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DOES FIRM OWNERSHIP AFFECT SPILLOVER OPPORTUNITIES? EVIDENCE FROM CHINESE MANUFACTURING*

Fariha Kamal

U.S. Census Bureau, Center for Economic Studies, 4600 Silver Hill Road, Washington, DC, 20233
E-mail: fariha.kamal@census.gov

ABSTRACT. The clustering of economic activity is believed to generate both positive own-industry (localization) spillovers and negative competitive pressures. Using data on manufacturing enterprises operating in China during 1998–2006, this paper provides evidence on the net effect of opposing spillovers from nearby economic activity. Central to the analysis is the opportunity to distinguish local manufacturing enterprises by state, private, or foreign ownership. Systematic differences in average productivity of these firms enable inferences about differences in the strength of spillovers from one type of firm to another type. Results indicate that spillovers are larger *within* the same ownership type than they are *across* them, consistent with localization economies that operate within segmented channels of influence.

1. INTRODUCTION

The clustering of economic activity has long been considered to create opportunities for own-industry (localization) spillovers in the urban economics literature (Marshall, 1920).[1] The international economics literature has further focused on spillovers transmitted across countries as a result of activities of foreign firms (Blomström and Kokko, 1998; Görg and Greenaway, 2004). However, systematic studies employing firm-level data to estimate spillovers from domestic to foreign, between domestic, or between foreign firms are less prevalent.[2] This paper combines insights on the nature and scope of spillovers from the urban and international economics literatures to address this gap by studying the role of firm ownership structure in shaping the gains from spillovers arising in the presence of agglomerations of economic activity.

I estimate differences in the strength of localization spillovers within and across ownership types using data on manufacturing enterprises operating in China during 1998–2006. The data are drawn from the Annual Surveys of Industrial Production.[3]

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[1]I use the term spillover throughout this paper to mean horizontal or intra-industry spillovers. Vertical or inter-industry spillovers are not considered in this paper.

[2]Few exceptions include Li, Liu, and Parker (2001) and Chang and Xu (2008) who consider spillovers from domestic to foreign firms.

[3]The Annual Surveys of Industrial Production is not a plant level data set. However, the majority of observations are of single-plant operations mitigating concerns about measurement error in the localization variables. See Section 2 for a detailed discussion.

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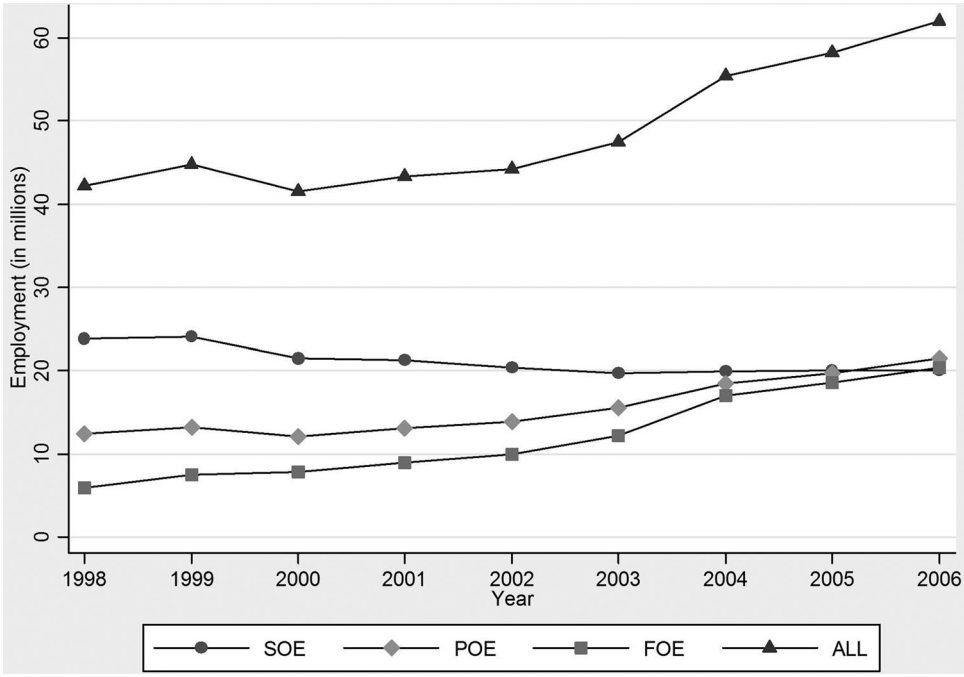

Note: State-owned enterprise (SOE), private owned enterprise (POE), foreign owned enterprise (FOE); all enterprises (ALL).

Source: Author's calculations using the Annual Surveys of Industrial Production.

FIGURE 1: Employment, by Ownership Type, 1998–2006.

The data set contains detailed information on the ownership structure of an enterprise in addition to enterprise-level inputs and output.[4] I estimate an augmented production function for enterprises in each ownership type, including measures of intra-industry employment differentiated by ownership types within a Chinese city. In addition, the preferred specification includes four-digit Chinese industry and city by year fixed effects to control for a range of industry-specific and time varying city-level characteristics that potentially impact enterprise-level productivity.

