certain cluster) expresses the law of total probability. That is to say, the log-likelihood function can be divided into two parts, namely, the first term, which gives the location probabilities that n_j establishments are located in a cluster C_j and the second term, which gives the location probability that n_r establishments are located in district r in cluster C_j given that the individual establishments choose their location completely randomly within each cluster. The location probability of district r under the condition that an establishment is located in a cluster C_j is a_r/a_{C_j}, where a_r expresses the economic area[4] in district r and a_{C_j} represents the economic area in a cluster C_j. We use the above information on industrial clusters to divide all districts in Vietnam into cluster and non-cluster areas for each industry.[5]

[1] The number of firms in Vietnam is very large. However, they are mostly micro and small enterprises. A similar tendency is observed in neighboring countries. The economic census of Lao PDR in 2006, for example, shows the total number of firms to be 126,913, and the share of micro and small enterprises (fewer than 50 employees) to be 99.6 percent of the total.

[2] We use the district as a geographical unit of analysis, because zoning and planning are determined at the district level (Howard et al., 2016).

[3] As the algorithm for this calculation is complex and its workload is extremely heavy, we used the supercomputer at the Academic Center for Computing and Media Studies (ACCMS), Kyoto University.

[4] The economic areas are obtained from the 2000 Global Land Cover by the Joint Research Center of the European Commission. Omitting any area that is not suitable for economic activity, we calculated the economic area of each district using the shape file of Vietnam.

[5] The recent trend in the index of industrial agglomeration is to test the "the null hypothesis" that spatial distribution could have emerged by chance (Ellison & Glaeser, 1997; Duranton & Overman, 2005; and Mori, Nishikimi, & Smith, 2005). Mori and Smith (2013) conducted a test of spurious clusters to examine whether the BIC of the detected cluster scheme is significantly higher than that under a random location pattern generated by a Monte Carlo test. As a result, only significant clusters are selected for analyzing industrial agglomerations.

4.2. Measure of productivity

To measure firm-level productivity, we assume the firm-level production function follows a Cobb-Douglas functional form:

$$lny_e = \beta_1 lnk_e + \beta_2 lnl_e + \varepsilon_e, \quad (2)$$

where y_e is the firm's value added and k_e and l_e are the capital and labor employed by firm e. We estimate Eq. (2) by the ordinary least squares (OLS) method and take the residual ε_e as the log of firm e's TFP.[6]

The parameters of the production function may differ across industries. Furthermore, possible inputs omitted in the estimation due to data availability such as land use and floor space may differ across industries. To address these issues, we estimate Eq. (2) by industry (the two-digit level in VSIC).

4.3. Estimation of agglomeration economies

Based on the measures described in the previous subsections, we estimate the agglomeration economies with the following equation:

$$ln\mathrm{TFP}_e = \alpha + \beta_1 \mathrm{agglom}_{er} + Z_{er}\delta + \varepsilon_{er}, \quad (3)$$

where agglom_r represents agglomeration in the district r in which firm e is located, Z_{er} is the vector of control variables, and ε_{er} is disturbance. The coefficient β_1 represents agglomeration economies.

Agglomeration economies can be classified into two types, localization economies and urbanization economies. Localization economies improve firm-level productivity through the agglomeration of firms within an industry (e.g., Glaeser, Kallal, Shainkman, & Shleifer, 1992). On the other hand, urbanization economies improve firm-level productivity through the diversity of industries (e.g., Jacobs, 1969). This study constructs a variable that allows for estimation of the effects of both types of agglomeration economies. As the variable for localization economies, we use a dummy variable equal to 1 if district r where firm e is located is detected as a cluster of industry i to which firm e belongs. This is an indicator variable that specifies whether the firm is located in its own industry cluster. In contrast, a variable for urbanization economies should represent the diversity of industries. The cluster-detecting methodology enables us to define the degree of urbanization by the number of cluster layers in different industries in a district. For district r, we count the number of industries that have a cluster there. The number of industries that have a cluster in a district represents the variety of clustered industries and is taken as the urbanization index for the district.

To control for unobserved heterogeneity across districts and industries, we include prefectural and industrial fixed effects. For industry classification, we use the two-digit VSIC code.

A major concern is that firm location choice may endogenous because high-productivity firms may choose to locate in highly agglomerated areas, which naturally increases firm productivity in those areas. We discuss this possibility for each type of firm. First, for SOEs it is well known that the location choice is often determined by political considerations rather than economic objectives. In particular, regional disparities are major political concerns for the Vietnamese government, and this may make it difficult for SOEs to choose their locations on economic grounds. Further, local favoritism is involved in directing public resources toward preferred groups in office holders' hometowns.[7] Such local favoritism may affect the location choice of SOEs.

