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Ramírez Grajeda, Mauricio and Sheldon, Ian

Universidad de Guadalajara, The Ohio State University

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TRADE OPENNESS AND CITY INTERACTION

Mauricio Ramírez Grajeda[a] & Ian Sheldon[b]

Abstract

The New Economic Geography framework supports the idea that economic integration plays an important role in explaining urban concentration. By using Fujita *et al*. (1999) as a theoretical motivation, and information on the 5 most important cities of 84 countries, we find that the size of main cities declines and the size of secondary cities increases as a result of external trade. Similar results are obtained for cities with a population over a million. However, cities with a large fraction of the urban population grow independently of their position in the urban ranking. The implications for urban planners and development economists is that investment in infrastructure must take place in secondary cities when a country is involved in a process of trade liberalization, especially, those located near ports.

Keywords*:* New Economic Geography, Trade Openness, Agglomeration and Urban Economics.
JEL Classification: F12, F15 and R12.

"Trade is spatial by nature."

Rossi-Hansenberg (2006, p. 1464)

Introduction

During the 1950s, 1960s and 1970s the "import substitution" paradigm dominated within policy circles in countries of the developing world such as Brazil, India or Mexico, among others, see Edwards (1993) and Krueger (1997). In addition, metropolises also emerged in those countries: Sao Paulo, Bombay and Mexico City. This paper deals with

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[a] *Corresponding author.* Universidad de Guadalajara, Centro Universitario de Ciencias Económico Administrativas, Departamento de Métodos Cuantitativos. Periférico Norte 799, Módulo M, segundo nivel, C.P. 45100, Zapopan, Jalisco, México. *E-mail:* ramirez-grajeda.1@osu.edu. Tel. +52 (33) 3770 3300 ext. 5223.
[b] Andersons Professor of International Trade. The Ohio State University. Department of the Agricultural, Environmental and Development Economics. 234 Agricultural Administration Building, 2120 Fyffe Av. , Columbus, OH, 43210. *E-mail:* sheldon.1@osu.edu. Tel. (614) 292 0078 ext. 5223.
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this relationship between foreign trade and internal geography under the New Economic Geography (NEG) paradigm.[1]

In this context, standard trade theory does not explain both intra-industry trade and its spatial implications, but instead focuses on the reasons for trade, the impact on prices due to changes in fundamental variables, the welfare implications of trade and the allocation effects of trade restrictions. Moreover, the system of cities literature mainly consists of intrametropolitan analysis of spatial structure, but lacks an explicit model with intermetropolitan implications (Ionnides, 2004).

The theoretical basis of this paper, (Krugman & Livas, 1996) and (Fujita, Krugman and Venables, 1999), does frame old ideas on space, intra-industry trade and city interaction by embedding trade costs, increasing returns to scale and love for variety in a general equilibrium setting.[2] The former claims that restrictive "trade policies of the developing countries and their tendency to develop huge metropolitan cities are closely linked". On the other hand, trade openness undermines advantages of urban concentration which arise from proximity to industrial suppliers and consumers. The market structure associated with (Krugman & Livas, 1996), and Fujita *et al.* (1999) is monopolistic competition à la (Dixit & Stiglitz, 1977). Given three local cities and high international trade costs, the larger a city is, in terms of population, the higher its real wage is with respect to the secondary ones (centripetal force). Therefore, consumers/workers migrate

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[1] This paper focuses on the distribution of economic activity across space under the NEG framework. However, according to (Fujita & Thisse, 1996), there are two other major approaches that also address this issue. One takes informational spillovers under perfect competition as a centripetal force, see Henderson (1974) and Rauch (1991). The other considers spatial competition under strategic interaction, Hotelling (1929).

[2] NEG reintroduces old ideas on space from Von Thünen (1826), Weber (1909), Christaller (1933) and Lösch (1940).

from the secondary cities to the main one. Although more concentration negatively affects real wages due to congestion (centrifugal force), workers keep flowing to the main city up to the point where real wages are equalized across cities because both opposite forces cancel each other out. This self-reinforcing dynamic is interrupted when international trade costs fall below a threshold, where agglomeration does not sustain differentials in real wages for further population growth. In summary, concentration of production activities arises from the interplay of centripetal and centrifugal agglomeration forces. These models work for any level of urban population and suggest that city interaction arises as a consequence of trade openness because it enhances competition among secondary cities to attract workers that have moved out from the main city.