China provides a unique setting to investigate heterogeneity in firms' responses to economic activity within own and across ownership types due to the coexistence of enterprises under various ownership structures.[5] Since opening its economy in 1978, China's economic landscape has transformed from being entirely composed of state-owned enterprises (SOEs) to one shared by private and foreign-owned enterprises (FOEs). For instance, in 1980, SOEs accounted for 81 percent of industrial output and only 41 percent in 2005; private-owned enterprises (POEs) and FOEs accounted for 27 percent and 30 percent of total industrial output, respectively, in 2005 (Perkins and Rawski, 2008). Figure 1 depicts total employment in each ownership category during the sample period showing

[4]Ownership is identified using the registration status code, reported by China's National Bureau of Statistics that is assigned at the time of establishment of the firm. See Section 3.1 for further details.

[5]See Naughton (2007, pp. 298–304) for a history on the evolution of various ownership types in China.

TABLE 1: Distribution of Firms by Various Ownership Classifications, Selected Years

	1998	2002	2006	% Δ (2006–1998)
Panel A: Number of Firms in Sample				
State owned	42,080	42,346	54,758	30
Private owned	58,167	80,081	156,984	170
Foreign owned	21,607	31,779	58,024	169
Panel B: Percent Share in Sample				
State owned	34.53	27.46	20.30	
Private owned	47.73	51.93	58.19	
Foreign owned	17.73	20.61	21.51	

Note: The table displays the number of manufacturing firms in the raw data.
Source: Authors' calculations from Annual Surveys of Industrial Production, selected years.

a decline in the state-owned sector while employment in the private and foreign sectors increases steadily over time. Table 1 shows that by 2006, state-owned firms represented only 20 percent of all firms in the sample.

Firms operating in China can further be ranked along a well-established productivity hierarchy. On average, FOEs are more productive than their domestic counterparts; and among domestic-owned enterprises, POEs are more productive compared to SOEs (Zhang, Zhang, and Zhao, 2001; Wen, Li, and Lloyd, 2002; Hu et al., 2003). Ownership type of an enterprise embodies enterprise-specific assets such as technology, brand name, managerial expertise, local networks, and the like that are associated with productivity.[6] In this sense, ownership structure reflects firm productive capabilities and the above described hierarchy facilitates analysis of the equilibrium pattern of spillovers among the three ownership types and draw inferences about the various channels that may be at work.

Marshall (1920) posited that input sharing, labor market pooling, and knowledge spillovers are the primary channels for the transmission of localization economies (Gallagher, 2013; Abel, Dey, and Gabe, 2012; Ghinamo, 2012; Marrocu, Paci, and Usai, 2013; provide recent empirical evidence). Spillovers from foreign firms are thought to occur via the channels of demonstration, imitation, labor mobility, exports, and competition (Crespo and Fontura, 2007).[7] However, input competition, particularly for skilled labor, could diminish the gains of locating in close proximity to own-industry activity (Combes and Duranton, 2006) as well as output market competition that may cause less productive domestic firms to lose market shares to more productive foreign firms (Aitken and Harrison, 1999). I estimate net spillover effects between and across state, private and foreign firms operating within the same four-digit industry and Chinese city.

This paper offers two core results. First, within the same ownership type (own-type), I find evidence of traditional localization economies consistent with a large literature on agglomeration economies.[8] Second, across different ownership types (cross-type), spillovers differ in two ways. They tend to be much weaker compared to own-type spillovers and spillovers from more productive foreign to less productive domestic enterprises are smaller compared to spillovers in the reverse direction.

[6]See Syverson (2011) for a survey of firm-specific factors that affect productivity.

[7]Crespo and Fontura (2007) also include backward and forward linkages with domestic firms as an additional spillover channel. I have excluded this in my discussion since this paper only considers horizontal spillovers.

[8]See Rosenthal and Strange (2004) and Puga (2010) for surveys of the empirical evidence on agglomeration economies.

As an additional exercise, I decompose foreign enterprises into those originating from ethnically Chinese economies (ECEs) and primarily from Organization of Economic Co-operation and Development (OECD) countries (non-ECEs). The basic patterns discussed above still persist. In addition, we observe that when foreign spillovers are present, POEs are more likely to benefit than SOEs. Notably, I find that nearby activity in ECEs has no impact on productivity of non-ECEs and vice versa. This result offers preliminary evidence on relationships between foreign firms, particularly between those operating at different technology levels.[9]

The paper is organized as follows: Section 2 develops and presents the hypotheses to be tested and discusses estimation issues. Section 3 describes the data and measurement of key variables. Section 4 discusses the empirical findings and the final section concludes.

2. EMPIRICAL STRATEGY AND ESTIMATION ISSUES

To examine the relationship between enterprise productivity and manufacturing activity by ownership types within the same industry and Chinese city, I divide the data into three samples—state, private, and foreign owned. This division is motivated by the productivity hierarchy present in the Chinese manufacturing sector where foreign-owned firms are on average more productive than private-owned firms who are in turn more productive than their state-owned counterparts. A large literature on foreign direct investment (FDI) has documented the superior performance of multinational companies relative to firms in their host countries (Arnold and Javorcik, 2009). The superior efficiency of private versus state-owned firms has also been documented in countries other than China (Megginson and Netter, 2001).

Although we observe equilibrium outcomes that reflect the net effect between positive spillovers and negative competition effects, we can make inferences about the spillover channels that may be at play by analyzing the relative strengths of spillovers by ownership type. Spillovers can be expected to be strongest in the presence of positive localization economies, often called Marshallian externalities, that are thought to operate via segmented channels of input sharing, labor pooling, and knowledge spillovers. FDI spillovers, in particular, will be strongest when domestic firms are able to imitate new products or processes at foreign firms; hire foreign trained labor who may carry codified knowledge; or through knowledge spillovers that might result from foreign firms' use of advanced technology.

