Spatial organization of firms: local vs. national firms and the impact of trade liberalization

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Preliminary draft

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Abstract

What is the impact of international trade on cities and rural areas within a country? Existing studies on this topic are built on new economic geography models, which focus on the effect of international trade on the change in the balance between agglomeration and dispersion forces of the manufacturing firms. Recent studies, however, suggest that large cities today can be characterized as specializing in providing business services to host corporate headquarters, rather than as agglomeration of manufacturing. The aim of this paper is then to analyse the impact of international trade on internal cities and rural areas, taking into account the changing spatial organization of firms and the role of cities today. We construct and analyse an urban-rural model with a city hosting headquarters of firms, but allowing for the coexistence of headquarters in rural areas. The balance between the gains from having headquarters in the city with access to business services and the urban cost determines the spatial organization of firms and the corresponding city size. The model is extended to analyse the impact of trade liberalization. In an open economy, despite the urban costs, the city is likely to grow larger compared to a closed economy. When exporting requires additional fixed costs in the form of larger headquarters, the result may be reversed; opening up to international trade may work in favour of smaller local firms, leading to a dispersion of economic activities away from the city. Reduction of existing international trade cost can affect the city size in either way.

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1 Introduction

What is the impact of international trade on cities and rural areas within a country? Existing studies on this topic are built on new economic geography models, which focus on the effect of international trade on the change in the balance between agglomeration and dispersion forces of the manufacturing firms. Recent studies, however, suggest that large cities today can be characterized as specializing in providing business services to host corporate headquarters, rather than as agglomeration of manufacturing. The aim of this paper is then to analyse the impact of international trade on internal cities and rural areas, taking into account the changing role of cities today. The analysis is presented in two steps: the first step is to construct and analyse an urban-rural model with a city specializing in hosting headquarters (hereafter HQ) of firms. In the second step, the model is extended to introduce international trade in order to examine the impact of international trade on the urban-rural structure.

There are various functions within a firm but they are not necessarily located in one place. In fact, different functions of a firm often locate separately in different places. How firms locate their various functions are called spatial organization of firms. (Aarland et al. (2003) and Ono (2003) provide empirical analyses of the spatial organization of firms in the United States.) One most notable aspect of a firm's spatial organization is the separation of its headquarters (HQ) and factory. The main ingredient for the urban-rural model in this paper is to explicitly introduce the HQs. HQs are typically located in cities while factories can be located elsewhere. According to an empirical study by Davis and Henderson (2008), HQs locate in cities in order to gain best access to various producer services. (Headquarter location decisions are mostly driven by the existence of a large and diverse local supply of business services rather than by the presence of a large number of other HQs.) Duranton and Puga (2005) provide a theoretical explanation for why cities today specialize in different functions rather than have full sets of industries. Cities today can be described as a place that hosts many HQs by supplying producer services.

On the other hand, empirical observations suggest that the separation of HQs and factories are not the only pattern of the spatial organization of firms. Some firms have HQs and factories integrated in the same location, which coexist with the former type of firms. Firms that have separate HQs in cities are typically larger firms, which can be called national firms. Firms that have their HQs and factories integrated in rural areas are smaller, which can be called local firms. In the case of Japan, nearly 70% of multi-unit firms have their HQs in major metropolitan areas and they are twice as large as firms that do not have HQs in metropolitan areas.

The first step of the analysis in this paper is to develop a simple model that explains the observation that firms are separated into two types, national and local, taking into account one of today's feature of cities that they supply producer services and host corporate HQs. Assuming

that face-to-face communication is important in purchasing producer services it is advantageous for firms to locate their HQs in the city. However, having HQs in the city can be costly because of urban costs such as commuting and land rent. The balance between the gains from having urban HQs and the urban cost determines the spatial organization of firms and the corresponding city size. Initially identical firms are separated into national and local firms, and the HQs of the former form the city.

The second step is to analyze the impact of trade liberalization on an economy with such a geographic structure. Existing studies on trade and internal geography including Krugman and Livas-Elizondo (1996), Monfort and Nicolini (2000) and Paluzie (2001) are all based on new economic geography settings in which there are two locations where manufacturing firms can locate, and have analyzed the impact of trade liberalization without such aspects of spatial organization of firms and the corresponding urban-rural charcteristics.[1] The literature on this topic has provided two opposing results. Krugman and Livas-Elizondo (1996) suggest that trade liberalization brings about a dispersed distribution of manufacturing firms. On the contrary, Monfort and Nicolini (2000) and Paluzie (2001) suggest that international trade liberalization leads to agglomeration of manufacturing within the country. This study focuses on the impact of trade liberalization on the spatial organization of firms and the corresponding urban-rural structure by extending the model to an open economy. When there is a foreign market, the city is likely to grow larger despite the urban costs, because the gains from locating HQs in the city to become larger exporters outweigh the costs of increased urban costs. However, when exporting requires additional fixed costs such as foreign market entry costs requiring larger management forces or HQs, the result may be reversed; opening up to international trade may work in favour of smaller local firms, leading to a dispersion of economic activities away from the city. Reduction of existing international trade cost can affect the city size in either way, depending on foreign market size.

2 Spatial organization of firms

This section presents some of the characteristics of the spatial organization of firms today using Japanese establishment data. The data in this section is based on multi-unit firms, which employ around half of the total corporate labour forces in Japan. As shown in Table 1, nearly 70% of the firms have their HQs in major metropolitan areas, and they are twice as large as firms that do

[1] Behrens et al. (2007) have used a monopolistic competition model with a quasi-linear demand structure to analyse the positive and normative aspects of the international trade and domestic geography issue. However their geographic set up is the same as in Monfort and Nicolini (2000) and Paluzie (2001).

not have HQs in metropolitan areas.

Figure 1a and 1b plot the firm sizes and the shares of employment within the same prefectures as the HQ (as a measure of the degree of the spatial integration of the firms), against the population densities (as a measure of urbanization) of the prefecture in which the HQs locate, respectively. Figure 1a suggests that firms that have HQs in urban areas tend to be larger; figure 1b suggests that firms that have HQs in urban areas have more dispersed spatial organizations, while firms that have HQs in rural areas are more spatially integrated.