Stylized facts show that both trade openness and urbanization have steadily grown since 1970. By assuming spatial dependence, the aim of this paper is to disentangle the effects of trade openness on the size of the most important cities for 84 countries after controlling for political, geographic and economic factors in the 1970-2000 period. The key results are that main cities reduce in size and secondary cities (ranked from 2 to 5) grow when trade openness is increased. Similar results arise for cities with a population over a million. In both cases our results are consistent over time and for different trade openness definitions related to trade volumes. With respect to cities whose population represents 5 percent or more of the urban population little can be said though. Furthermore, the fundamental relationship between internal trade costs and the size of cities established by Krugman (1991) is empirically supported: the higher the trade costs are the lower is the urban agglomeration.[3]

In this vein, other economists have given a prominent role to the effects of international trade on the world's main cities size. Venables (1998) investigates the effects of external trade costs on the share of manufacturing employment. A single city will have a high amount of employment when the economy of a country is closed to external trade. However, when the economy has access to imports due to lower trade costs the amount of industrial employment goes down. The economy develops a duocentric structure if it is open to external trade. Alonso-Villar (2001), following the (Krugman & Livas 1996) setting, adds a new foreign country and suggests that the negative relationship between trade openness and city size depends on the relative size of the home country. If it is small with regard to the rest of the world, a dispersed equilibrium is not sustainable given low levels of trade costs. By the same token, Mansori (2003) introduces a fixed and a marginal trade cost that may cause the following two outcomes after trade barriers fall. One is that a megalopolis that is already in equilibrium does not shrink in size: Buenos Aires and Bangkok are examples of this outcome; and the other is that cities in the dispersed equilibrium become a megalopolis like Seoul.[4]

In the NEG literature, there are different explanations for urban concentration. For example, Puga (1998) explains the urbanization differences between Europe and developing countries. He finds that European countries developed a balanced urban

[3] There is an inconsistency in (Ades & Glaeser, 1995). On pages 211-212, they claim that their results support Krugman (1991): high internal trade costs create incentives for the concentration of economic activities. But they should have written dispersion instead of concentration.

system in the 19th century due to high trade costs, weak economies of scale and a relatively low supply of labor from rural areas. On the contrary, in developing countries trade costs were low, economies of scale at firm level strong and there was an abundant pool of peasants available to migrate into their cities.

On the empirical side, (Rosen & Resnick, 1980) show that countries that export a small fraction of their gross national product tend to have a larger degree of urban primacy. (Ades & Glaeser, 1995) examine the forces that concentrate population in a single city. They define three types of agglomeration force: political, economic and geographic. They use a sample of 85 countries and information on their prime cities. Their basic results related to political forces are that main cities are 42 percent larger if they are also capitals; they are 45 percent larger in countries with dictatorial regimes. Furthermore, political factors affect urban concentration but not the other way around. The results related to economic forces are the following: first, a one standard-deviation increase in the share of trade in GDP reduces the size of the main city by 13 percent; second, a 1 percent increase in the ratio of import duties increase the size by 3 percent; and finally, a 1 percent increase in the share of government transportation expenditure in GDP reduces the size by 10 percent. Regarding geographic forces a 10 percent increase in the area of the country increases population in the main city by about 1.2 percent.

Hanson (1998) summarizes the literature on changes in spatial organization among North American countries since NAFTA took place. More precisely, he focuses on the case of Mexico City to demonstrate that its population decreased due to a process of trade

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[4] Contrary to what Mansori claims, (Henderson, Shalizi & Venables, 2001) find that Korea has experienced a process of deconcentration of manufacturing due to infrastructure improvements.

liberalization that started in the mid-1980s.[5] After forty years of industrialization based on the “import substitution” paradigm, Mexico opened its economy to international trade by becoming a member of the General Agreement of Tariffs and Trade (GATT). Hanson (1996, 1997) finds that trade liberalization has contributed toward the break up of the traditional manufacturing belt around Mexico City and the formation of export oriented centers along the U.S.-Mexican border.

(Gaviria & Stein, 2000) find that the impact of international trade depends on geography. Population growth does not change in cities located at ports whereas landlocked cities exhibit slower growth. Nitsch (2003) tests the effects of trade volumes on the main cities for 111 countries. [6] His most important result is that both main and secondary cities (from 2 to 5) reduce their size with higher trade flows.

