Agglomeration in World Cities

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Abstract

World cities (or global cities) are defined by various aspects such as socioeconomic, political and cultural characteristics by several organizations. Some world cities have been growing rapidly, whereas others have not. The purpose of this paper is to investigate economic reasons for the variations in the growth of world cities. According to the literature, there are roughly two possible reasons for the variations: costs of transport and trade and spillover effects of knowledge and technologies.

First, Martin and Ottaviano (1999) have developed a dynamic model of new economic geography, where accumulation of knowledge and technologies by research and development is the engine of economic growth. The accumulation of knowledge and technologies often spills over geographically limited regions. Although it is not easy to test the spillover effect of knowledge and technologies, we explore the effects of the economic growth (the GDP growth rate) and the trade dependency (the degree of dependence on foreign trade) as surrogate for knowledge spillover on urban agglomeration (the population share of the largest city).

Second, Behrens, Gaigne, Ottaviano and Thisse (2007) have shown that the degree

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of spatial agglomeration depends not only on the level of transport costs within a country, but also trade costs between countries. More specifically, they have shown that agglomeration is sustained when the domestic transport costs are low and the international trade costs are high. This would be true in Japan because Japan is geographically small with improved transport systems and is imposing high import tariffs especially for agricultural products. On the other hand, this is not true in the United States because the United States is geographically large and is imposing low tariffs. We examine the effect of the trade openness on the degree of agglomeration to the largest city in order to see if the results by Behrens, Gaigne, Ottaviano and Thisse (2007) hold.

We explore the reasons for agglomeration and dispersion in the world cities by regression analysis using the international data. We find that the factors affecting the level of agglomeration in the world cities differ from those affecting the change in agglomeration. We show that the level of agglomeration in the world city is negatively affected by the trade openness, while positively affected by the secondary and tertiary shares, and being a national capital. We also show that the change in agglomeration to the world city is strongly affected by economic development, weakly affected by the trade openness, and unaffected by being a national capital. Finally, we confirm that the country fixed effects are important factors of the changes in agglomeration to the world city.

Keywords: agglomeration, economic development, trade openness
J.E.L. Classification: R11, R12

1. Introduction

World cities (or global cities) are defined by various aspects such as socioeconomic, political and cultural characteristics by several organizations such as the Globalization and World Cities Study Group and Network (GaWC). Some world cities have been growing rapidly in certain periods, whereas others have not. In this paper, we examine economic reasons for the variations in the growth and decline of world cities.

New economic geography mainly focuses on growth and decline of economic activities in urban regions, where the spatial distribution of economic activities is determined by the trade costs consisting of physical transport costs, tariffs and non-tariff barriers. However, new economic geography does not necessarily predict the agglomeration or dispersion tendencies.

In his pioneering work, Krugman (1991) showed that decreasing trade costs yields agglomeration of economic activities to core regions involving world cities. On the other hand, Helpman (1998) showed the opposite: falling trade costs leads to dispersion of economic activities. The difference between the two outcomes is ascribed to the differences in their assumptions on dispersion forces. As a dispersion force, Krugman (1991) assumed immobile farmers who demand manufacturing products, whereas Helpman (1998) assumed land consumption for nontraded goods such as housing. It is know that the immobile demand acts as a dispersion force for high trade costs, while the land consumption acts as a dispersion force for low trade costs. As a result, the former yields an agglomeration trend while the latter a dispersion trend for a steadily decrease in trade costs. In fact, incorporating these two dispersion forces, Tabuchi (1998) showed the U-shaped relationship: agglomeration tendency in the early period and the dispersion tendency in the late period.

There are other factors of agglomeration and dispersion besides the immobile demand and land consumption in the literature on new economic geography. For example, Tabuchi and Thisse (2002) showed that attachment to region is a dispersion force be-cause it hinders migration to urban regions, i.e., world cities. Furthermore, Fujita, Krugman and Venables (1999) and Picard and Zeng (2005) clarified that the agricultural trade cost is also a dispersion force. On the other hand, agglomeration economies due to face-to-face communications are technological externalities and considered to be an agglomeration force. In sum, there is no agreement in the relationship between the level of agglomeration to world cities and the trade costs, and hence, new economic geography does not have a precise predictive capability.