Second, for private firms a significant proportion are micro and small enterprises established by owners in their home districts. This suggests that the location choice of these micro and small enterprises is not endogenously determined. The shares of private firms having less than 10 workers (micro enterprises) and less than 50 (micro and small enterprises) are 71 percent and 93 percent, respectively (calculated from Establishment Census, 2012). Moreover, as shown in Table 2, the number of private firms is much larger than the numbers of foreign-owned firms and SOEs. Therefore, the geographical distributions of Vietnamese firms are strongly influenced by private firms, especially micro and small enterprises.[8]

Finally, for foreign-owned firmsalthough there was a period (especially during the 1990s) when the government's active interventions helped to attract foreign-owned firms to Northern Vietnam[9] they can now choose their locations more freely. However, caution should be exercised in the case of areas where they are clustered. Foreign-owned firms are mostly

[6] OLS estimates could be biased due to the correlation between unobservable productivity shocks and the input level. However, we use OLS because census data for constructing a panel data set are not available. Moreover, the annual survey data, which were used by Ni, Spatareanu, Manole, and Otsuki, (2017), cannot be used for our model, because they do not cover all administrative areas in Vietnam. Of note, Ni et al. (2017), using the survey data for analysis of technological spillovers from FDI in Vietnam, found that the "coefficient estimates using OLS and OP (Olley & Pakes, 1996) do not differ substantially from each other [in Vietnam]."

[7] Do, Nguyen, and Tran (2017) empirically studied hometown favoritism in Vietnam, as it leads to the development of a broad range of hometown infrastructure.

[8] It should be noted that larger private firms could perhaps move freely in wider geographical areas, although the number of such firms is not very great.

[9] In comparison with China's FDI policy, which emphasizes technology and exports, Vietnam's FDI policy has focused on regional development in addition to exports and transfer of technology. Regional development has always been Vietnam's major concern, as the northern half of the country is traditionally poorer than the south, due to long wars and mismanagement under centrally planned systems. A well-known example of government intervention in foreign-owned firms' location choice is the case of the oil refinery project Dung-Quat, where Total Oil & Gas of France had the project approved but withdrew later over a disagreement with the government imposed location preference for Dung-Quat, based on regional development priority (Thuyet, 1999).

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clustered within industrial parks in the three metropolitan areas (i.e., Hanoi, Ho Chi Minh City, and Da Nang), which provide quality infrastructure and urban amenities for foreign workers, besides good access to markets and a skilled labor pool.

In sum, the location choices of firms are constrained by a host of factors, including the peculiarities of a transition economy. This implies that location choice depends importantly on exogenous influences.

However, even if location choice is constrained, locating in a cluster may increase firm productivity due to the more competitive environment found in agglomerated areas such that only high-productivity firms can survive. We check this possibility using the methodology of Combes et al. (2012), which is widely adopted in the literature. Agglomeration economies are beneficial for all firms in the clusters, while the competitive selection process drives out low-productivity firms. Combes et al. identify these selection effects from the shape of the distribution of firm productivity. Intuitively, agglomeration economies shift the distribution of firm productivity rightward by improving productivity of all firms in clusters, while selection left-truncates the distribution by eliminating low-productivity firms from clusters. Combes et al. distinguish the strength of the two types of forcesagglomeration and selectionby estimating the extent of the rightward shift and left truncation of the distribution of firm productivity within clusters.

4.4. Composition of the agglomeration measure

To compose the agglomeration measure, we construct an index for each agglomeration element. We assumed that an establishment benefits from agglomeration effects associated with the industry cluster to which it belongs.

First, we build a measure of inter-industry relationships. For inter-industry transaction relationships, we use input-output linkage information. Following the approach of Ellison et al. (2010), we use the 2012 Vietnam Input-Output table, which shows inter-industry transactions. We can estimate the strength of the input-output linkages by computing the input-output coefficients of the transaction matrix. To begin, we compute the proportion of total input that sector A purchases from sector B and vice versa and take the maximum of these input coefficients as a measure of the input linkages. We then calculate the proportion of its total output that sector A provides to sector B and vice versa and take the maximum of the output coefficients as a measure of the output linkages. Finally, we take the maximum of the above two measures to produce a measure of input-output linkages or transaction relationships. It is expected that firms in industries that are highly linked through transaction relationships are more likely to be located close to each other.