It is worth mentioning that the relationship between external trade and city size can have a different explanation outside the NEG theory. For example, (Ades & Glaser, 1995), explain that the current size of Buenos Aires is the result of two factors that arise in the late nineteenth century. One is international migration mainly from Italy and Spain. And two, the concentration of rent seeking activities around international trade activities at this port. Another case is the primacy of Mexico City due to the high level of incentives created by the political system to migrate from rural areas.[7]

The reminder of the paper is divided up as follows. Section 1 contains the theoretical framework and a discussion of the equilibrium conditions. Section 2 suggests

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[5] He never mentions that the very same day that Mexico got its full membership in GATT (9/19/1985), an earthquake killed 30,000 people in Mexico City.

[6] This paper is partially inspired by Nitsch (2003) because he also covers secondary cities.

the hypotheses on trade openness and city size. Section 3 is focused on the model specification and the estimation strategy. Definitions of trade openness are provided in section 4. In section 5, the construction of the data set is explained, while. In section 6, the basic results are shown. Finally, some implications of the results are presented.

1. Theory

To motivate the hypotheses to be tested, this section outlines the model of Fujita *et al*. (1999) for J locations.[8] It embeds imperfect competition in a dynamic general equilibrium setting, and assumes an exogenous congestion cost that directly affects real wages. Specific assumptions are set in order to analyze the way cities interact within an international context for different levels of trade openness.

The economy consists of one sector, which is monopolistically competitive. There are $j = 1, \ldots, J$ locations, each one is endowed with L_j agents (consumers/workers). λ_j denotes the fraction of the population that lives in location j. It is assumed that

$$\sum_{j=1}^{J} L_j = L = 1. \qquad (1)$$

Trade costs are of the Samuelson (1952) type: $T_{jj'} \geq 0$ denotes the amount of any variety dispatched per unit received. [9] It is assumed that if $j=j'$ then $T_{jj'}=1$; and $T_{jj'}= T_{j'j}$. It is worth mentioning four implications of assuming this type of trade costs. First, it

[7] Related references are (Ricahardson & Bae, 2005) and (Kresl & Fry, 2005), who overview the relationship between ubanization and globalization. The latter analyses the cases of Mexico City, Sao Paulo, Tijuana and Bogota.
[8] This model heavily draws on (Krugman & Livas, 1996).
[9] For (Limao & Venables, 2001) the cost of doing business across countries depends on geography, infrastructure, administrative barriers (e.g. tariffs) and the structure of the shipping industry (e.g. carriage, freight and insurance).

avoids the introduction of a transportation industry which might complicate the model when solving for the equilibrium. Second, it is a necessary condition for preserving a constant elasticity of aggregate demand. This feature simplifies the profit maximization conditions.[10] Third, $T_{jj'}$ may represent an explicit ad valorem tariff whose revenues are redistributed among economic agents but dissipated as a consequence of rent-seeking.[11] And fourth, trade costs are not related to the variety or distance between locations.

The representative agent in location *j* derives her utility from consumption represented by

$$U_j = \left(\sum_{n=1}^{N} c_{nj}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}, \qquad (2)$$

where σ is the elasticity of substitution between any pair of varieties and c_{nj} is the consumption of each available variety, *n,* in location *j.* Under these preferences, desire for variety is measured by $(\sigma-1)/\sigma$. If it is close to 1, for example, varieties are nearly perfect substitutes.

At the level of the firm, technology exhibits increasing return to scale.[12] The quantity of labor required to produce *q* units of variety *n* in region *j* is

$$l_{jn} = F + \rho q_{jn}, \qquad (3)$$

where *F* and *v* are fixed and marginal costs, respectively. The firm that produces variety *n* in region *j* pays nominal wage, w_{jn}, for one unit of labor. In order to characterize the

[10] A constant elasticity of aggregate demand means that firms maximize profits by setting a price that is a constant mark-up over marginal cost. A specific level of production satisfies this condition.
[11] Agents devote resources (lobbying expenses, lawyer's fees and public relations costs) to obtain these tariff revenues.

equilibrium, $F = 1/\sigma$ and $\rho = (\sigma\text{-}1)/\sigma$.[13] The number of firms in location j, n_j, is endogenous. $N = n_1+\ldots+n_J$ is the total number of available varieties.