However, more productive foreign firms are also known to place competitive pressures on less productive domestic firms in both input and output markets. Foreign presence can reduce domestic firm productivity if domestic firms have to spread the fixed costs of production over a smaller market. In addition, higher wages at foreign firms could attract skilled labor away from domestic firms. We could expect that along with positive spillover forces, firms higher in the productivity hierarchy would exert negative competitive pressures on those lower in the hierarchy thereby diminishing the strength of positive spillover effects. This implies that, *a priori*, we may expect spillovers within the same ownership type to be strongest while they attenuate across ownership types. The following testable hypotheses emerge from the preceding discussion.

Hypothesis 1: Spillovers are expected to attenuate as they become more dissimilar in ownership space.

[9]See Hu, Jefferson, and Jinchang (2005) for a discussion of technology differences between ECE and non-ECE firms operating in China.

TABLE 2: Expected Signs of Spillover Variables

	Productivity of Firms in:		
	State Owned	Private Owned	Foreign Owned
Spillovers from:			
State owned	+	−	−
Private owned	±	+	−
Foreign owned	±	±	+

Notes: The table summarizes the expected signs of the three spillover variables by ownership type (measured as intra-industry employment within a Chinese city) on the productivity (measured as value added) of firms in each of these three ownership groups. "+" indicates a positive effect; "±" indicates that the spillover effect might be positive or negative; "−" indicates that, *a priori*, the sign cannot be determined.

Hypothesis 2: Spillovers within the same ownership type are expected to be positive and larger compared to spillovers across different ownership types.

I estimate the following augmented production function that includes measures of intra-industry employment within a Chinese city, differentiated by ownership types, as explanatory variables:[10]

$$\ln Y_{foict} = \beta_0 + \beta_1 \ln L_{foict} + \beta_2 \ln K_{foict} + \gamma_o^{\mathrm{SOE}} \ln(A_{ict})_{\mathrm{SOE}} + \gamma_o^{\mathrm{POE}} \ln(A_{ict})_{\mathrm{POE}} + \gamma_o^{\mathrm{FOE}} \ln(A_{ict})_{\mathrm{FOE}} + \mu_i + \delta_c + \varphi_t + \varepsilon_{foict}, \quad (1)$$

where Y_{foict} is real value added, L_{foict} is total employment, and K_{foict} is real fixed assets of enterprise f, under ownership type o, in industry i, city c at time t; $(A_{ict})_{\mathrm{SOE}}$, $(A_{ict})_{\mathrm{POE}}$, and $(A_{ict})_{\mathrm{FOE}}$ represent intra-industry employment within a city at time t under SOE, POE, and FOE types, respectively; μ_i denotes a set of four-digit industry dummies; δ_c a set of city dummies; and φ_t a set of year dummies; and ε_{foict} captures idiosyncratic differences in enterprise-level value added.

Each set of fixed effects controls for various types of unobservable factors that could affect enterprise-level productivity. Industry dummies control for industry-specific technology, skill requirements, and other common shocks. City dummies control for location-specific natural resources, infrastructure, and local policies. For example, several cities and parts of cities in China are designated as special economic zones and other special economic areas such as economic and technological development area, hi-technology development areas, and export processing zones (Wang and Wei, 2010). These areas were primarily set up to encourage interactions between foreign and domestic firms in the hopes of realizing positive externalities. Without city-level controls or city dummies, effects of such policies on productivity would be incorrectly attributed to the localization variables. City dummies further absorb any aggregate employment or urbanization effect. Time dummies control for macroeconomic shocks such as inflation, China's accession to the World Trade Organization (WTO), and other national-level shocks.

The net spillover effects are captured by γ_0^{SOE}, γ_0^{POE}, and γ_0^{FOE} where o can be state, private or foreign owned. For example, $\gamma_{\mathrm{POE}}^{\mathrm{SOE}}$, $\gamma_{\mathrm{POE}}^{\mathrm{POE}}$, $\gamma_{\mathrm{POE}}^{\mathrm{FOE}}$, capture the impact of intra-industry employment in the state, private, and foreign-owned sectors, respectively, on the productivity of private enterprises within a Chinese city. Table 2 summarizes the expected signs of the three spillover variables on firm productivity by ownership type. We

[10]This is a log-linearized equation derived assuming a Cobb-Douglas production function for enterprise f, $Y_{foict} = L_{foict}^{\beta_1} K_{foict}^{\beta_2} \prod_{o=1}^{3} A_{oict}^{\gamma}$, where Y is output, L is labor, K is capital, and A is a measure of intra-industry activity under each of the three ownership types (o), industry (i), and city (c) at time (t).

expect spillovers within the same ownership type, represented by the diagonal terms, to be positive and larger compared to cross-type spillovers.

Cross-type spillovers, those originating from firms both higher and lower in the productivity hierarchy, are represented by the off diagonal terms. The lower left quadrant depicts spillovers from foreign to domestic-owned firms and from private to state-owned firms. Since these spillovers originate from firms higher in the productivity ranking, competition might diminish the strength of positive localization economies. The upper right quadrant depicts spillovers from state and private to foreign-owned firms and from state to private-owned firms. Since these spillovers originate from firms lower in the productivity ranking it is ambiguous as to what we may expect in terms of the relative strength of spillovers except that they are likely to be smaller compared to within-type spillovers. Therefore, the signs of these spillovers are an empirical question.