Figure 2a and 2b take a closer look by comparing firms with HQs in Tokyo (which is the biggest metropolis in Japan) and those with HQs in Kagoshima prefecture in southwestern Japan which is relatively rural. The regional distribution of 'Tokyo firms' in Figure 1a suggest they are operating nationally. (Only 25% of their employees are in Tokyo. The bars in the figure add up to one.) In contrast, 'Kagoshima firms' activities are geographically concentrated within the Kagoshima prefecture or neighbouring prefectures (more than 80% are employed locally).

Given the differences in the sizes and the geographic area of operation, firms that have their HQs in large cities have the characteristics of national firms. Other firms may be called local firms.

The breakdown by industry is provided in Table 2. One clear difference is that in agriculture and in mining, unlike other sectors, the majority of firms are rural firms, and the size difference between the urban and rural firms are small. This may also suggest that in these sectors in which products are less likely to be differentiated, locating HQs in cities are less important.

The separation of firms into the two types suggest that there is indeed an advantage in locating HQs in the city, and that the advantage allows the firms with their HQs in the city operate at much larger scales. Large firms with their HQs in a large city with spatially dispersed structures may be called national firms. Smaller firms with their HQs and other facilities located closely together in rural areas may be called local firms. In the next section, we present a model that explains the coexistence of the two types of the firms and the corresponding city size.

Table 1: Spatial organization of firms in Japan

Location of HQs	Number of firms		Employment		Average firm size
Urban	138,535	69.1%	19,554,837	82.8%	141.2
Rural	61,926	30.9%	4,068,759	17.2%	65.7
Total	200,461	100.0%	23,623,596	100.0%	117.8

Note: "Urban" corresponds to firms that have their HQs in the 14 major metropolitan areas in Japan.

Source: Establishment statistics of Japan, 2006.