Second, for the knowledge spillovers measure, we follow Howard et al. (2016). The GSO survey contains information on the technology transfer from suppliers to firms. First, we construct a technology transfer variable by calculating the proportion of firms that received technology transfer from their suppliers, weighted according to the number of employees in each firm. Second, we form a matrix of inter-industry technology transfer by multiplying the weighted technology transfer variables by the input coefficients. Third, we take the maximum of the bilateral technology transfers between two sectors (say, from sector A to B and vice versa) to construct a measure of technology transfer from suppliers to firms. Fourth, using the information on technology transfer from firms to customers and the output coefficients, we construct a measure of technology transfer from firms to customers. Finally, we take the maximum of the above two measures to construct a measure of technology transfer or knowledge spillovers.

Third, for the labor pooling measure, we use information on the number of workers in each occupation in each industry to calculate the correlation coefficient between a pair of industries and use it as a measure of labor pooling between industries. It is expected that firms in industries with similar skill sets will be more likely to locate in close proximity.

The three inter-industry relationship measures form the basis for our agglomeration variables of type $t \in \{transaction, knowledge\,spillovers, labor\,pooling\}$ for firm e in industry i located in district r as follows:

$$AGG^t_{e(i)r} = \sum_j d_{jr} w^t_{ij}, \tag{4}$$

where d_{jr} is a cluster dummy that equals 1 if district r is detected as a cluster of industry j and w^t_{ij} is the strength of type t's inter-industry relationships between industries i and j.

Using the agglomeration variables from Eq. (4), we obtain estimates of agglomeration economies, β^t, from the following equation:

$$ln\mathrm{TFP}_{e(i)} = \alpha + \sum_t \beta^t \mathbf{AGG}^t_{e(i)r} + Z_{er}\delta + \varepsilon_{er}. \tag{5}$$

We also control for industry and province fixed effects.

5. Results

5.1. Descriptive statistics and distributional analysis

Descriptive statistics are shown in Table 1. Our data cover 42,389 observations. The average value added is 19,459 million Vietnamese dong (VND) (approximately 872 thousand USD). The average number of employees is 102, and the average capital 50,764 million VND. Standard deviations are quite high relative to means indicated very skewed distributions.

Table 1
Descriptive statistics.

Variables	Mean	SD
Value added (VND mil)	19,459	291,359
Eemployees (persons)	102	652
Capital (VND mil)	50,764	470,313
Ln (TFP)	0.24	1.22

Note: Number of observations is 42, 289.

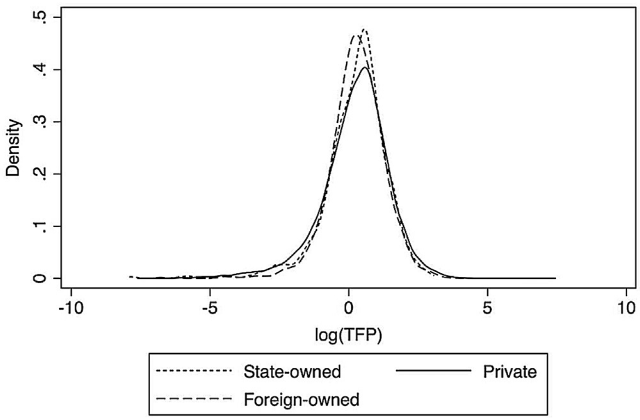

Fig. 1. TFP kernel density distributions by firm type.

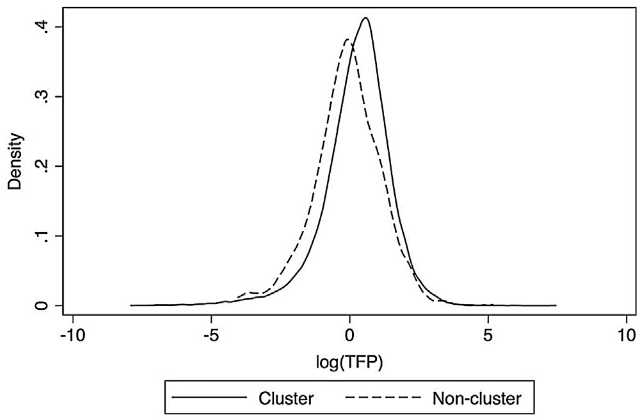

Fig. 2. TFP kernel density distributions in cluster and non-cluster areas.

For the three types of firms (state-owned, private, and foreign-owned), productivity may differ. We show the difference in the TFP distributions of these firm types in Fig. 1. The TFP distributions are not seemingly different across firm types, but the *t*-test shows that foreign-owned firms have significantly higher average TFP than private firms.[10]

We then move to the investigation of agglomeration economies. To investigate localization economies, we compare productivity distributions between cluster and non-cluster firms within an industry. Fig. 2 shows the TFP kernel density distributions in cluster and non-cluster areas. We observe that the peak of the distribution shifts rightward for firms in cluster areas. This suggests the existence of localization economies. Furthermore, the distribution becomes longer in the tails for firms in cluster areas. This implies that the lowest-productivity firms can survive only in clusters. This result contradicts previous research that emphasizes the selection mechanism in the clusters (e.g., Arimoto, Nakajima, & Okazaki, 2014).