There are two types of prices: mill (or f.o.b) and delivered (c.i.f.).[14] The former are charged by firms. The latter, paid by consumers, are defined as

$$p^n_{jj'} = p^n_j T_{jj'}, \tag{4}$$

where $p^n{}_j$ denotes the mill price of a good of variety n produced in location j. $p^n{}_{jj'}$ is the delivered price in location j'. By the assumptions on trade costs, both prices are equal when $j=j'$.

Real wages in location j are defined as

$$\omega_j = w_j G_j^{-1}, \tag{5}$$

where G_j is a price index, which is the minimum cost of achieving one unit of utility given N varieties and N prices associated with them.[15]

Short- run equilibrium

The economy reaches its short-run equilibrium when agents and firms optimize their utility and profit functions respectively, such that the market clearing conditions in both labor and product markets are satisfied.

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[12] Increasing returns to scale are essential in explaining the distribution of economic activities across space. This is known as the "Folk Theorem of Spatial Economics".
[13] To assume a particular value of F means to choose units of production such that solving for the equilibrium is easier. To assume a particular value of ρ allows us to characterize the equilibrium without loss of generality.
[14] f.o.b stands for free on board and c.i.f. for carriage, insurance and freight.
[15] G is defined in equation 2.6.

Assumptions on agent's taste, trade costs, technology parameters, free entry and exit of firms and a potentially unlimited value of *N*, allow the characterization of the equilibrium as follows. Nominal wages are equal within a particular location. Profits are zero. Since there are no economies of scope each firm produces a single variety. All firms hire the same amount of labor irrespective of the variety they produce and their location, then the level of production across varieties is equal. Within a particular location, mill prices are equal across varieties, then they can be denoted without the *n* as in (4). Agents consume all varieties. Within a particular location, consumption across agents is identical, where the consumption level in location *j* is equal across all varieties produced in j', $n_{j'}$. By knowing this characterization and given $\lambda_1, \ldots, \lambda_j$, then the short- run equilibrium can be redefined as a vector: $\{n_j^*, w_j^*, q^*, l^*, p_j^*, c_{1j}^*, .., c_{Jj}^*\}$ for $j=1, \ldots, J$ such that

(e.1) $\{c_{1j}^*, \ldots, c_{Jj}^*\}$ $Max\ U(c_{1j}, \ldots, c_{Jj})$ s.t. $Y_j=\lambda_j w_j^* \geq \lambda j n_1^* c_{1j} T_{1j} p_1^* + \ldots + \lambda_j c_{Jj} n_J^* T_{Jj} p_J^*$ for all $j=1,..,J,$

(e.2) $\{q^*\}$ $Max\ p_j^* q - w^*(F+vq)$, for any $j=1,\ldots,J,$

(e.3) $q^*=\lambda_1 c_{n1}^* + \ldots + \lambda_J c_{nJ}^*$ for all $n=1,\ldots,J$ and

(e.4) $(n_1^* + \ldots + n_J^*) l^* = L.$

(e.1) is the optimal consumption of the representative agent in location *j*. The maximization of her utility is subject to a budget condition, where her income can be expressed either individually w_j or aggregated $\lambda_j w_j$. Individual consumption in location *i* of all varieties produced in location *j* is denoted by $n_j c_{ji}$. (e.2) is the level of production by any firm. The assumptions of the model allow one to obtain q^* irrespective of the price and wage associated with a particular variety. (e.3) is the equilibrium condition in the product market and (e.4) is the equilibrium condition in the labor market.

The model does not have a closed-form solution. For $j = 1, \ldots, J$ the equilibrium must satisfy the following system of *Jx2* non-linear equations instead:

(6) $$G_j = \left[\sum_{s=1}^{J} \lambda_s \left(w_s T_{js} \right)^{(1-\sigma)} \right]^{\frac{1}{(1-\sigma)}}$$

and

(7) $$w_j = \left[\sum_{s=1}^{J} Y_s \left(T_{js} \right)^{1-\sigma} G_s^{\sigma-1} \right]^{\frac{1}{\sigma}}.$$

(6) represents a price index in location j. (7) is the wage equation, which generates zero profits given prices, income and trade costs. Real wages across locations might be different.