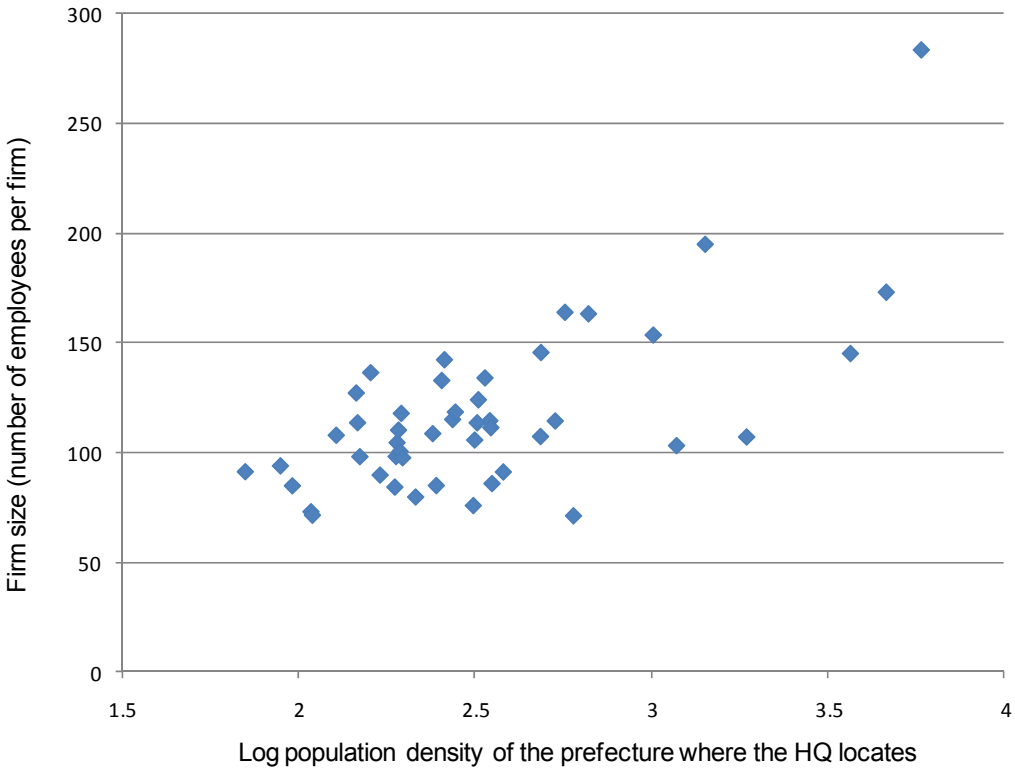


Figure 1a: HQ location and firm size

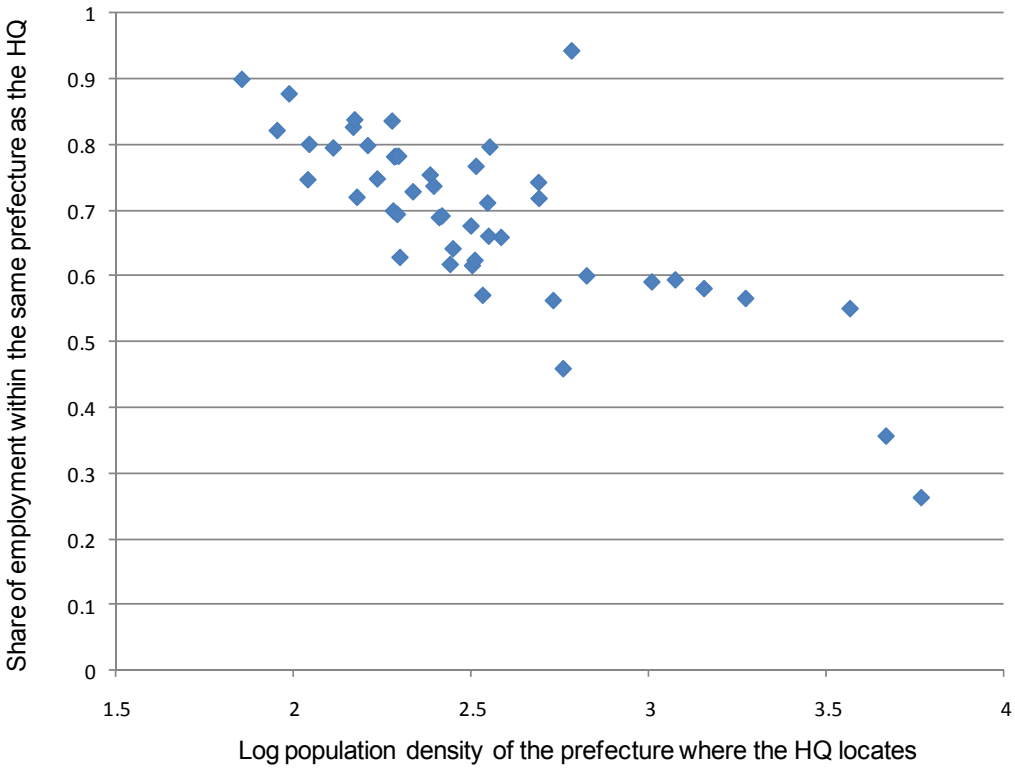
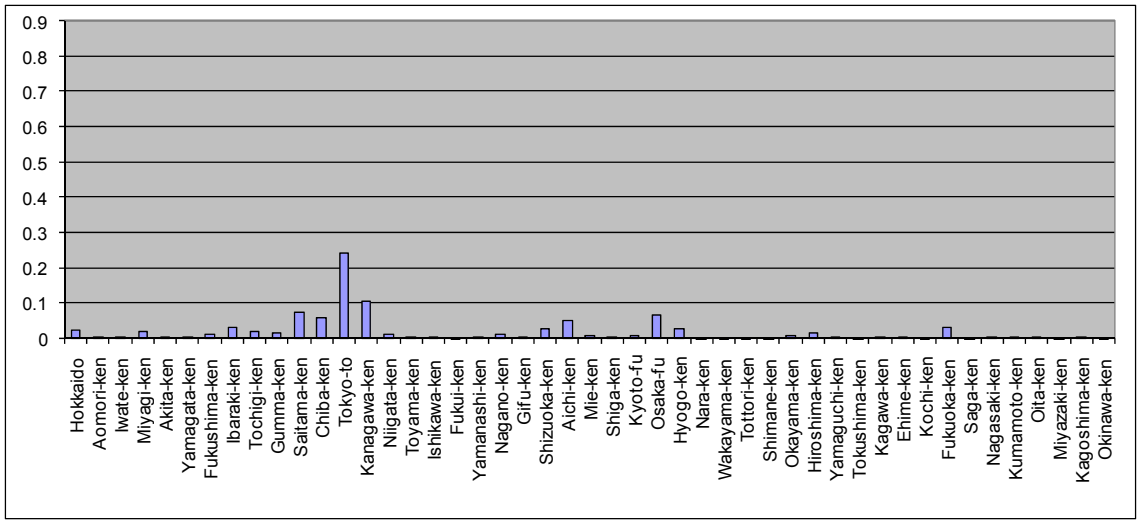


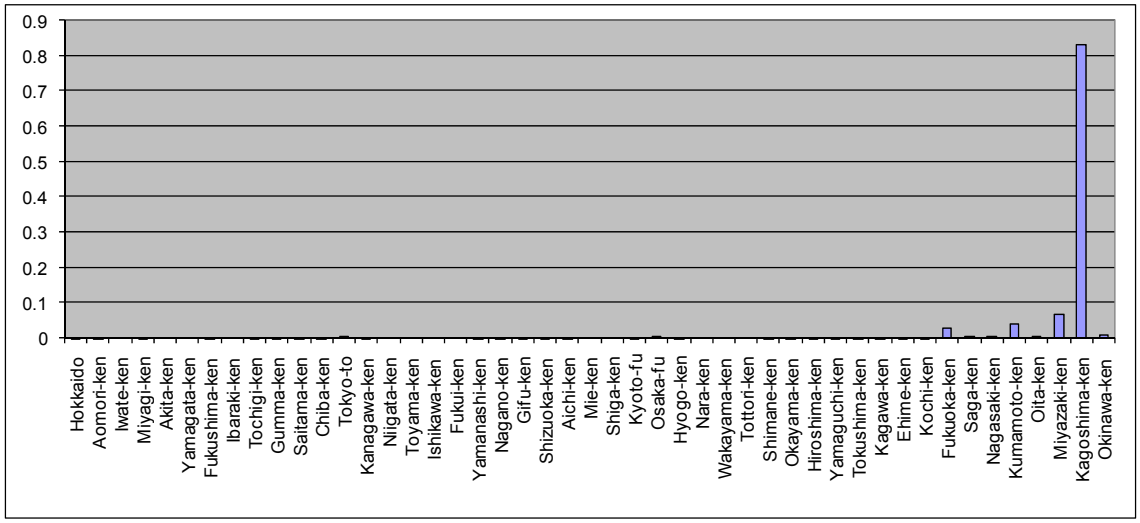
Figure 1b: HQ location and spatial organization of firms



Note: The names in the horizontal axis are the names of the 47 prefectures in Japan.

Source: Establishment statistics of Japan, 2006.

Figure 2a: Geographic distribution of employment of an average Tokyo firm



Note: The names in the horizontal axis are the names of the 47 prefectures in Japan.

Source: Establishment statistics of Japan, 2006.