[10] The average TFP (the log of TFP) of state-owned, private, and foreign-owned firms is 0.246, 0.232, and 0.289, respectively, among which only foreign-owned firms have significantly higher average TFP than private firms at the 5% significance level. In contrast, Ramsteter and Ngoc (2013) find that state-owned enterprises have significantly higher productivity compared to private firms.

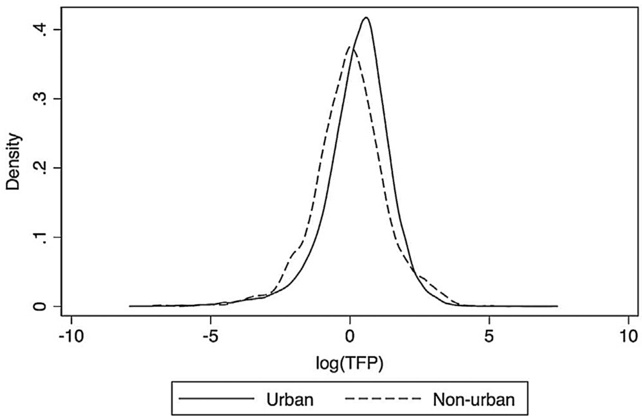

Fig. 3. TFP kernel density distributions in urbanized and non-urbanized areas.

Next, we investigate urbanization economies. We define urbanized areas by the number of industries that have clusters in a given region. Specifically, we calculate the number of industries that have clusters in each district and deem a district to be an urbanized area if the district has an above-median number of clustered industries. Fig. 3 shows the TFP kernel density distribution in urbanized and non-urbanized areas. For firms in urban areas, the peak of the distribution shifts rightward and the distribution becomes longer in right tail. This suggests the existence of urbanization economies.

The effects of agglomeration economies may differ across firm types. Therefore, we present the TFP distribution of urbanized and non-urbanized areas for each firm type. Fig. 4 shows the TFP kernel density distributions of state-owned enterprises in urbanized and non-urbanized areas. The two distributions do not have a different peak. Furthermore, the left tail of the distribution is longer for the firms in urbanized areas. This implies that low-productivity state-owned enterprises survive in urbanized areas.

Fig. 5 shows the TFP kernel density distribution of private firms in urbanized and non-urbanized areas. For firms in urbanized areas, the peak of the distribution shifts rightwards and the right tail of the distribution is longer. This implies that urbanization economies are effective for private firms.

Finally, Fig. 6 shows the TFP kernel density distribution of foreign-owned firms in urbanized and non-urbanized areas. For firms in urbanized areas, the peak of the distribution shifts strongly rightward. This implies that urbanization economies are particularly effective for foreign-owned firms.

Table 2 shows the TFP descriptive statistics by firm type and urbanized location. For state-owned enterprises, there is no difference in mean TFP between urban and non-urban areas. On the other hand, for private and foreign-owned firms, mean TFP is significantly higher in urban than in non-urban areas. These results imply that agglomeration economies are effective mainly for private and foreign firms.

Finally, urbanization economies may differ across industries. Table 3 shows the TFP descriptive statistics across industries. In 11 of the 22 industries, we find a statistically significant difference in mean TFP between urbanized and non-urbanized areas. The strength of the urbanization economies differs across industries. Most of the industries that have significant urbanization economies are light industries such as food, tobacco, textiles, and so on. This contradicts Henderson

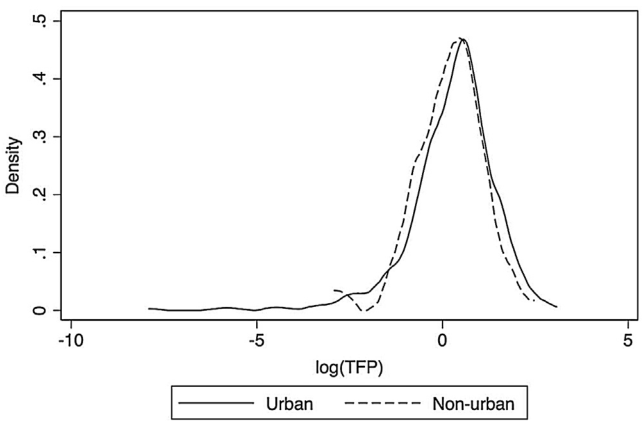

Fig. 4. TFP kernel density distributions of state-owned enterprises in urban and non-urban areas.