The long-run equilibrium

When real wages are different, labor moves from regions with a low real wage to regions that pay higher real wages. Fujita *et al.* (1999) define

(8) $$\varpi = \sum_{j=1}^{J} \lambda_j \omega_j.$$

The labor share dynamics over time for $j=1, \ldots, J$ is

(9) $$\Delta \lambda_j = \gamma (\omega_j - \varpi) \lambda_j.$$

When (6) and (7) are satisfied there is no interaction among locations. Put another way, it is the (Dixit & Stiglitz, 19977) setting for multiple regions. Then, (9) is added up to connect locations by equalizing it to zero. More precisely, under this particular law of motion, any initial difference in real wages among regions implies that equation (9) is positive, driving over time a population distribution different from the original.[16]

2. Hypotheses on trade openness and city size

Solving out the model summarized in (6), (7) and (9) does not make economic sense because it predicts that the long-run equilibrium will be total concentration in a single city if the original population distribution is unequal across locations. In order to relate urban agglomeration and trade openness, three assumptions are incorporated. First, there are two countries termed, foreign and home. Only one location or city is located in the foreign country and *J-1* in the home country. Trade among *J*-1 cities in the home country involves the same Samuelson (1952) type trade costs, *T*. But trade costs between a particular city in the home country and the unique city in the foreign country is T_0. Second, it is assumed that migration is allowed between cities within the home country but not across countries.

Third, a centrifugal force of concentration like a congestion cost is included. (Krugman & Livas, 1996) consider that labor is not thoroughly effective because agents incur commuting costs. The available labor in one city given γ, is

[16] By using discrete choice theory the size of regions may depend upon other factors different from monetary (wage) considerations. Particularly, there are two departures to explain migration. One, is to assume taste heterogeneity among workers, Murata (2003). The other, is to assume that regions exhibit several features like (Tabuchi & Thisse, 2002).

(10) $$Z_j = L_j(1-0.5\gamma L_j).$$

However, there are other ways to model congestions costs by directly reducing real wages. Fujita *et al.* (1999) use a non linear congestion diseconomy to the city size. Then, real wages are defined as

(11) $$\omega_j = \frac{w_1(1-\lambda_j)^{\delta}}{G_j},$$

where δ is a congestion parameter.

A particular case

In this paper, Fujita´s *et al.* (1999) model is specified in terms of one city in the foreign country and 3 in the home country. [17] The value of the parameters are L_0 = 2 (population in the foreign city), $L_1 + L_2 + L_3 = 1$, δ = 0.1, σ = 5 and T = 1.25. The distribution of the population over time and across domestic cities is represented in the unit simplex in figures 1 and 2. What happens in the foreign city is neglected because the size never changes.

In both figures, the center represents equal distribution of the population across cities. Points (0, 0), (0.5, 0.86) and (1, 0) mean that the whole domestic population is concentrated in cities 1, 2 or 3, respectively. The middle point between the line that joins points (0, 0) and (0.5, 0.86) means that total population is equally divided between cities 1 and 2. In these figures, the initial point of an arrow is a point which represents a short-term equilibrium given a particular distribution of the population. This means that real

[17] In the Fujita´s *et al.* (1999) model there are *J* locations, however, for exposition reasons *J=3:* two local cities and one foreign city.

wages might be different across cities, then labor immigration is expected to generate a new distribution. The length of the arrow represents the magnitude of labor movements over time across cities ($\Delta\lambda_1$, $\Delta\lambda_2$, $\Delta\lambda_3$) and the direction represents the sign of these changes ($\Delta\lambda_j \geq 0$ or $\Delta\lambda_j < 0$).

Figure 1 shows that for high levels of international trade costs ($T_0 = 1.9$), partial concentration in one city is a stable long-run equilibrium. It should be pointed out that concentration in one city is not total because a small fraction of the total population is distributed across the rest of the cities. Equal distribution between three or two cities implies an unstable equilibrium. Internal and international trade takes place and all varieties produced in the economy are consumed in all cities. The main city produces a large variety of goods and the secondary cities produce a limited variety of goods and trade between cities is balanced. Figure 2 shows that the equal distribution of population in the domestic country is a stable long-run equilibrium for high levels of trade openness. Partial concentration in one or two cities is unstable.

Figures 1 & 2

With high international trade costs, both firms and workers, by emphasizing their expenditure on national goods magnify the market size effects of agglomeration through prices and nominal wages. In other words, an extra worker in a particular city represents a higher demand and such a benefit always offsets fiercer competition in the labor market. Thus, equilibrium is reached when congestion costs are high enough to prevent further agglomeration. For lower trade costs (T_0 = 1) imports weight in agents' expenditure is large enough such that any deviation from the dispersed equilibrium is associated with weak market size effects.