Figure 2b: Geographic distribution of employment of an average Kagoshima firm

Table 2: Spatial organization of firms by industry

	Location of HQs	Number of firms		Employment		Average firm size	urban/rural
All	Urban	138,535	69.1%	19,554,837	82.8%	141.2	2.15
	Rural	61,926	30.9%	4,068,759	17.2%	65.7	
	Total	200,461	100.0%	23,623,596	100.0%	117.8	
Agriculture, forestry and fishery	Urban	285	38.5%	16,462	41.5%	57.8	1.14
	Rural	456	61.5%	23,162	58.5%	50.8	
	Total	741	100.0%	39,624	100.0%	53.5	
Non-Agriculture	Urban	138,250	69.2%	19,538,375	82.8%	141.3	2.15
	Rural	61,470	30.8%	4,045,570	17.2%	65.8	
	Total	199,720	100.0%	23,583,945	100.0%	118.1	
Mining	Urban	115	38.9%	6,799	51.1%	59.1	1.65
	Rural	181	61.1%	6,497	48.9%	35.9	
	Total	296	100.0%	13,296	100.0%	44.9	
Construction	Urban	11,518	62.0%	960,023	75.5%	83.3	1.89
	Rural	7,051	38.0%	310,700	24.5%	44.1	
	Total	18,569	100.0%	1,270,723	100.0%	68.4	
Manufacturing	Urban	26,002	72.7%	4,873,757	83.0%	187.4	1.83
	Rural	9,765	27.3%	1,000,824	17.0%	102.5	
	Total	35,767	100.0%	5,874,581	100.0%	164.2	
Electricity, gas, heat supply, water	Urban	134	67.0%	159,345	90.0%	1189.1	4.44
	Rural	66	33.0%	17,674	10.0%	267.8	
	Total	200	100.0%	177,019	100.0%	885.1	
Information and communication	Urban	3,767	81.4%	881,246	91.0%	233.9	2.32
	Rural	861	18.6%	86,956	9.0%	101.0	
	Total	4,628	100.0%	968,202	100.0%	209.2	
Transportation	Urban	6,487	69.9%	1,418,248	82.7%	218.6	2.06
	Rural	2,793	30.1%	296,069	17.3%	106.0	
	Total	9,280	100.0%	1,714,317	100.0%	184.7	
Wholesale and retail	Urban	51,871	66.9%	5,327,742	79.9%	102.7	1.97
	Rural	25,718	33.1%	1,338,759	20.1%	52.1	
	Total	77,589	100.0%	6,666,501	100.0%	85.9	
Finance and insurance	Urban	1,236	72.7%	870,442	88.2%	704.2	2.81
	Rural	464	27.3%	116,340	11.8%	250.7	
	Total	1,700	100.0%	986,782	100.0%	580.5	
Real estate	Urban	5,275	82.0%	327,925	91.4%	62.2	2.34
	Rural	1,157	18.0%	30,674	8.6%	26.5	
	Total	6,432	100.0%	358,599	100.0%	55.8	
Restaurant, hotel	Urban	7,819	65.9%	1,391,794	83.6%	178.0	2.65
	Rural	4,050	34.1%	272,091	16.4%	67.2	
	Total	11,869	100.0%	1,663,885	100.0%	140.2	
Medical and welafre	Urban	1,566	76.1%	154,264	86.7%	98.5	2.06
	Rural	493	23.9%	23,622	13.3%	47.9	
	Total	2,059	100.0%	177,886	100.0%	86.4	
Education	Urban	2,040	74.2%	262,786	88.3%	128.8	2.62
	Rural	709	25.8%	34,878	11.7%	49.2	
	Total	2,749	100.0%	297,664	100.0%	108.3	
Other service	Urban	20,420	71.4%	2,904,004	85.0%	142.2	2.27
	Rural	8,162	28.6%	510,486	15.0%	62.5	
	Total	28,582	100.0%	3,414,490	100.0%	119.5	

Source: Establishment statistics of Japan, 2006.

3 A spatial model of national and local firms

This section introduces a model of city formation based on corporate HQs and the mobility of skilled workers who work for them, and explains the coexistence of the two types of firms – large national firms with dispersed spatial structures and small local firms with relatively integrated spatial structures.

3.1 Assumptions

Activity of manufacturing firms

A manufacturing firm's activity consists of an HQ and a factory. The HQ manages the factory, and business services are essential for HQs to operate and make decisions. The HQ requires fixed number of skilled workers. Factory production requires a fixed number of unskilled workers per unit output. Manufacturing firms thus face increasing returns to scale. The total cost of producing a given amount q^M is

$$c\left(q^M\right) = Fw^S + mq^M w^U , \tag{1}$$

where w^S is the wage of skilled workers and w^U is the wage of unskilled workers. Manufacturing firms are assumed to be monopolistically competitive.

City and rural

There are two locations, city and rural. Producer services are provided at the city. The city is modelled as a special location that provides business services to corporate HQs. (It is assumed that factories do not locate inside the city.) Examples of producer services are financial services, legal services, consultations, marketing, etc. Firms purchase producer services through their HQs. It is assumed that face-to-face contact is important in purchasing these producer services. As Gasper and Glaeser (1998) point out, face-to-face communications are still important in our age of advanced communication technologies.[2]

It is assumed then that the spatial organisation of firms affect the productivity of their factories: the manufacturing firms which have their HQs in the city obtain productivity advantages, and their cost function is

$$c\left(q^{SEP}\right) = Fw_C^S + Amq^{SEP} w^U , \tag{2a}$$

where $0 < A < 1$ and subscripts C and R denote the city and rural, respectively. A therefore represents the advantage that the firm gains from having its HQ in the city. This type of firms will be denoted as SEP firms hereafter. (The business service sector is not modelled explicitly.) In contrast, local firms have higher marginal costs because of their disadvantaged

[2] In fact, communication technology and the need for face-to-face contact can be complimentary.

access to (or lack of face-to-face communication with) producer services. The total cost of firms that do not have their HQs in the city is

$$c\left(q^{INT}\right) = Fw_R^S + mq^{INT}w^U, \tag{2b}$$

where INT stands for Integrated firms in rural areas.

As in standard models of urban economics, the city has an internal geographic structure: the urban workplaces, which are in our case producer service firms and HQs, are located in the centre of the city, or in the central business district (CBD).[3] This implies that the workers living in the city must commute to the CBD from their residences. The CBD itself is assumed to be dimensionless. It is assumed that a fixed lot of land is necessary to live in the city. For simplicity, the opportunity cost of land is assumed to be zero.

The population of the city consists of skilled workers who are working for the HQs. The population of the rural area consists of skilled workers working for other HQs and unskilled workers employed in the factories or in the homogeneous good sector. The share of skilled workers in the city is denoted as λ. Correspondingly, the share of skilled workers working in rural HQs is $1-\lambda$. These are summarized in Figure 3.