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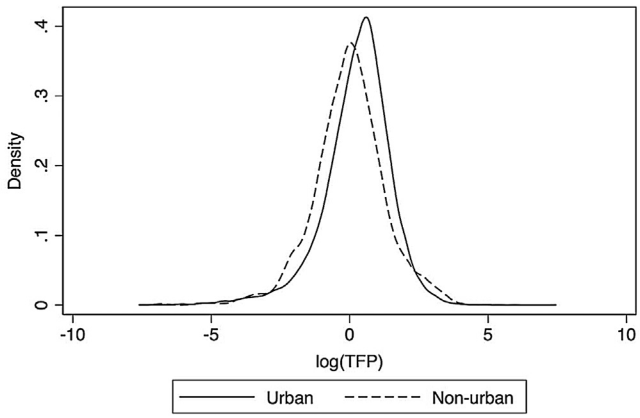

Fig. 5. TFP kernel density distributions of private firms in urban and non-urban areas.

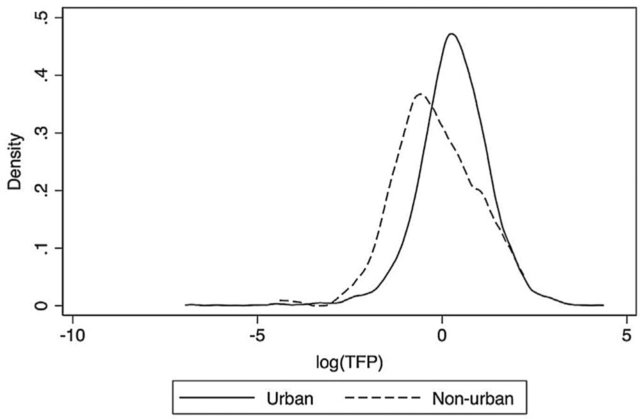

Fig. 6. TFP kernel density distributions of foreign-owned firms in urban and non-urban areas.

Table 2
TFP in urban and non-urban areas by firm type.

	Urban			Non-urban				
Types	Obs.	Mean	SD	Obs.	Mean	SD	p-value	$p < 0.05$
State-owned	549	0.265	1.181	63	0.161	0.958	0.552	
Private	41,229	0.255	1.238	3,840	−0.018	1.307	0.000	*
Foreign-owned	4,897	0.298	1.006	111	−0.174	1.119	0.000	*

(2003), who finds urbanization economies in the high-tech sector. In Vietnam, the high-tech sector is still developing and urbanization economies may be a result of large demand from urban areas.

5.2. Estimation results for the agglomeration economies

According to the descriptive statistics, we find the existence of both localization and urbanization economies, with the strength of these effects differing across firm types. This subsection formally tests these effects using regression analysis.

Table 4 shows the estimation results for Eq. (3) involving localization economies. Column (1) shows the results for all firm types. The coefficient for the localization dummy is positive and significant. This implies that there are localization economies that improve the productivity of firms located in clusters. Column (2) shows the results for state-owned enterprises. The coefficient for the localization dummy is positive but not significant. Therefore, for state-owned enterprises, firm-level productivity is not affected by locating in clusters; that is to say, localization economies are not effective for state-owned enterprises. Possible interpretations of this result are: (i) SOEs may lack regional linkages or absorptive capacity, as shown by the case of Chinese SOEs (Girma & Gong, 2008); and (ii) SOEs may lack the incentive to increase productivity due to

Table 3
TFP in urban and non-urban areas by ISIC.

	Urban			Non-urban				
ISIC	Obs.	Mean	SD	Obs.	Mean	SD	p-value	p < 0.05
10	4057	0.158	1.423	1247	0.385	1.377	0.000	*
11	1707	0.102	1.263	231	−0.01	1.303	0.252	
12	25	1.593	1.112	0				
13	2069	0.115	1.192	53	−0.551	1.258	0.000	*
14	4184	−0.109	1.161	144	−0.488	0.892	0.002	*
15	1168	−0.072	1.209	30	−0.314	0.848	0.361	
16	3168	0.302	1.315	882	−0.269	1.25	0.000	*
17	1797	0.552	1.026	42	−0.265	1.194	0.000	*
18	3438	0.662	1.105	38	0.301	0.9	0.074	
19	81	0.759	1.108	4	−0.675	2.236	0.021	*
20	1924	0.336	1.265	82	−0.277	1.541	0.000	*
21	336	0.564	1.054	7	0.039	0.851	0.192	
22	3265	0.462	1.191	42	0.143	0.985	0.126	
23	3079	0.205	1.147	546	−0.195	1.081	0.000	*
24	947	0.67	1.235	29	0.227	0.934	0.065	
25	7754	0.278	1.127	292	−0.034	1.177	0.000	*
26	609	0.015	1.187	6	−0.667	0.704	0.200	
27	1037	0.22	1.124	2	−0.739	1.737	0.229	
28	1173	0.469	1.057	22	0.028	1.243	0.073	
29	346	0.439	1.117	3	−0.808	2.126	0.118	
30	542	0.05	1.167	43	−0.311	0.97	0.075	
31	2853	0.141	1.156	235	−0.47	1.249	0.000	*
32	1116	0.016	1.245	34	−0.534	1.66	0.028	*