Despite the fact that NEG models are highly stylized, their results are quite compelling. Furthermore, adding one domestic city to Fujita *et al.* (1999) allows a richer model in order to consider the following hypotheses to be tested:

Hypothesis 1: Trade openness reduces the size of main cities and increases the size of secondary cities.

Hypothesis 2: Trade openness reduces the size of the main city and increases the size of secondary cities given that these cities represent a substantial fraction of the urban population.

Hypothesis 3: Trade openness reduces the size of the main city and increases the size of secondary cities given that these are heavily populated.

Hypothesis 1 cannot be theoretically established with two cities in the home country because the population in the secondary city is the residual from the main city. In the case of 3 cities, trade openness predicts competition for workers between cities instead, due to their incentives to take advantage of agglomeration. Hypothesis 2 is based on the fact that secondary cities may have some degree of primacy although the main city is overwhelmingly huge. Hypothesis 3 is generated by the lack of implications of the size of the urban population: the model works for any size. For example, given the parameters used in figure 1 (high trade costs: $T_0=1.9$), most of the population is not entirely unexpected to live in one city as it happens to be the case in Dublin or San Jose. The model does not work, for example, for India because in equilibrium hundreds of million people would be expected to live in Bombay.

3. Model specification and method of estimation

As (Behrens & Thisse, 2007) suggest spatial econometrics is a road in empirical regional economics. Nevertheless, they claim that its application to multi-regional trading is "practically non-existent". For this reason among others, in this section we propose 3 basic specifications to test the hypotheses set out in section 2. The first one is linear, cross-sectional, and first order dependences are incorporated as a regressor in the form of a spatially lagged dependent variable, because cities in the model are interconnected, their size is determined simultaneously within a country. The first model, referred to as spatial lag, is expressed as:

(12) $$\boldsymbol{Y} = \boldsymbol{X\beta} + \rho\,\boldsymbol{WY} + \boldsymbol{\varepsilon},$$

where $\boldsymbol{Y}$ is a $nx1$ vector of observations of the dependent variable. $\boldsymbol{X}$ is a nxk matrix of observations on k exogenous variables. $\boldsymbol{W}$ is a nxn the spatial weights matrix of known constants. $\boldsymbol{\varepsilon}$ is a $nx1$ vector of i.i.d error terms. $\boldsymbol{\beta}$ a $kx1$ vector of regression coefficients. ρ is a scalar autoregressive parameter. The spatial lag term $\boldsymbol{WY}$ is correlated with $\boldsymbol{\varepsilon}$, therefore it must be treated as an endogenous variable. $\boldsymbol{W}$ captures the spatial interdependence underlying in figures 1 and 2.The second specification is given by defining a particular spatial structure for the disturbance terms. Hence,

(13) $$\boldsymbol{Y} = \boldsymbol{X\beta} + \boldsymbol{\varepsilon}$$

and

(14) $$\boldsymbol{\varepsilon} = \lambda \boldsymbol{W\varepsilon} + \boldsymbol{\xi}.$$

where $\boldsymbol{\xi}$ is an i.i.d random variable and λ is the spatial autoregressive coefficient for the error lag $\boldsymbol{W}\varepsilon$.[18] (13) is referred to as the spatial error model. This model is applied when the political divisions do not match economic divisions. The third specification assumes $\rho = 0$ in (12). We also carried out estimations of the panel data versions of (12) and (13), see Elhorst (2003), where the general form is usually written as:

(15) $$\boldsymbol{Y_t} = \boldsymbol{X_t\beta} + \rho\, \boldsymbol{WY_t} + \boldsymbol{\varepsilon_t}$$

and

(16) $$\boldsymbol{\varepsilon_t} = \lambda \boldsymbol{W\varepsilon_t} + \boldsymbol{\xi_t}.$$

The assumptions on $\boldsymbol{W}$ are that $w_{ij}=b_{ij}{}^{\phi}/d_{ij}{}^{\alpha}$, where d_{ij} is the distance between city i and j. α and ϕ are parameters equal to one. b_{ij} is equal to one if cities i and j belong to the same country and equal to zero otherwise.