An alternative strategy to Equation (1) is to estimate the total factor productivity (TFP) for each enterprise and then regress enterprise-level TFP on the agglomeration measures. The results are robust to this alternative lending confidence that they are not driven by specification of the production function.[11]

Estimation Issues

In estimating own and cross-type localization spillovers, there are three estimation issues of particular concern. First, selection bias is a likely issue in the Chinese context. The sample years coincide with a period of rapid privatization of SOEs. There might be concern that unproductive SOEs were disproportionately being privatized during this period so that relatively productive enterprises remained in the state-owned category. This selection could lead to a positive correlation between productivity of SOEs and economic activity under the three ownership types. In order to address such concerns, I consider a balanced panel of SOEs, constructed to include only those enterprises that were state owned in 1998 and remained state owned throughout the entire sample period.

The second concern is measurement error in the key variables of interest, intra-industry employment within a city organized by ownership type. In the context of this study, measurement error arises when employment at a multiplant firm is allocated to a particular location when in fact the employment is located across a number of different locations. The Annual Surveys of Industrial Production collects observations at the firm level. In principle, this creates ambiguity as to where a firm's workers are located and could therefore complicate efforts to measure the degree of employment agglomeration in a given location and industry. Fortunately, this issue turns out to be much less of a concern than might otherwise be feared.

Over 95 percent of all firms in the analysis sample are single-plant firms (Brandt, Van Biesebroeck, and Zhang, 2011). Table 3 indicates that the number of multiplant firms is decreasing over time. This trend can be explained by observing that SOEs have the largest share of multiplant firms compared to private and FOEs. Table 4 shows that the share of employment represented by single-plant firms within each ownership type is lowest in SOEs. Beginning in the mid nineties, the Chinese government aggressively privatized SOEs, leading to massive reorganization that decreased the number of SOEs and hence number of multiplant firms. This implies that any measurement error issue will be more pronounced for measures of economic activity for the sample of SOEs compared to the sample of private and foreign firms. The main results are carried out on the sample

[11]Results are available upon request. Firm TFP is constructed using a semiparametric method proposed by Olley and Pakes (1996).

TABLE 3: Distribution of enterprises by number of plants (percentage), 1998–2006

Year	Single-Plant Firms	Firms with two Plants	Firms with 3+ Plants
1998	96.69	1.43	1.88
1999	95.58	1.40	3.02
2000	97.09	1.15	1.76
2001	95.35	1.89	2.76
2002	94.97	2.30	2.73
2003	96.76	1.49	1.75
2004	95.60	2.42	1.98
2005	97.00	1.57	1.43
2006	97.40	1.38	1.22

Notes: Enterprises with missing information on number of plants have been excluded.
Source: Author's calculations using the Annual Surveys of Industrial Production.

TABLE 4: Percentage share of employment represented by single-Plant enterprises within each ownership type, 1998–2006

Year	State Owned	Private Owned	ECE	non-ECE
1998	79	94	99	99
1999	75	94	98	98
2000	77	95	99	98
2001	64	89	97	95
2002	65	90	96	94
2003	76	95	98	98
2004	67	92	96	93
2005	72	94	97	96
2006	73	95	97	94

Notes: Enterprises with missing information on number of plants have been excluded; ECE (enterprises from Hong Kong, Macao, Taiwan), non-ECE (enterprises from all other countries).
Source: Author's calculations using the Annual Surveys of Industrial Production.

of single-plant firms and localization measures derived from employment in single-plant firms only. The basic patterns in the results remain qualitatively unchanged when pooling all firms.

Finally, after controlling for industry, city, and time-specific unobservable variables it is still possible that time-varying unobservables remain which are correlated with the error term. For example, policies set at the level of the central government that are implemented at different times at the city level will not be picked up by city fixed effects alone. In particular, privatization of SOEs is carried out at the level of the city government and the pace and time of implementation varies across cities and time. Controlling for city-time effects also captures the potential influence of unobservable variables that might be correlated with the error term but that might have drawn in talented entrepreneurs to a city. Therefore, city by year fixed effects replace city and year fixed effects in Equation (1).

$$\begin{aligned}\ln Y_{foict} = {} & \beta_0 + \beta_1 \ln L_{foict} + \beta_2 \ln K_{foict} + \gamma_0^{\mathrm{SOE}} \ln(A_{ict})_{\mathrm{SOE}} + \gamma_0^{\mathrm{POE}} \ln(A_{ict})_{\mathrm{POE}} \\ & + \gamma_0^{\mathrm{FOE}} \ln(A_{ict})_{\mathrm{FOE}} + \mu_i + (\delta_c * \varphi_t) + \varepsilon_{foict},\end{aligned} \tag{2}$$

where $\delta_c * \varphi_t$ is a set of city by year dummies.

3. DATA AND VARIABLES

Data Description

Data used in this study are drawn from the Annual Surveys of Industrial Production conducted by the Chinese government's National Bureau of Statistics (NBS). The data set includes all nonstate-owned firms whose annual sales exceed 5 million yuan (referred to as "above-scale" industrial firms) and all SOEs during 1998–2006.[12,13] The data set includes enterprise identification code, four-digit industry code, six-digit geographic administrative code, ownership type, value added, total employment, capital stock, and intermediate inputs. The NBS classifies enterprises into 23 detailed ownership categories. An enterprise is assigned a registration code at time of establishment designating its ownership type. These codes have been grouped into three broad categories for purposes of this study.[14]

Key Variables

Table 5 provides summary statistics of key variables used in this study differentiated by the three ownership types.