Table 4
Regression results for localization economies.

	(1) All	(2) State	(3) Private	(4) Foreign
Localization dummy	0.155***	0.153	0.152***	0.367**
	(3.750)	(0.575)	(3.551)	(2.570)
Industry fixed effects	yes	yes	yes	yes
Province fixed effects	yes	yes	yes	yes
Observations	42,289	587	37,122	4,580
R-squared	0.056	0.323	0.057	0.130

Note: Robust t-statistics are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

soft budget constraints (Vu-Thanh, 2017) and business objectives and missions that are unclear (Deepak, 2011). Column (3) shows the results for private firms. The coefficient for the localization dummy is positive and significant. Localization economies do function for private firms. Finally, Column (4) shows the results for foreign-owned firms. Similar to the results for private firms, the coefficient for the localization dummy is positive and significant, but the magnitude is much larger than that for private firms. Foreign-owned firms, therefore, benefit more from localization economies.

For a robustness check of the productivity measure, we use labor productivity (i.e., value added per worker) as a measure of productivity and conduct a similar analysis. Results, shown in Appendix Table A1, are qualitatively unchanged. Other than for SOEs, localization economies are significantly positive.

As discussed in Section 4.3, higher productivity for firms in the clusters could be due to selection. To test this possibility, we apply the methodology of Combes et al. (2012) to distinguish agglomeration economies from selection effects. The results are shown in Table 5. Column (1) shows results for all firms. Agglomeration economies are significantly positive. Furthermore, an estimate of the dilation parameter of less than 1 implies that the benefit of agglomeration is larger for low-productivity firms. In addition, we observe negative and significant left-truncation from the results, which indicates that rather than selection eliminating low productivity firms, a larger number of such firms are present in the clusters. This suggests that higher productivity in the clusters is due to agglomeration economies, not selection. Column (2) shows the results for state-owned enterprises. None of the effects is significant. Column (3) shows the results for private firms. These results are similar to those for all firms. Column (4) presents the results for foreign-owned firms and it can be seen that agglomeration effects are positive and significant. However, selection effects are not significant. On the whole, these results suggest that left truncation of the distribution, indicating that tough competition in agglomerated areas drives out low productivity firms, is not observed in Vietnam.

We then consider urbanization economies. The results are shown in Table 6. Column (1) shows the results for all firms. The coefficient for the urbanization variable is positive but not significant. This implies that urbanization economies do not

Table 5
Regression results to distinguish agglomeration and selection effects.

	(1) All	(2) State	(3) Private	(4) Foreign
Shift (agglomeration economies)	0.421***	−0.017	0.440***	0.639**
	(0.025)	(0.407)	(0.028)	(0.269)
Dilation (heterogeneous impact of agglomeration)	0.837***	1.238	0.832***	0.637***
	(0.019)	(0.344)	(0.019)	(0.121)
Left-truncation (selection)	−0.076***	0.058	−0.087***	−0.244
	(0.012)	(0.267)	(0.014)	(0.639)
Observations	38,056	545	33,197	4,314

Note: We use observations from the 5th to 95th percentile of the TFP distribution to remove outliers. *** $p < 0.01$. Null hypotheses are as follows: Shift = 0; Dilation = 1; Left truncation = 0.

Table 6
Regression results for urbanization economies.

	(1) All	(2) State	(3) Private	(4) Foreign
Urbanization dummy	0.00123	−0.00114	0.00120	0.00274***
	(1.183)	(-0.424)	(1.014)	(3.126)
Industry fixed effects	yes	yes	yes	yes
Province fixed effects	yes	yes	yes	yes
Observations	42,289	587	37,122	4,580
R-squared	0.056	0.323	0.057	0.131

Note: Robust t-statistics are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

improve firm productivity overall in Vietnam. This weak urbanization effect is consistent with the findings of Henderson (2003). Column (2) shows the results for state-owned enterprises. The coefficient for the urbanization variable is negative but not significant.[11] Column (3) shows the results for private firms. The coefficient for the urbanization variable is positive but not significant. Finally, Column (4) shows the results for foreign-owned firms. The coefficient for the urbanization variable is positive and significant at the 1% level. Therefore, in Vietnam, urbanization economies act only on foreign-owned firms to improve productivity.