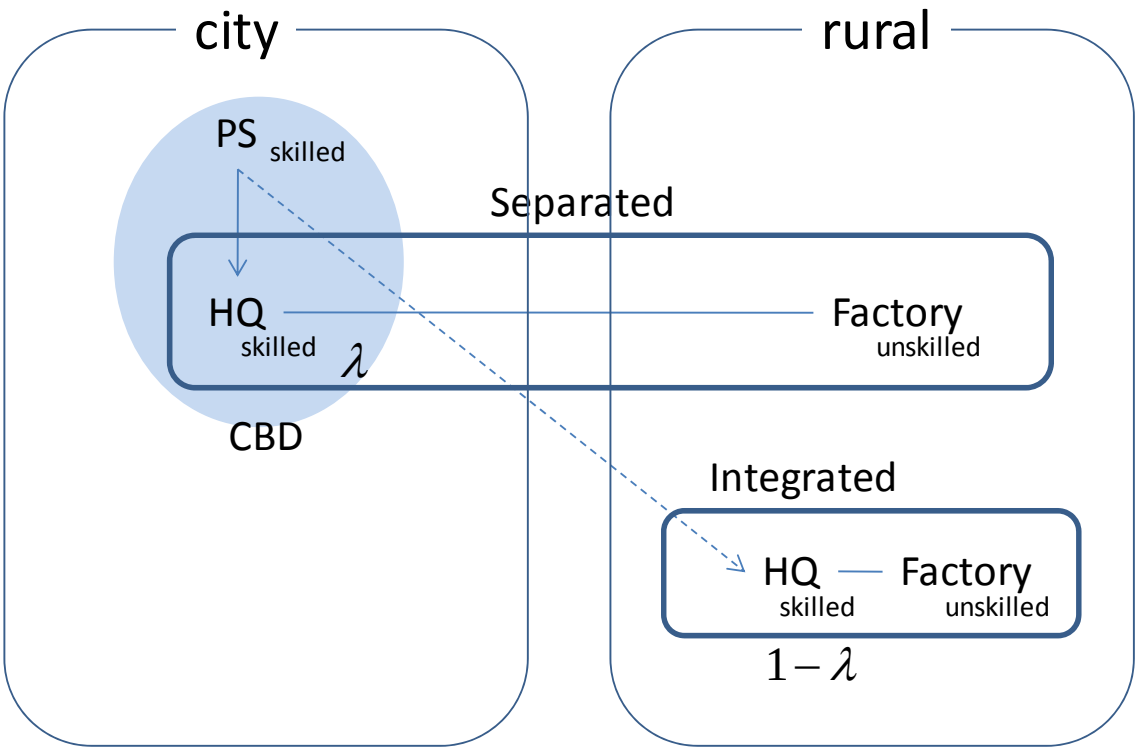


Figure 3: City and rural

[3] See for example Abdel-Rahman (2000) on general equilibrium models of cities.

The homogeneous good

Consumers have a positive initial endowment of the homogeneous good that is also produced using unskilled workers only, under constant returns to scale and perfect competition. This good is chosen as the numeraire. (Therefore, $w^U = 1$ in equilibrium.)

Trade and communication costs

Unlike the NEG based studies, domestic trade costs are not considered in this analysis (but international trade costs will be considered later).[4] This is because in a modern developed economy, domestic markets are well integrated – efficient distribution networks or supermarket chains exist both in urban and rural areas, leading to lower domestic price differentials of manufactured goods today. In addition, communications costs that typically arise between HQs and factories when they are spatially separated are also not considered. Instead, the focus here is on the importance of face-to-face communication between the HQs and business service suppliers in the city.

Consumer preference

The consumer preference and the corresponding demand structure follows the one developed by Ottaviano et al (2002). All consumers have the same preferences with the following utility function,

$$U = \alpha \int_{i=0}^{n} c_i d_i - \frac{\beta - \delta}{2} \int c_i^2 - \frac{\delta}{2} \left(\int_{i=0}^{n} c_i d_i \right)^2 + c^A \quad (0 < \alpha, \ 0 < \delta < \beta), \tag{3}$$

where c_i is the consumption of variety i of the manufactured good, c^A is the consumption of the homogeneous good, and n is the total mass of varieties of the manufactured good. α, β and γ are exogenous parameters. α represents the intensity of the preferences for the manufactured good, and $\beta > \delta$ is required for the utility function to exhibit the love of variety. For a given value of β, δ expresses the substitutability between the varieties. With the budget constraint

$$\int_{i=0}^{n} p_i q_i di + q_0 = w^r + \bar{q}_0, \tag{4}$$

utility optimization yields the following demand function for a typical variety of manufactured good

$$c_i = a - (b + cn) p_i + cP, \tag{5}$$

[4] Jacks et al. (2008) demonstrates that international trade costs are still considerably high compared to domestic trade costs.

where

$$a \equiv \frac{\alpha}{\beta + \delta(n-1)}, \quad b \equiv \frac{a}{\alpha}, \quad c \equiv \frac{\delta b}{\beta - \delta}, \quad P \equiv \int_{i=0}^{n} p_i d_i \, .$$

3.2 Firm behaviour

Given the demand functions of the individual consumers, the profit of a typical SEP firm can be written as

$$\left(p^{SEP} - Am\right)\left[a - (b + cn)p^{SEP} + cP\right](S + L) - Fw_C^S \, . \tag{6}$$

The profit maximizing price that the SEP firm sets is then

$$p^{SEP} = \frac{1}{2}\left(Am + \frac{a + cP}{b + cn}\right). \tag{7a}$$

Similarly, the profit maximizing price that the INT firm sets is

$$p^{INT} = \frac{1}{2}\left(m + \frac{a + cP}{b + cn}\right). \tag{7b}$$

This implies a constant price differential of

$$p^{SEP} - p^{INT} = \frac{m(A-1)}{2} \tag{8}$$

between the SEP and INT firms. (The SEP firms always set lower prices than the INT firms.)

3.3 Equilibrium and city formation

Equilibrium is defined as a situation in which all goods and labour markets clear, firms earn zero (pure) profits due to free entry, and all skilled workers in the city and in rural areas achieve the save utility level.

Market clearing of the manufactured goods require

$$q^{SEP} = \left[a - (b + cn)p^{SEP} + cP\right](S + L), \tag{9a}$$

and

$$q^{INT} = \left[a - (b + cn)p^{INT} + cP\right](S + L). \tag{9b}$$

This implies a constant size differential between the SEP and the INT firms:

$$q^{SEP} - q^{INT} = \frac{1 - A}{2} m(b + cn)(S + L), \tag{10}$$

that is, the SEP firms always operate at lager scales. Given that the SEP firms' functions are spatially dispersed between the city and the rural area, and the result that they are bigger, the SEP firms have the characteristics as national firms. The INT firms, on the other hand, operate within smaller geographic areas with smaller scales, so they have the characteristics as local

firms.