According to the vast literatures on urban growth and decline, one can think of three major reasons for the variations: (1) economic development, (2) trade openness, and (3) being political capital. Note that economic development and trade openness are interrelated through spillover effects of knowledge and technologies.

The first reason is economic development. Panayotou (2001, Figure 16.1) found a strong correlation between the urban population share and GNP per capita using Asian country data in 1995. That is, the degree of urbanization is affected by the level of economic development. Hohenberg and Lees (1985) showed that economic growth accelerates urban agglomeration and vice versa. These studies suggest that Industrial Revolution is the engine of economic growth as well as the engine of urban agglomeration.

Martin and Ottaviano (1999) developed a dynamic model of new economic geography, where accumulation of knowledge and technologies by research and development is considered the engine of economic growth. The accumulation of knowledge and technologies often spills over geographically limited regions. Because it is not easy to test the spillover effect of knowledge and technologies directly, we explore the effects of the economic growth (the GDP growth rate) and the trade dependency (the degree of dependence on foreign trade) as a surrogate for knowledge spillover on urban agglomeration (the population share in the largest city).

The second reason is trade openness. Distance has been the major obstacle to trade for years. However, the obstacle has been steadily decreasing due to improvements in transport facilities in the aftermath of the Industrial Revolution as demonstrated by Bairoch (1997). In fact, Cipolla (1962) argues that "Fast and cheap transportation has been one of the main products of the Industrial Revolution". Furthermore, the tariffs have been decreasing over time in the world (Combes, Mayer and Thisse, 2008). These exogenous changes in trade costs have been contributing to the emergence of agglomeration of economic activities according to Krugman (1991), whereas they have been contributing to dispersion of economic activities according to Helpman (1998) as mentioned above.

Behrens, Gaigne, Ottaviano and Thisse (2007) constructed a model of international and interregional trade building on Ottaviano, Tabuchi and Thisse (2002). They showed that the degree of spatial agglomeration depends not only on the level of domestic transport costs within a country, but also international trade costs between countries. They further showed that agglomeration is sustained when the domestic transport costs are low and the international trade costs are high. This is true in Japan because Japan is geographically small with improved domestic transport systems whereas Japanese government is imposing high import tariffs especially on agricultural products. On the other hand, the opposite may be true for the United States because the United States is geographically large and is imposing low tariffs in most of commodities. Based on their results, we predict that decentralization from the largest city takes place as international trade costs decrease given unchanging domestic transport costs.

The third reason is political capital. Casual empiricism suggests that when the largest city coincides with the national capital, the largest city tends to be large relative to the rest of the cities in the same country. They are Paris, Tokyo and Buenos Aires. This may be ascribed by the fact that agglomeration of economic activities is enhanced by non-market interactions through face-to-face communications between company workers and government officials in addition to those among company workers in private firms. On the other hand, when the national capital is located in the largest city, the largest city is not distinct relative to the rest of the cities. For example, Shanghai, New York and San Paulo are not so large relative to the second largest cities.

There are few studies on international comparison of the world city growth. Using extensive data on cities in the Americas, Galiani and Kim (2010) showed that political capitals contribute significantly more to urban concentration in Latin America possibly due to the centralization of political power in the Americas, a factor which has deep colonial roots.

In the next section, we present descriptive statistics. Based on the above considerations, and explore the effects of (1) economic development, (2) trade openness, and (3) political capital on the degree of agglomeration to the largest city, we investigate the degree of agglomeration to the largest city in section 3 and the change of agglomeration in the largest city in section 4. Section 5 concludes the paper.

2. Descriptive analysis

We pay attention to the growth and decline of the world cities, such as New York, London, Peking, and Tokyo. Because there is no unanimous definition for world cities, we consider the largest city in each country as a surrogate for a world city. Since the largest cities often spread beyond municipal boundaries, we choose metropolitan areas (MAs) rather than municipal city areas as the unit of analysis. Although the definitions of MAs differ between countries, United Nations has a database of urban agglomerations which include both central cities and suburbs with a unifying definition of MAs across countries.[3] This is open to the public at the

3) According to World Urbanization Prospects (http://esa.un.org/wup2009/wup/source/country.aspx), the term "urban agglomeration" refers to the population contained within the contours of a contiguous territory in-habited at urban density levels without regard to administrative boundaries. It usually incorporates the population in a city or town plus that in the suburban areas lying outside of but being adjacent to the city boundaries. Whenever possible, data classified according to the concept of urban agglomeration are used. However, some

web site of World Urbanization Prospects: The 2009 Revision Population Database.