For a robustness check, we estimate the effect of urbanization economices using labor productivity rather than TFP as the dependent variable, with results shown in Appendix Table A2. The results are qualitatively unchanged, except that the coefficient for urbanization economies turns insignificant even for foreign-owned firms.

Another concern is that urbanization economies may arise over a wider geographic range (instead of at district level). It has been observed that different industries localize in different geographical ranges (e.g., Duranton & Overman, 2005; Nakajima, Saito, & Uesugi, 2012). Our definition of urbanization, namely the number of clustered industries in each district may overlook this possibility, and thus we extend the geographical range for the urbanization index. We count the number of clustered industries in each district and the adjoining districts for the extended urbanization index.

The results are shown in Table 7, and are qualitatively similar to those in Table 6. However, in the estimation for all firms, urbanization economies become significantly positive at the 10 percent level (Column (1)). This implies that urbanization economies have a wider geographical range across firm types generally. Moreover, when labor productivity is used as a measure of productivity, urbanization economies become significant for all firms at the 1 percent level and for private firms at the 5 percent level as shown in Appendix Table A3.

5.3. Decomposition of agglomeration economies

The estimation results for the decomposition of agglomeration economies (Eq. (5)) are shown in Table 8. Column (1) shows the results for all firms. The coefficient for transactions is positive and significant. This suggests that when firms in clusters are closely related through transaction relationships, they achieve higher productivity. The other agglomeration economies are not significant for all firms.

Column (2) shows the results for state-owned enterprises. None of the agglomeration effects are significant, implying that state-owned enterprises do not benefit from any type of agglomeration economies. Likewise, these results are observed

[11] Fu and Hong (2011) obtain similar results on urbanization externalities of SOEs as well as non-SOEs. However, Fu and Hong use the one-digit industry classification, while the present study uses the four-digit industry classification. Therefore, caution should be exercised in interpreting their results. On the other hand, our results differ from those of Howard et al. (2014), which demonstrate positive urbanization externalities for SOEs. This may be caused by the fact that Howard et al. use a commune as the unit of a regional boundary, while the present study uses a district. As shown by Rosenthal and Strange (2003), agglomeration effects may attenuate at a short distance.

Table 7
Estimation results for urbanization economies using extended measure.

	(1) All	(2) State	(3) Private	(4) Foreign
Urbanization dummy	0.00124*	0.000436	0.00122	0.00323**
	(1.702)	(0.150)	(1.599)	(2.270)
Industry fixed effects	yes	yes	yes	yes
Province fixed effects	yes	yes	yes	yes
Observations	42,289	587	37,122	4,580
R-squared	0.056	0.323	0.057	0.131

Note: The extended urbanization measure includes adjoining districts to define regional boundaries. Robust t-statistics are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 8
Estimation results for agglomeration economies decomposition.

	(1) All	(2) State	(3) Private	(4) Foreign
Transactions	0.0290***	0.0237	0.0347***	−0.00964
	(3.318)	(0.385)	(3.671)	(-0.852)
Knowledge spillovers	−0.0549	−0.108	−0.0767	0.145**
	(-0.984)	(-0.392)	(-1.252)	(2.339)
Labor pooling	0.00244	0.00123	0.00224	0.00442**
	(1.436)	(0.239)	(1.197)	(2.077)
Industry fixed effects	yes	yes	yes	yes
Province fixed effects	yes	yes	yes	yes
Observations	42,286	587	37,119	4,580
R-squared	0.057	0.323	0.058	0.132

Note: Robust t-statistics are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

when labor productivity is used as a measure of productivity, with results shown in Appendix Table A4. This is consistent with the above baseline analysis that finds neither localization nor urbanization economies for state-owned enterprises.

Column (3) shows the results for private firms. As with the full sample of firms, the coefficient for transactions is positive and significant. When we use labor productivity as a measure of productivity, labor pooling becomes significant at the 10 percent level, implying that agglomeration economies for private firms are effective mainly through inter-firm transactions and partially through labor pooling.