Productivity. Under the augmented production function approach real firm value added is regressed on labor, real capital, and spillover measures. The data set provides information on nominal value added that is converted to real terms using the Brandt-Rawski two-digit industry output deflators (Brandt et al., 2011).[15]

Localization economies. Localization spillovers by ownership type are measured as follows:

$$\mathrm{A}_{foict} = \sum_{g, g \neq f} \mathrm{employment}_{goict}, \tag{3}$$

where $\mathrm{employment}_{goict}$ is total employment summed over all enterprises g in the same industry i and city c, at time t as enterprise f but excluding f, under ownership type o (o = SOE, POE, FOE).

Information on location of an enterprise is crucial for construction of the localization variables. The data set provides information on the six-digit county codes where the first two digits represent the province and the first four designates the city. China's administrative boundaries change often so that county codes, the most disaggregated level of geography, also change over the sample period.[16] To ensure consistency over time, county codes for all enterprises were matched and recoded against one benchmark system.[17]

[12]The NBS classifies non-SOEs to include collectively owned enterprises, Chinese indigenous POEs, and FOEs operating in China. The industry section of China Statistical Yearbook is compiled based on this data set. Basic information of each four-digit industry in the China Markets Yearbook is also based on this data set.

[13]Five million yuan amounts to approximately $US 600,000 over this period.

[14]SOE: 110, 141, 143, 151, 159, 160; POE: 120, 130, 142, 149, 171, 172, 173, 174, 190; enterprises from ECEs of Hong Kong, Macao, and Taiwan (ECE): 210, 220, 230, 240; enterprises from all other countries (non-ECE): 310, 320, 330, 340; FOE: ECE and non-ECE. See Hu et al. (2003) for further details on each category.

[15]The deflators were accessed at http://www.econ.kuleuven.be/public/N07057/CHINA/appendix/.

[16]See Lu and Tao (2009) for a discussion about this issue.

[17]The benchmark system adopted was the set of 2,873 county codes used in the 2000 China County Population Census Data.

TABLE 5: Data Definitions and Summary Statistics

Variable	Definition	State Owned	Private Owned	Foreign Owned
Firm Level				
Log value added	Real value added	9.081	8.320	8.911
		(1.814)	(1.161)	(1.449)
Log capital	Real total fixed assets	9.700	7.893	8.814
		(1.884)	(1.485)	(1.734)
Log employment	Total number of workers	5.750	4.535	5.068
		(1.327)	(0.958)	(1.105)
Four-digit industry and city level				
Log own industry-city employment				
State owned	Total employment in state-owned firms within a four-digit CIC and Chinese city	4.449	4.587	4.178
		(3.379)	(3.383)	(3.432)
Private owned	Total employment in private-owned firms within a four-digit CIC and Chinese city	3.822	5.967	5.398
		(3.381)	(3.200)	(3.465)
Foreign owned	Total employment in foreign-owned firms within a four-digit CIC and Chinese city	2.208	3.843	7.519
		(3.150)	(3.703)	(2.006)

Notes: Chinese industrial Classification (CIC); "city" refers to prefectures, prefecture-level cities and the four municipalities of Beijing, Tianjin, Shanghai, and Chongqing; samples span 1998-2006 and includes single-plant firms only; standard deviation in parentheses.

China is divided into 27 provinces plus four province-status municipalities of Beijing, Chongqing, Shanghai, and Tianjin. The provinces are further divided into prefectures and prefecture-level cities that can be further subdivided into counties. The term "city" in this paper refers to prefectures, prefecture-level cities, and the four municipalities. There are 371 cities in the sample, excluding seven cities in Tibet.

In addition to ownership and location information, the data set provides information on four-digit manufacturing industries according to the Chinese Industrial Classification (CIC) system. CIC codes were readjusted and renumbered in 2003.[18] Consequently, industry codes were adjusted for years prior to 2003 ensuring that codes are comparable across the sample period. There are 465 four-digit industries in the analysis sample, excluding the tobacco manufacturing industry.[19]

[18]Prior to 2003, NBS followed GB/T 4754 - 1994 industry classification system and 2003 onwards GB/T 4754 - 2002 was adopted. Two changes were made in the two digit divisions: (i) the 1994 division 39 ("Arms and Ammunition Manufacturing") was added to 2002 division 36 ("Special Equipment Manufacturing"). Then the remaining 2002 division codes were renumbered accordingly, i.e., 1994 division 40 corresponds to 2002 division 39, 1994 division 41 corresponds to 2002 division 40, 1994 division 42 corresponds to 2002 division 41, and 1994 division 43 corresponds to 2002 division 42 (ii) 2002 division 43 ("Waste Resources and Old Material Recycling and Processing") was added which was not part of manufacturing in the previous period.

[19]Nearly all of the enterprises operating in Industry 16 "Tobacco Products Processing" are state owned.

4. RESULTS

In Tables 6–9, separate panels present the results for each sample. The sample of state-owned firms is a balanced panel and divided into all SOEs (designated "ALL") and those that have sales exceeding 5 million yuan only (designated "ABOVE-SCALE ONLY"). Separating SOEs that are above-scale potentially controls for measurement error that might be introduced in the analysis due to correlation between productivity and scale.[20] Two columns are reported for each sample. The first column presents results from model (1) which includes a full set of four-digit industry, city, and year dummies. The second column presents results from model (2) which includes four-digit industry and city by year dummies. Standard errors are clustered at the four-digit industry and city level. I focus on results in column (2) for each sample in the discussion below, as these are the most demanding of the data. For the state-owned sample, results under "ALL" are discussed below since results considering above-scale only firms are qualitatively similar.