From this database, we select top 30 countries with the highest national GDP in 2005. We focus on the population of the largest MA (= agglomeration) in these countries is our analytical category. They are given in the Appendix. We have collected the data for every five years of 1950, 1955, . . . , 2005. Since the national population in each country has been increasing during the study period, the population in each largest MA has also been increasing. However, due to interregional migration, the population shares of some largest MAs were increasing while others were decreasing over time. In order to check this trend, we regressed the population share of the largest MA on the year using the ordinary least square method. That is, for each country *c*, we ran the following simple time-series regression:

$$s_t^c = a + \beta t + \varepsilon_t \qquad (1)$$

for t=1950, 1955, . . . , 2005. i.e., the number of observations is 12. The dependent variable s_t^c is the population share of the largest MA in country c and year t, the independent variable t is the year, and the last term ε_t is a stochastic error. It was revealed that the regression coefficient β is significantly positive in 23 countries, significantly negative in 6 countries, and insignificant in 1 country out of 30 countries at the 5 percent level. We may roughly say that *most of the world cities are gaining the population share after the World War II.*

Figure 1 displays the increasing population share of the largest MA in the 23 coun-tries over time. The slope is the steepest in Seoul, then Riyadh, and then Tokyo, where the population has been concentrating to the largest MA very rapidly.

countries do not produce data according to the concept of urban agglomeration but use instead that of metropolitan area or city proper. If possible, such data are adjusted to conform to the concept urban agglomeration. When sufficient information is not available to permit such an adjustment, data based on the concept of city proper or metropolitan area are used.

Figure 2 depicts the decreasing population share of the largest MA in the 7 countries one of which is insignificant. The slope is the steepest in Caracas, then London, and then Amsterdam.

Figure 1 is about here

Figure 2 is about here

The first question is why these shares differ among countries. The second one is why these shares have been increasing in some countries, whereas others have been decreasing. As we discussed in the introduction, there are in various economic factors for agglomeration and dispersion of the largest MA (= world city) such as development stages, trade openness, being capital, and so forth. We explore these economic factors on the first question in the next section and the second question in section 4 by using econometric analysis.

3. Level of agglomeration

We first consider why the level of agglomeration differs among countries. Due to lack of time-series data, we can only use the data for t = 1965,1970,..., 2005 and c = 1,2,...,30. Let s^c_t be the share of the largest MA in country c and year t, G^c_t be the real GDP per capita in country c and year t, and o^c_t be the trade openness defined by (import + export)/GDP in country c and year t, $v^c_{2,t}$ be the value added share of the secondary sector mainly manufacturing industry, and $v^c_{3,t}$ be the value added share of the tertiary sector mainly service industry. Also let K^c be the national capital dummy, which is 1 if the largest MA is the capital, and 0 otherwise. The range and mean of these variables are summarized in Table 1.

Table 1: Summary statistics of the major data for 1965-2005

variables	minimum	maximum	mean
population share of largest MA s^c_t (%)	7.0	8.33	4.11
real GDP per capita G^c_t (constant 2000 USD)	122	38972	8488
trade openness o^c_t (%)	5.32	220	51.8
VA share of secondary sector $v^c_{2,t}$ (%)	6.12	72.2	2.35
VA share of tertiary sector $v^c_{3,t}$ (%)	21.6	77.0	52.8

Using the panel data constructed in the above, we run the following regression for t = 1965,1970,..., 2005 and c = 1,2,...,30, where ε^c_t is a stochastic error.

$$s^c_t = a + \beta_1 G^c_t + \beta_2 o^c_t + \beta_3 v^c_{2,t} + \beta_4 v^c_{3,t} + \delta K^c + \varepsilon^c_t \tag{2}$$

Although there are 9 years and 30 countries, the number of observations is 235 due to lack to data in some periods and some countries. There may exist a problem of endogeneity in regression (2) because the GDP per capita G^c_t and the trade openness o^c_t are in turn determined by the degree of agglomeration to the largest city, s^c_t. However, we do not investigate the problem further due to the limitation of internationally comparable data.