Finally, Column (4) shows the results for foreign-owned firms. The patterns are very different compared to other firm types. The coefficients for labor pooling and knowledge spillovers are significant and positive, although when using labor productivity as the dependent variable, labor pooling becomes insignificant. Therefore, agglomeration economies for foreign-owned firms are derived mainly from knowledge spillovers. Foreign-owned firms use relatively advanced technology in comparison with local firms, and thus it is natural that knowledge spillovers are beneficial for foreign-owned firms. With respect to labor pooling, we note that foreign-owned firms employ a large number of workers in each plant. Thus a strong supply of specialized workers, especially in urban areas, would be beneficial. On the other hand, unlike private firms, foreign-owned firms do not benefit from inter-firm transactions. Since a supplier base is still weak in Vietnam, foreign-owned firms maintain close links with international markets, and thus there is little room to enjoy the benefit of local sourcing and procurement.

6. Conclusion

This study examines the effects of agglomeration economies on firm-level productivity in Vietnam using the cluster detection method proposed by Mori and Smith (2014). Specifically, we consider the different effects of localization and urbanization economies across firm types—state-owned, private, and foreign-owned.

We find the following results. First, localization economies improve firm-level productivity in Vietnam, with firms clustered in areas with other firms of the same industry generally exhibiting higher productivity. However, localization economies do not apply to state-owned enterprises. Second, urbanization economies improve productivity only for foreign-owned firms. State-owned and private firms do not benefit from urbanization economies. These results imply that agglomeration economies, especially urbanization economies, may not be fully effective in Vietnam. The weak urbanization economies are consistent with previous studies such as Henderson (2003), which only find urbanization effects in high-tech industries.

In economies under transition, state-owned enterprises have distinct characteristics in comparison with other types of firms. In Vietnam, state-owned enterprises do not necessarily have lower productivity than other types of firms. However, they do not benefit from either localization or urbanization economies. It can be presumed that the location choices of state-owned enterprises, which are partly determined by political considerations, do not enable them to pursue the benefits of agglomeration.

Foreign-owned firms, which are a growing presence in Vietnam, greatly benefit from both localization and urbanization economies. Furthermore, the sources of agglomeration economies for foreign-owned firms differ from those of private firms. For foreign-owned firms, knowledge spillovers and labor pooling are the drivers of agglomeration economies. By contrast, for private firms the source of agglomeration economies is local transactions. These findings are consistent with foreign firms being more knowledge intensive and larger and relying more on international than local transactions.

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Appendix A. Regression results using labor productivity as the dependent variable

Table A1
Regression results for localization economies.

	(1) All	(2) State	(3) Private	(4) Foreign
Localization dummy	0.227***	0.292	0.201***	0.526***
	(4.774)	(0.804)	(4.158)	(2.719)
Industry fixed effects	yes	yes	yes	yes
Province fixed effects	yes	yes	yes	yes
Observations	44,818	596	39,558	4,664
R-squared	0.105	0.364	0.097	0.251

Note: Robust t-statistics are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A2
Regression results for urbanization economies.

	(1) All	(2) State	(3) Private	(4) Foreign
Urbanization dummy	0.00218	0.00241	0.00253	0.000559
	(1.300)	(0.723)	(1.399)	(0.382)
Industry fixed effects	yes	yes	yes	yes
Province fixed effects	yes	yes	yes	yes
Observations	44,818	596	39,558	4,664
R-squared	0.105	0.364	0.097	0.250

Note: Robust t-statistics are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A3
Estimation results for urbanization economies using extended measure.

	(1) All	(2) State	(3) Private	(4) Foreign
Urbanization dummy	0.00319***	0.00252	0.00257**	0.00356*
	(2.652)	(0.582)	(2.221)	(1.655)
Industry fixed effects	yes	yes	yes	yes
Province fixed effects	yes	yes	yes	yes
Observations	42,289	587	37,122	4,580
R-squared	0.056	0.323	0.057	0.131

Note: The extended urbanization measure includes adjoining districts to define regional boundaries. Robust t-statistics are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A4
Estimation results for agglomeration economies decomposition.

	(1) All	(2) State	(3) Private	(4) Foreign
Transactions	0.0336***	0.00933	0.0433***	−0.0245
	(2.787)	(0.131)	(3.433)	(-1.502)
Knowledge spillovers	−0.0267	0.0107	−0.0850	0.278***
	(-0.333)	(0.0329)	(-1.003)	(3.299)
Labor pooling	0.00392	0.00356	0.00473*	−0.000234
	(1.527)	(0.525)	(1.726)	(-0.0691)
Industry fixed effects	yes	yes	yes	yes
Province fixed effects	yes	yes	yes	yes
Observations	44,818	596	39,558	4,664
R-squared	0.106	0.364	0.098	0.251

Note: Robust t-statistics are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

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