Localization Spillovers by Ownership Type

Table 6 presents the main results. The key pattern observed is that localization spillovers attenuate as enterprises become more dissimilar in ownership space consistent with Hypothesis 1. Own-type localization spillovers are positive and largest, except for the sample of SOEs, which is discussed in more detail shortly. Focusing on the diagonal terms, beginning with the sample of SOEs, we observe that a doubling of employment in nearby own-type activity increases productivity by 0.90 percent; for the sample of private and FOEs the magnitude of the own-type effect is 1.50 percent and 2.30 percent, respectively. The magnitude of these positive spillover effects are comparable to Henderson's (2003) elasticity estimates of own-industry activity in the U.S. that are in the range of 1.2 percent and 2.1 percent.[21]

We further find that spillovers across different ownership types are weaker compared to spillovers within the same ownership type. Foreign presence confers spillovers of much smaller magnitude, which are negative when statistically significant, on both private and SOEs relative to own-type spillovers in each sample. This suggests that competitive forces are likely diminishing the strength of positive localization economies arising from more productive foreign to less productive domestic firms. Spillovers from less productive domestic to more productive foreign firms are also smaller compared to own-type spillovers although positive when statistically significant. This accords with intuition that less productive firm types are unlikely to exert competitive pressures on more productive firm types.

Activity in SOEs appears to have no effect on the productivity of private enterprises while there is a positive effect on FOEs. SOEs rank lowest in terms of productivity suggesting knowledge spillovers are an unlikely channel. It has also been documented that state workers tend to be older, less educated, have less foreign work experience, and get lower wages in comparison to the domestic private sector (Hale and Long, 2011). This would imply that labor pooling with state workers would also be unlikely. The most likely candidate explaining the strength of spillovers would be input sharing.

On the other hand, activity in POEs confers strong, positive spillovers on both state and FOEs. In addition, the private spillover effect on FOEs is larger than FDI spillovers in the private-owned sector. The asymmetric pattern of spillovers, point to likely negative

[20] I thank an anonymous referee for this suggestion.

[21] Henderson (2003) measures nearby activity as the number of own industry plants in a U.S. county and for machinery and high tech industries only.

TABLE 6: Own and cross-Type localization spillovers (single-plant firms only)

Dependent Variable: Log of Enterprise Value Added

	STATE OWNED				PRIVATE OWNED		FOREIGN OWNED	
	ALL		ABOVE-SCALE ONLY					
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Log Own Industry Employment								
State owned	0.006*	0.009***	0.005	0.008***	−0.001	−0.000	0.003**	0.004***
	(0.003)	(0.004)	(0.003)	(0.003)	(0.001)	(0.001)	(0.001)	(0.001)
Private owned	0.029***	0.032***	0.022***	0.026***	0.011***	0.015***	−0.000	0.003**
	(0.004)	(0.004)	(0.003)	(0.004)	(0.001)	(0.001)	(0.001)	(0.001)
Foreign owned	−0.010**	−0.005	−0.009**	−0.005	−0.003***	0.000	0.019***	0.023***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.001)	(0.001)	(0.004)	(0.004)
Log Production Inputs								
Labor	0.684***	0.674***	0.587***	0.581***	0.505***	0.507***	0.581***	0.584***
	(0.017)	(0.017)	(0.017)	(0.017)	(0.003)	(0.003)	(0.005)	(0.005)
Capital	0.298***	0.302***	0.307***	0.309***	0.205***	0.204***	0.263***	0.262***
	(0.012)	(0.012)	(0.013)	(0.013)	(0.002)	(0.002)	(0.003)	(0.003)
City, year, industry dummies	Y	–	Y	–	Y	–	Y	–
City*Year, Industry Dummies	–	Y	–	Y	–	Y	–	Y
Adjusted R^2	0.75	0.75	0.69	0.69	0.42	0.43	0.50	0.50
# Enterprises	33,650	33,650	28,943	28,943	830,729	830,729	329,598	329,598

Notes: Standard errors in parentheses are robust and clustered at the four-digit industry and city level; ***, **, * denotes significance at the 1, 5, and 10 percent levels, respectively.

TABLE 7: Own and cross-Type Localization spillovers, by source of foreign investment (single-plant firms only)

Dependent Variable: Log of Enterprise Value Added

	STATE OWNED				PRIVATE OWNED		ETHNICALLY CHINESE OWNED		NON-ETHNICALLY CHINESE OWNED	
	ALL		ABOVE-SCALE ONLY							
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Log Own Industry Employment										
State owned	0.006*	0.009***	0.005	0.008***	−0.001	−0.000	0.001	0.002	0.004*	0.004**
	(0.003)	(0.004)	(0.003)	(0.003)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Private owned	0.029***	0.032***	0.022***	0.026***	0.012***	0.015***	−0.004**	0.000	−0.001	0.001
	(0.004)	(0.004)	(0.003)	(0.004)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Ethnically Chinese owned	−0.005	−0.003	−0.005	−0.004	−0.003**	−0.001	0.013***	0.011***	−0.000	0.000
	(0.004)	(0.004)	(0.004)	(0.004)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Non-ethnically Chinese owned	−0.008*	−0.003	−0.006	−0.001	−0.001	0.002	−0.001	0.000	0.010***	0.011***
	(0.004)	(0.005)	(0.004)	(0.004)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Log Production Inputs										
Labor	0.684***	0.674***	0.587***	0.581***	0.505***	0.507***	0.593**	0.599***	0.588***	0.589***
	(0.017)	(0.017)	(0.017)	(0.017)	(0.003)	(0.003)	(0.006)	(0.006)	(0.006)	(0.006)
Capital	0.298***	0.302***	0.307***	0.309***	0.204***	0.204***	0.239***	0.237***	0.273***	0.273***
	(0.012)	(0.012)	(0.013)	(0.013)	(0.002)	(0.002)	(0.004)	(0.004)	(0.004)	(0.004)
City, year, industry dummies	Y	–	Y	–	Y	–	Y	–	Y	–
City*year, industry dummies	–	Y	–	Y	–	Y	–	Y	–	Y
Adjusted R^2	0.75	0.75	0.69	0.69	0.42	0.43	0.47	0.48	0.52	0.52
# Enterprises	33,650	33,650	28,943	28,943	830,729	830,729	176,305	176,305	153,111	153,111