The regression results are summarized in Table 2.

Table 2: Regression result of regression (2)

dependent variable	s_t^c
constant	-8.93***
per capita GDP G_t^c	0.000013
trade openness o_t^c	-0.00673***
secondary share $v_{2,t}^c$	0.194***
tertiary share $v_{3,t}^c$	0.221***
capital dummy K^c	7.19***
adjusted R^2	0.302

Note: *** significant at 1% level

The regression results in Table 2 may be summarized as follows. First, the regression coefficient of the GDP per capita G_t^c is insignificant implying that the level of economic development would not be related to the level of agglomeration in the world city. Second, the regression coefficient of the trade openness, o_t^c, is significantly negative. This means that population is dispersed in countries with high freeness of trade while population is concentrated in isolated countries. This result may suggest that trade is a s*ubstitute for urban agglomeration*. Third, the secondary and tertiary shares, $v_{2,t}^c$ and $v_{3,t}^c$, are positive and significant. This implies that industrialization accompanied with high secondary and tertiary shares is closely related to urbanization and concentration to the world city. This is consistent with the previous literature. Fourth, the capital dummy K^c is also positive and significant, which means that the casual empiricism mentioned in the introduction is correct. That is, being a capital is an important factor of agglomeration to the capital city.

4. Change in agglomeration

Next, we consider why the share s_t^c of the largest MA has been increasing in some countries while decreasing in other countries. We focus on the analysis of the long-run agglomeration trend. We deal with the five-year changes for 1965-2005 rather than 1950-2005. For t = 1970,1975...,2500 and c = 1,2,...,30, let $\Delta s_t^c \equiv s_t^c - s_{t-5}^c$ be the five-year percent change in the share of the largest MA, $g_t^c \equiv (G_t^c - G_{t-5}^c)/ G_{t-5}^c$ be the five-year growth rate in G (≡ the real GDP per capita), and $\Delta o_t^c \equiv o_t^c - o_{t-5}^c$ be the five-year percent change in the trade openness o(≡ (import + export)/GDP), $\Delta v_{2,t}^c$ be the percent change in the value added share of the secondary sector, and $v_{3,t}^c$ be the percent change in the value added share of the tertiary sector. The seven period dummies are given by $T_{\tau,t}$ (τ = 1970,1975,...,2000), which are 1 if $\tau = t$, 0 otherwise. The 29 country dummies are $C^{\varsigma,c}$(ς = 1,2,000,29), which are 1 if $\varsigma = c$, 0 otherwise. The range and mean of these variables are listed in Table 3.

Table 3: Summary statistics of the major data for 1965-2005

variables	minimum	maximum	mean
% change in population share of largest MA Δs_t^c	−1.8	2.70	0.23
growth rate of GDP per capita g_t^c	−0.18	0.98	0.14
% change in trade openness Δo_t^c	−21.4	45.2	5.37
% change in VA share of secondary sector $\Delta v_{2,t}^c$	−14.9	16.4	0.43
% change in VA share of tertiary sector $\Delta v_{3,t}^c$	−12.4	15.2	1.26

Using the panel data constructed in the above, we run the following regression for t = 1970,1975,...,2005 and , c = 1,2,...,30, where is a stochastic error.

$$\Delta s_t^c = \alpha + \beta_1 g_t^c + \beta_2 \Delta o_t^c + \beta_3 \Delta v_{2,t}^c + \beta_4 \Delta v_{3,t}^c + \sum_{\tau=1970}^{2000} \gamma_\tau T_{\tau,t} + \delta K^c + \varepsilon_t^c \tag{3}$$

Although there are 8 periods and 30 countries, the number of observations is 199 due to lack to data in some periods and countries. In order to check multicollinearity, we computed the correlation coefficients of the independent variables and found that all the correlation coefficients are less than 0.379 in absolute value. This confirms absence of multicollinearity in running the regression (3).

The regression results are summarized in Table 4.