Assuming free entry and exit, the profits are driven down to zero. That is

$$\left(p^{SEP} - Am\right)\left[a - \left(b + cn\right)p^{SEP} + cP\right]\left(S + L\right) - Fw_C^S = 0\,, \tag{11a}$$

and

$$\left(p^{INT} - m\right)\left[a - \left(b + cn\right)p^{INT} + cP\right]\left(S + L\right) - Fw_R^S = 0\,. \tag{11b}$$

The equilibrium skilled wages are then derived as

$$w_C^S = \frac{1}{4F}\left(\frac{a + cP}{b + cn} - Am\right)\left[2a - Am\left(b + cn\right) + 2cP\right]\left(S + L\right), \tag{12a}$$

and

$$w_R^S = \frac{1}{4F}\left(\frac{a + cP}{b + cn} - m\right)\left[2a - m\left(b + cn\right) + 2cP\right]\left(S + L\right). \tag{12b}$$

Within the city, since all skilled workers are mobile, all residents earn the same disposable income in equilibrium. Therefore, if R is the land rent in the city centre, θ is the commuting cost per unit distance, and X is the distance to the city edge from the CBD, $w_C^S - R = w_C^S - \theta X$ should hold. Further, since full employment of skilled workers imply

$$n^{SEP} = \frac{\lambda S}{F} \quad \text{and} \quad n^{INT} = \frac{\left(1 - \lambda\right)S}{F}, \tag{13}$$

the city population $n^{SEP}F$ is equal to λS. The unit land requirement for each city resident implies $X = n^{SEP}F$. Therefore in equilibrium,

$$R = \theta X = \theta\lambda S\,. \tag{14}$$

The total land rent is $RX/2 = \theta\left(\lambda S\right)^2/2$, and it is assumed that this is equally distributed among the city residents (Figure 4). The net urban cost for each individual is therefore $\theta\lambda S/2$. In addition, free mobility of skilled workers between rural and the city requires that the skilled workers' utility in the city and in rural are equalized. That is

$$w_C^S - \frac{\theta\lambda S}{2} = w_R^S\,. \tag{15}$$

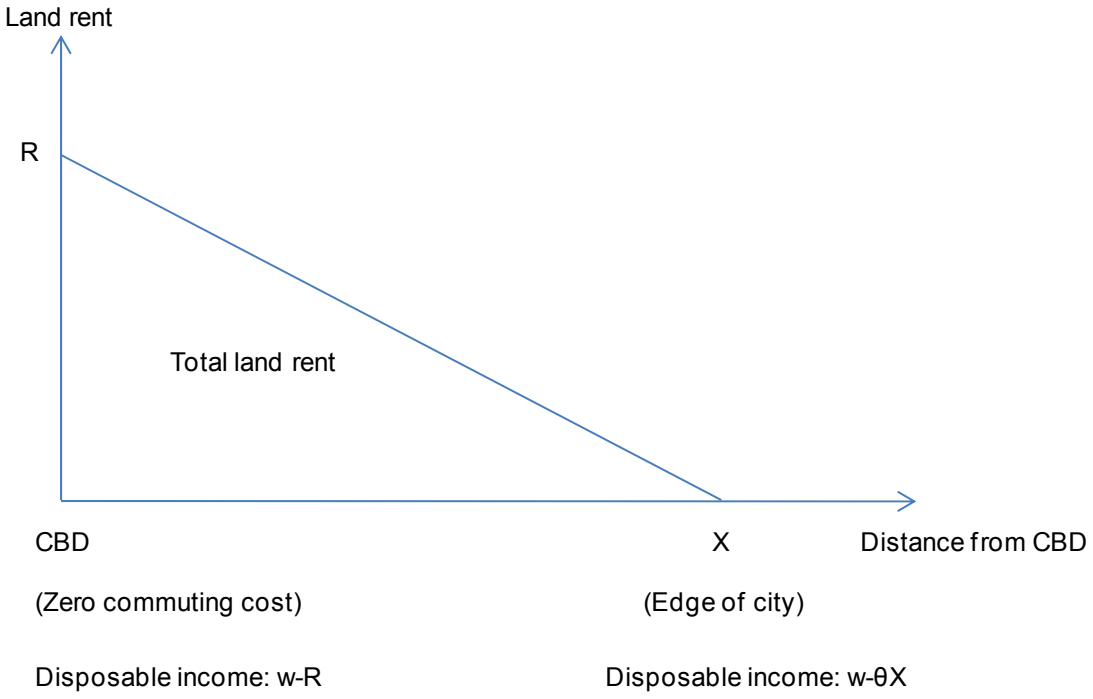


Figure 4: Internal structure of the city

3.4 National and local firms and the city size

Because of the obvious advantage of the SEP (or the national) firms, the urban nominal skilled wages are higher than the rural skilled wages. However, sufficiently high urban costs of land rent and commuting lead to an equilibrium in which not all skilled workers work and reside in the city. Figure 5 shows the urban and rural skilled wages as a function of the share of skilled workers in the city, λ. The two wage curves, w_C^S and w_R^S are downward sloping. This is because competition gets 'tougher' or the overall price level, P, declines as more firms locate their HQs in the city and become productive. As in (15), equilibrium distribution of skilled workers (λ) and the corresponding city size is determined at the intersection of the $w_C^S - \theta\lambda S/2$ and the w_R^C curves.[5] It can be confirmed that

$$\frac{\partial w^{SEP}}{\partial \lambda} - \frac{\partial w^{INT}}{\partial \lambda} = -\frac{(A-1)^2 cm^2 S(L+S)(bF+cS)}{2F^2(2bF+cS)} < 0, \tag{16}$$

so there can be a stable internal solution ($0 < \lambda < 1$), otherwise all HQs will locate in the city

[5] The analytical solution of λ is

$$\lambda = \frac{\frac{S+L}{4F}(1-A)m\left\{2a - m(1+A)\left(b+\frac{cS}{F}\right) + \frac{2cS}{F(2bF+cS)}\left[(bF+cS)m+Fa\right]\right\}}{S\left[t + \frac{S+L}{4F^2}(1-A)^2 cm^2\left(\frac{cS}{2bF+cS}+1\right)\right]}$$

($\lambda = 1$).