Notes: Standard errors in parentheses are robust and clustered at the four-digit industry and city level; ***, **, * denotes significance at the 1, 5, and 10 percent levels, respectively.

TABLE 8: Own and cross-Type localization spillovers (Single and Multiplant Firms)

Dependent Variable: Log of Enterprise Value Added

	STATE OWNED				PRIVATE OWNED		FOREIGN OWNED	
	ALL		ABOVE-SCALE ONLY					
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Log Own Industry Employment								
State owned	0.010***	0.009***	0.008***	0.008**	0.000	0.000	0.003**	0.004***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.001)	(0.001)	(0.001)	(0.001)
Private owned	0.030***	0.031***	0.024***	0.025***	0.016***	0.016***	−0.001	0.002*
	(0.003)	(0.004)	(0.003)	(0.003)	(0.001)	(0.001)	(0.002)	(0.001)
Foreign owned	−0.001	0.001	−0.001	0.002	−0.001	0.002	0.013***	0.013***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.001)	(0.001)	(0.002)	(0.002)
Log Production Inputs								
Labor	0.691***	0.682***	0.598***	0.591***	0.507***	0.509***	0.590***	0.594***
	(0.016)	(0.016)	(0.016)	(0.016)	(0.003)	(0.003)	(0.005)	(0.005)
Capital	0.306***	0.311***	0.322***	0.326***	0.207***	0.206***	0.264***	0.263***
	(0.011)	(0.012)	(0.012)	(0.012)	(0.002)	(0.002)	(0.003)	(0.003)
City, year, industry dummies	Y	–	Y	–	Y	–	Y	–
City*year, industry dummies	–	Y	–	Y	–	Y	–	Y
Adjusted R^2	0.78	0.78	0.73	0.73	0.43	0.44	0.50	0.51
# Enterprises	40,419	40,419	35,407	35,407	855,374	855,374	335,237	335,237

Notes: Standard errors in parentheses are robust and clustered at the four-digit industry and city level; ***, **, * denotes significance at the 1, 5, and 10 percent levels, respectively.

TABLE 9: Own and cross-Type localization spillovers, by source of foreign investment (Single and Multiplant Firms)

Dependent Variable: Log of Enterprise Value Added

	STATE OWNED				PRIVATE OWNED		ETHNICALLY CHINESE OWNED		NON-ETHNICALLY CHINESE OWNED	
	ALL		ABOVE-SCALE ONLY							
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Log Own Industry Employment										
State owned	0.010***	0.009***	0.008***	0.008***	0.000	−0.000	0.001	0.002	0.004**	0.005***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Private owned	0.030***	0.031***	0.024***	0.025***	0.017***	0.016***	−0.003	0.001	0.002	0.003
	(0.004)	(0.004)	(0.003)	(0.003)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Ethnically Chinese owned	0.001	0.002	0.001	0.001	−0.000	−0.000	0.013***	0.012***	0.002	0.002
	(0.004)	(0.004)	(0.004)	(0.004)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Non-ethnically Chinese owned	−0.004	−0.000	−0.002	0.002	−0.000	0.002**	0.000	0.002	0.013***	0.015***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Log Production Inputs										
Labor	0.691***	0.682***	0.598***	0.591***	0.507***	0.509***	0.596***	0.601***	0.590***	0.591***
	(0.016)	(0.016)	(0.016)	(0.016)	(0.003)	(0.003)	(0.006)	(0.006)	(0.006)	(0.006)
Capital	0.306***	0.311***	0.322***	0.326***	0.207***	0.206***	0.241***	0.238***	0.274***	0.274***
	(0.011)	(0.012)	(0.012)	(0.012)	(0.002)	(0.002)	(0.004)	(0.004)	(0.004)	(0.004)
City, year, industry dummies	Y	–	Y	–	Y	–	Y	–	Y	–
City*year, industry dummies	–	Y	–	Y	–	Y	–	Y	–	Y
Adjusted R^2	0.78	0.78	0.73	0.73	0.43	0.44	0.48	0.48	0.52	0.53
# Enterprises	40,419	40,419	35,407	35,407	855,374	855,374	179,078	179,078	156,159	156,159

Notes: Standard errors in parentheses are robust and clustered at the four-digit industry and city level; ***, **, * denotes significance at the 1, 5, and 10 percent levels, respectively.

competition forces diminishing the value of FDI spillovers. Tables 6–9 indicate that POEs exert positive spillovers on enterprises under all ownership types. POEs are the fastest growing segment in China and positive private spillovers underscore the importance of the private sector in China's transition towards a more market-oriented economy.