Table 4: Regression result of regression (3)

dependent variable = change in largest MA share Δs_t^c	(A)	(B)	(C)	(D)
constant	0.00814	0.00962	−0.0614	−0.0561
per capita GDP growth rate g_t^c	1.62***	1.35***	1.38***	1.22***
trade openness change Δo_t^c	−0.00176	−0.00532	−0.00213	−0.00451
secondary share change $\Delta v_{2,t}^c$	—	0.0425	—	0.0281
secondary share change $\Delta v_{3,t}^c$	—	0.0258	—	0.0172
period dummies $T_{\tau,t}$	—	—	yes	yes
capital dummy K^c	−0.00732	0.00089	−0.00561	0.00031
adjusted R^c	0.103	0.117	0.142	0.143

Note: *** significant at 1% level, ** significant at 5% level, * significant at 10% level

Observe that the regression results (A)-(D) in Table 4 are common in the following respects. First, the per capita GDP growth rate g_t^c is very significant is each regression, implying that *the economic development positively affects the degree of agglomeration to the world city*. This is consistent with the literature mentioned in the introduction. Note that the results on the change of agglomeration are different from the result on the level of agglomeration in Table 2 in the previous section. That is, the per capita GDP growth rate affects the agglomeration change whereas the per capita GDP does not affect the agglomeration *level*.

Second, the change in trade openness, Δo^c_t, is insignificant in each regression. The insignificance may be attributed to two opposing effects. On the one hand, as shown by Behrens, Gaigne, Ottaviano and Thisse (2007), falling trade costs leads to dispersion of economic activities within a country, and thus the world city loses the population share. On the other hand, a deepening economic integration with trade freeness fosters economic growth, and hence agglomeration to the world city. The insignificance of the change in trade openness may be a market outcome of these two opposing effects.

Third, the changes in the secondary and tertiary shares, $\Delta v^c_{2,t}$ and $\Delta v^c_{3,t}$, are shown to be positive. This may be explained by the fact that industrialization creates new employment in the secondary and tertiary sectors which are often agglomerated in world cities.

Fourth, the capital dummy K^c is insignificant is each regression, which means that the casual empiricism mentioned in the introduction is not statistically correct. That is, being a capital is not a main factor of agglomeration tendencies. Instead of the capital dummy K^c, we next introduce country dummies $C^{\varsigma,c}$ defined above. In this case, we cannot include both the national capital dummy and the country dummies $C^{\varsigma,c}$ in the regression because K^c is dependent on the linear combination of the 29 country dummies $C^{\varsigma,c}$.

The new regression equation to be estimated is as follows.

$$\Delta s^c_t = \alpha + \beta_1 g^c_t + \beta_2 \Delta o^c_t + \beta_3 \Delta v^c_{2,t} + \beta_4 \Delta v^c_{3,t} + \sum_{\tau=1965}^{1995} \gamma_\tau T_{\tau,t} + \sum_{\varsigma=1}^{29} \delta^\varsigma C^{\varsigma,c} + \varepsilon^c_t \qquad (4)$$

The results are listed in Table 5.

Table 5: Regression result of regression (4)

dependent variable = change inlargest MA share Δs^c_t	(A’)	(B′)	(C′)	(D’)
constant	0.00293	0.0103	—0.406	—0.312
per capita GDP growth rate g^c_t	1.62***	1.35***	1.71***	1.37***
trade openness change Δo^c_t	—0.00179	—0.00531	0.00180	—0.00277
secondary share change $\Delta v^c_{2,t}$	—	0.0423**	—	0.0517***
tertiary share change $\Delta v^c_{3,t}$	—	0.0258*	—	0.0264*
29 country dummies $C^{\mathcal{C},c}$	—	—	yes	yes
adjusted R^2	0.117	0.140	0.412	0.433

Note: *** significant at 0.01% level, ** significant at 0.05% level, * significant at 0.10% level

The difference between the four regressions (A)-(D) in Table 4 and the four regressions (A’)-(D’) in Table 5 is country dummies. The former uses the capital dummy, while the latter uses the 29 country dummies. The adjusted R^2 between the first two regressions (A)-(B) in Table 4 and the first two regressions (A’)-(B’) in Table 5 are nearly the same. However, the R^2 adjusted between the last two regressions (C)-(D) in Table 4 and the last two regressions (C’)-(D’) in Table 5 are very different. This suggests that *introducing the country dummies* $C^{\mathcal{C},c}$ *significantly raises the adjusted* R^2 *from* 0.14 *to* 0.43. Hence, we should pay more attention to the last two regressions (C’)-(D’) in Table 5, which shows that in comparison to being the capital, the country fixed effects are very important factors of the changes in agglomeration to the world city.