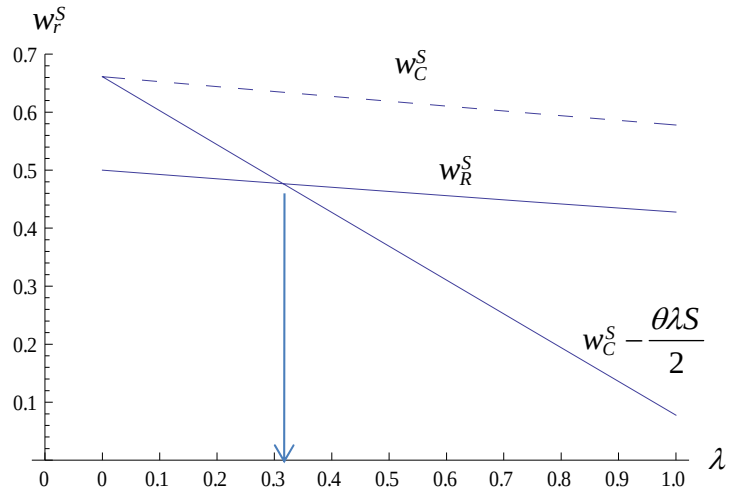


Figure 5: equilibrium urban size

To summarise the (autarky) analysis, with the fundamental assumption that 1) business services are provided in the city and 2) access to business services improves firm productivity, firms locate their HQs in the city in order to gain best access to business services. However, as more HQs locate in the city, the city size increases and the commuting distance and land rent increases. Such urban costs can restrict all firms from locating their HQs in the city, and in equilibrium, there exist two types of firms – large firms with a dispersed spatial organization (SEP/national firms) and small firms with a relatively integrated spatial organization (INT/local) as presented in Section 2. In the next section, we introduce a foreign economy to consider possible impacts of international trade on the spatial organisation of firms and the urban-rural relationship.

4. The impact of international trade on the urban-rural structure

The impact of international trade on the urban-rural relationship is analysed by introducing a foreign economy (or the rest of the world) and international trade costs. For simplicity, the urban-rural dimension of the foreign economy is ignored as in the studies by Krugman and Livas-Elizondo (1996) and Paluzie (2001).

4.1. Firm behaviour in the foreign market

It is assumed that international trade costs τ units of the numeraire per unit of the manufactured good. The home SEP and INT firms' profits from the foreign markets are then

$$\left(p_f^{SEP} - Am - \tau\right)\left[a - \left(b + cn^W\right)p_f^{SEP} + cP_f\right]\left(S_f + L_f\right). \tag{17a}$$

and

$$\left(p_f^{INT} - m - \tau\right)\left[a - \left(b + cn^W\right)p_f^{INT} + cP_f\right]\left(S_f + L_f\right). \tag{17b}$$

The foreign firms' profit in the foreign market is

$$\left(p_f^f - m^f\right)\left[a - \left(b + cn^W\right)p_f^f + cP_f\right]\left(S_f + L_f\right). \tag{17c}$$

Profit maximization of the firms results in the pricing behaviour as in Table 3, where p_f is the local price set by foreign manufacturing firms in the foreign market, and $m^f > 0$ is the productivity parameter of foreign firms. Hereafter in the analysis it is assumed that international trade costs are not too high so that both types of firms export.

Table 3: Pricing behaviour

	Home market	Foreign market
Home SEP (national) firms	$p_h^{SEP} = \frac{1}{2}\left(Am + \frac{a + cP_h}{b + cn^W}\right)$	$p_f^{SEP} = p_f^f + \frac{1}{2}\left(Am - m^f + \tau\right)$
Home INT (local) firms	$p_h^{INT} = \frac{1}{2}\left(m + \frac{a + cP_h}{b + cn^W}\right)$	$p_f^{INT} = p_f^f + \frac{1}{2}\left(m - m^f + \tau\right)$
Foreign firms	$p_h^f = \frac{a + cP_h + \left(m^f + \tau\right)\left(b + cn^W\right)}{2\left(b + cn^W\right)}$	$p_f^f = \frac{1}{2}\left(m^f + \frac{a + cP_f}{b + cn^W}\right)$

Comparison of city size between autarky and with trade (L_f)

It can be confirmed that $\partial w^{SEP}/\partial L_f > 0, \partial w^{INT}/\partial L_f > 0$, which indicates that the existence of a foreign market raises the skilled wages of both national and local firms. However, it can

also be shown that the increase of the skilled wages of SEP/national firms is larger:

$$\frac{\partial w^{SEP}}{\partial L_f} - \frac{\partial w^{INT}}{\partial L_f} = \frac{(1-A)m\left[bF + c(S+S_f)\right]\left\langle -4aF + 2bF(m + Am + 2\tau) + c\left\{m\left[(1 + A - 2m^f)S_f + S(-1 + A - 2\lambda(-1 + A))\right] + 2S_f\tau\right\}\right\rangle}{4F^2\left[2bF + c(S + Sf)\right]} > 0 \quad (18)$$

This is because the operating profits from abroad for the SEP/national firms are higher due to their productivity advantage. Despite the urban costs, this induces a relocation of skilled workers and HQs of local firms to the city, until the increased urban costs put a brake on it. An example of a new equilibrium in an open economy is shown in Figure 6. The result that the city becomes larger means that there are now more SEP/national firms so that firms are on average more productive and larger.

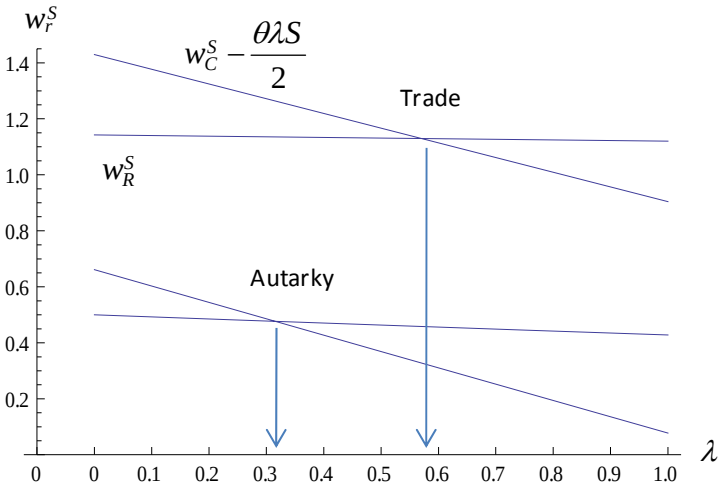


Figure 6: trade and urban size

The impact of the reduction of international trade costs (τ)

The reduction of international trade costs can affect the skilled wages in either way. This is because improved access to foreign not only leads to higher operating profits abroad for home firms, but also leads to increased import competition in home. Whether the reduction of international trade cost increases or decreases home skilled wages depend on country size: if the foreign economy is small, it is possible that reduction of trade costs leads to lower home skilled wages. The condition for this to happen is

$$\frac{L_f + S_f}{L + S} < \frac{cn_f}{2b + cn_f}, \quad (19)$$

and the reduction in the skilled wages of SEP/national firms are larger:

$$\frac{\partial w^{SEP}}{\partial \tau} < \frac{\partial w^{INT}}{\partial \tau}. \tag{20}$$

Therefore, in this case the reduction of international trade cost leads to a smaller city. An example of this case is shown in Figure 7. Otherwise, if the foreign economy is sufficiently large, reduction in international trade costs increases the city size, as in Figure 6.