The private localization variable has a particularly strong impact on the productivity of state-owned firms—the private sector offers double the productivity boost to SOEs relative to the state-owned sector. This is contrary to Hypothesis 2, that leads us to expect own-type spillovers to be positive and larger compared to cross-type spillovers. Existing evidence shows that SOEs often outsource their production activities to POEs (Jefferson and Rawski, 1994, 1999) and this may partly explain the significantly large positive effect from POEs. However, it is beyond the scope of this paper to identify the precise mechanism at work.

Differences by Source of Foreign Investment

To further tease out nuances in foreign spillovers across ownership types, Table 7 divides FOEs into those originating from ethnically Chinese economies of Hong Kong, Macao, and Taiwan (ECEs) and those from all other countries but dominated by the U.S., European Union, and Japan (non-ECEs).[22] This additional stratification of foreign ownership types allows us to consider interactions between multinationals from different source countries.

Foreign investment from these two sources has different motivations for locating in China. Investors from ECEs primarily engage in export-oriented FDI, locating in China to tap into the large and cheap source of labor to carry out production for export markets. On the other hand, investors from non-ECEs primarily engage in market-oriented FDI, locating in China to access the large domestic markets (Zhang, 2005). Foreign enterprises producing for the domestic market are more likely to source intermediate inputs from other domestic enterprises strengthening the opportunity for positive Marshallian externalities. In contrast, export-oriented foreign enterprises are more likely to source intermediate inputs from parent companies restricting the opportunity for interactions with domestic enterprises. Therefore, non-ECEs producing for the domestic market may be more likely to interact with domestic enterprises and create opportunities for FDI spillovers.

Within FOEs operating in China, there are distinct differences between ECEs and non-ECEs with respect to language and ethnicity relative to the host country. ECEs share cultural and linguistic ties with mainland China, as well as family and business ties. Non-ECEs are primarily from OECD countries lacking common cultural or language ties with China. Shared culture can facilitate communication and transactions with local businesses. From a domestic enterprise's perspective it may be "easier" to learn from ECEs compared to non-ECEs due to cultural similarities.

We find that the general patterns observed in Table 6 persist in Table 7. Own-type spillovers are positive and the largest while cross-type spillovers are much smaller, in particular, spillovers from foreign to domestic enterprises are smaller than those in the reverse direction. Additionally, we observe that spillovers from foreign enterprises to POEs originate from non-ECEs only. Since ECEs primarily engage in export processing activities, domestic-owned enterprises may have fewer opportunities to interact with them. In contrast, the market orientation of non-ECE investment increases the likelihood

[22]Between 1979 and 1999, the U.S., EU, and Japan together accounted for half of the FDI originating from non-ECEs (Zhang, 2005).

of interaction with domestic enterprises. There is some evidence of negative spillovers from non-ECEs to SOEs, although lacking statistical significance under the preferred specification in column 2. SOEs continue to provide positive spillovers to their foreign-owned counterparts, in particular, non-ECEs.

A novel result revealed in Table 7 is that ECEs and non-ECEs virtually have no impact on each other. This is particularly surprising since the respective own-type spillovers are positive, statistically significant, and of similar magnitude. Because these regressions include controls for cities, industries, and time we cannot attribute the results to any inter-city, inter-industry, or inter-temporal differences. Nonexistent spillovers from ECEs to non-ECEs might be a facet of the export driven orientation of ECE investment that makes it more unlikely for the two types of foreign enterprises to source inputs from each other. Existing evidence finds ECEs to be less technologically sophisticated and use less skilled labor compared to non-ECEs that would make knowledge spillovers or labor pooling unlikely.[23]

Single and Multiplant Firms

Tables 8 and 9 display results for single and multiplant firms pooled together using the augmented production function approach. As before, I focus on results in column (2) for each sample in the discussion below. The results reveal qualitatively similar patterns as in the single-plant only samples allaying fears about measurement error in the localization variables. We find that own-type spillovers are larger than cross-type localization spillovers. The absence of spillovers between ECEs and non-ECEs remain. FDI spillovers appear nonexistent. Positive productivity spillovers from SOEs to foreign enterprises are statistically significant and we find this to be the case for non-ECEs only when distinguishing by investment source.

5. CONCLUSION

The empirical agglomeration literature finds robust evidence of benefits arising from the proximity to nearby economic activity. However, these benefits have previously not been considered to vary along the ownership dimension of an enterprise, especially in the context of a transition economy. Although, the literature on FDI has paid particular attention to benefits arising to domestic firms from the proximity to foreign firms, spillovers in the reverse direction are less well examined. This paper addresses these gaps.

Using data on manufacturing enterprises operating in China during 1998–2006, this study estimates and offers explanations as to why localization spillovers might vary by ownership type of an enterprise. Exploiting a well-established average productivity hierarchy in China, where FOEs are more productive compared to POEs who are in turn more productive than SOEs, I find evidence of attenuation of localization spillovers as enterprises become more dissimilar in ownership space. Results indicate that spillovers are larger within the same ownership type than they are across them. I also find that within the foreign-owned sector, own-industry activity in enterprises originating from ECEs within a Chinese city has virtually no impact on the productivity of enterprises originating primarily from OECD countries and vice versa. This result warrants further research to understand interactions among multinational corporations from different source countries.

[23]See Todo, Zhang, and Zhou (2009) for a discussion and list of references documenting productivity differential between ECE and non-ECE enterprises.

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