The significance of the regression coefficients of the dependent variables is more or less the same between Tables 4 and 5 indicating the robustness of the model. The GDP per capita growth rate, g^c_t, is significant, the change in trade openness, Δo^c_t, is insignificant, and the changes in the secondary and tertiary shares, $\Delta v^c_{2,t}$ and $\Delta v^c_{3,t}$, are in/significant, and some of the country dummies $C^{c,c}$ are significant and others are not.

5. Conclusion

Thus far, we have investigated the reasons for agglomeration and dispersion in the world cities by regression analysis using the international data of World Urbanization Prospects. We have found that the factors affecting the level of agglomeration in the world cities are different from those affecting the change in agglomeration.

Specifically, we have shown that the level of agglomeration in the world city is negatively affected by the trade openness, and positively affected by the secondary and tertiary shares, and being a national capital. We have also shown that the change in agglomeration to the world city is strongly affected by the economic development, weakly affected by the trade openness, and unaffected by being a national capital. Finally, we have confirmed that the country fixed effects are important factors of the changes in agglomeration to the world city.

Appendix:

The largest cities in the top 30 countries with large national GDP in 2005 are New York in USA, Shanghai in China, Tokyo in Japan, Mumbai in India, Berlin in Germany, Moscow in Russia, London in UK, Paris in France, San Paulo in Brazil, Rome in Italy, Mexico City in Mexico, Madrid in Spain, Seoul in South Korea, Toronto in Canada, Istanbul in Turkey, Jakarta in Indonesia, Teheran in Iran, Sydney in Australia, Amsterdam in Netherlands, Warsaw in Poland, Riyadh in Saudi Arabia, Buenos Aires in Argentine, Bangkok in Thailand, Johannesburg in South Africa, Cairo in Egypt, Karachi in Pakistan, Bogota in Colombia, Brussels in Belgium, Kuala Lumpur in Malaysia, and Caracas in Venezuela.

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Figure1: Increasing population share of the largest agglomeration

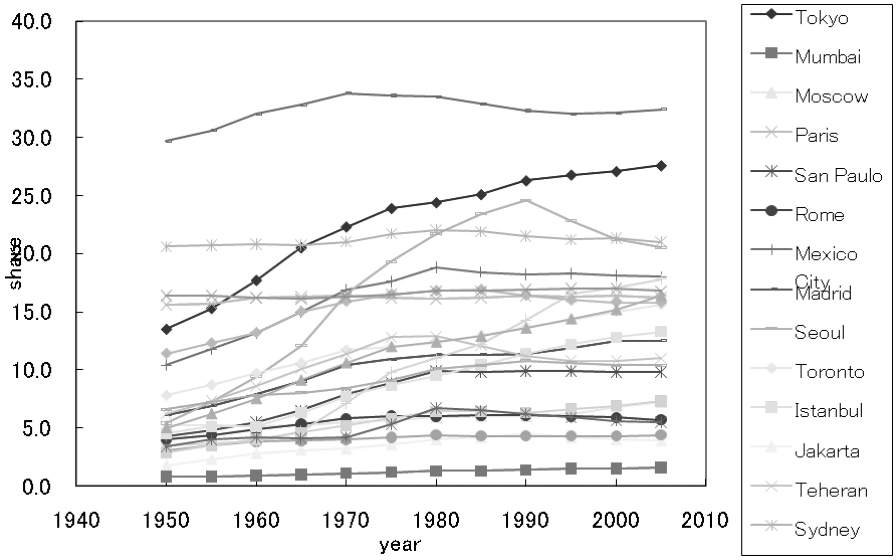

Figure2: Decreasing population share of the largest agglomeration