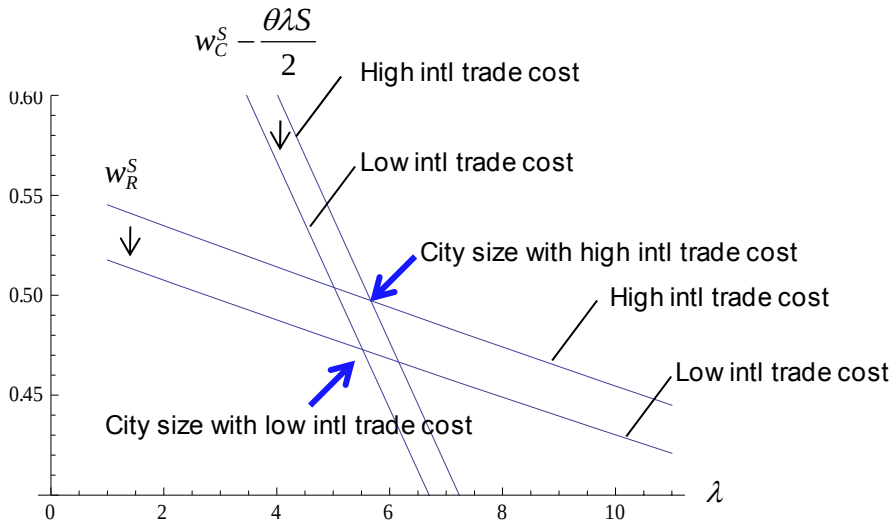


Figure 7: trade and urban size (the case of trade cost reduction leading to smaller city)

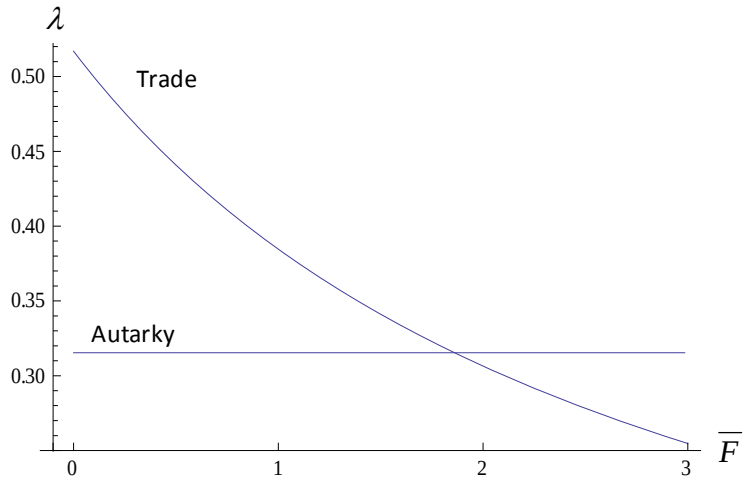
Fixed entry cost for exporting to the foreign market

As has been studied by Roberts and Tybout (1997), Bernard and Jensen (2001), and Bernard and Wagner (2001), typically in real business fixed entry costs into the foreign market are necessary in order to start exporting. Let us assume that additionally $\overline{F}$ skilled workers are necessary to become an exporting firm, which means that a larger HQ is necessary in order to manage exporting activities. In this case, the local firms are advantageous in employing additional skilled workers because the rural skilled wage is lower than that in the city.[6] Figure 8 shows that if such additional fixed costs for entering the foreign market exists, some of the city-enlarging effect of international trade may be cancelled out. With higher exporting costs, it is possible that the city becomes smaller with trade than in autarky. This is because it leads to a fewer number of firms, which eases competition and relatively increases the sales and operating

[6] In fact some of the well-known exporting firms in Japan such as Toyota, Yamaha, Suzuki or Nintendo do not have their headquarters in metropolises like Tokyo.

profits of local firms which have higher costs.

Figure 8: Trade and urban size with fixed costs for entering the foreign market



5. Concluding remarks

In the framework in this paper, the Krugman and Livas-Elizondo (1996) result that trade leads to dispersion of economic activities and reduces urban congestion cannot be guaranteed. It is likely that in developed economies today, where large cities or capital cities are characterized as locations that provide business service and host corporate HQs, large cities grow even larger with trade, unless there are such factors as the need for additional skilled workers to manage exporting activities.

Table 4: Comparison with related studies

	This study	NEG literature
Foundation of city or region	Agglomeration of business services and HQs	Agglomeration of manufacturing firms (No spatial separation of individual firms)
Mechanism of city/region formation	Business services in the city attracts corporate HQs.The trade-off between the gains from urban HQs and the urban cost (land rent/commuting cost) determines the equilibrium city size and the share of the two types of firms.	Market size and the price index effects support agglomeration. (The larger city/region has lower prices and larger markets of traded goods). When trade costs between the two internal cities/regions are low, the market size and the price index effects outweigh the local competition effect.
Impact of trade liberalization on internal geography	Trade liberalization (larger foreign market size) leads to a larger city But a fixed cost of foreign market entry acts as a dispersion force; the city can even be smaller with trade than the autarky level Reducing existing trade costs between a small foreign economy may also lead to a smaller city	Krugman and Livas-Elizondo (1996): Trade leads to dispersion between the two cities. Trade liberalization weakens the agglomeration force because of the urban congestion cost which is independent from international transport cost Paluzie (2001): Trade liberalization leads to agglomeration of internal geography Trade liberalization weakens the local competition effect (working as a dispersion force) because firms no longer have to compete only over a small local market of immobile farmers when they agglomerate in one region

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