(12) and (13) are not specified directly from theory due to the non-linearities that arise from the assumptions on preferences that impede an analytical solution. Following Anselin (1999, 2003), (12) and (13) partially capture the behavior of NEG models. By assuming that both sorts of innovations, ξ and $\boldsymbol{\varepsilon}$, are distributed as a $\boldsymbol{N}(0,\sigma^2\boldsymbol{I})$ the three models can be estimated by applying the method of maximum likelihood from (Anselin & Bera, 1998). The linear and spatial lag models estimates are obtained by using our own programs in MATLAB and the spatial error lag model by using James Le Sage's web

page programs. OLS estimates from the first model will be biased and inconsistent, and inefficient from the second model. ***Y*** is a vector of the values of the log of city size. The estimation strategy associated with testing the first hypothesis covers the five most important cities in 84 countries. In this case, every country has the same number of observations. The second hypothesis is tested using a sample consisting of cities whose size represents a fraction larger than 0.05 of the urban population. To test the third hypothesis, the sample is selected in terms of absolute population. It consists of cities with a population over a million. Hence the number of observations across countries is not equal to test these last two hypotheses. Some countries have just one observation like Costa Rica or Ireland and others have many observations like the U.S. or Brazil. The estimation is for the 1970-1985 and 1985-2000 periods, and panel data with time fixed effects. By invoking Zipf's (1949) law, samples 1 and 3 might be very similar if countries main city size were equal.[19]

We carry out tests for spatial dependence using the Rao score criterion. In the first model the null hypotheses are H_0: $\rho = 0$ ($RS\rho$) and H_0: $\rho = 0$ in the presence of local misspecification involving spatial-dependent error process ($RS^*\rho$). In the second model the null hypotheses are H_0: $\lambda = 0$ ($RS\lambda$) and H_0: $\lambda = 0$ in the presence of local misspecification involving spatial lag dependence ($RS^*\lambda$). A third test is also carried out for both models where the null hypothesis is H_0: $\lambda = 0$ and $\rho = 0$ ($RS\rho\lambda$). We also obtain the value of the log-likelihood function as goodness of fit. These class of tests only require estimation of the model under the null and also allow for the distinction between

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[18] This process is referred to as spatial autoregressive.

a spatial error and a spatial lag alternative. These tests are also implemented using own MATLAB routines. All of them are converge in distribution as a $\chi^2(1)$.

4. Trade openness definitions

NEG models specifically define international trade openness as low international trade costs, which are an abstraction of transport costs, tariffs, subsidies, taxes, non-tariff barriers, etc. Empirically, then, what are the variables associated with trade openness? Are these variables correlated? Do high trade volumes mean trade openness?[20] Yanikkaya (2003) points out that this definition is not unique and has evolved over time from "one extreme to another". On the one hand, trade liberalization can be achieved by lowering the degree by which the protective structure in a country is biased against exports. For example, subsidizing exports or encouraging export schemes. According to this definition an open economy could have very high import tariffs in order to foster import substitution. On the other hand, Harrison (1996) considers that trade openness is linked to the idea of neutrality, the indifference between earning a unit of foreign exchange by exporting and saving a unit of foreign exchange through import substitution.

Back to Yanikkaya (2003), trade openness can be divided into four categories. First, trade shares in GDP (imports plus exports over GDP). Second, trade barriers that include average tariff rates, export taxes, total taxes on international trade and indices of

[19] Zipf's law states that the number of cities with a population larger than S is approximately proportional to S^{-p} , where the p is close to 1.

[20] (Rodríguez & Rodrik, 2000) claim that trade openness indicators have been problematic as measures of trade barriers. For example, "simple tariff averages underweight high tariff rates because the corresponding import levels tend to be low". Pritchett (1996) addresses the implications of different indicators of trade policy stance to capture a common element that foster growth.

non tariff barriers. According to Baldwin (1989), the former falls under the category of an outcome-based measure and the latter under an incidence-based measure. Third, bilateral payments arrangements (BPAs) as a measure of trade orientation. A BPA is an agreement that describes the general method of settlement of trade balances between two countries. Fourth, the exchange rate black market premium is the most commonly used measure to show the severity of trade restrictions. Nevertheless, it measures a combination of bad policies rather than being a reference to just trade policy.

It is worth mentioning that (Limão & Venables, 2001) show that trade costs do not depend only on artificial or administrative barriers as Yanikkaya (2003) states, but also on countries´ geography and on their level of infrastructure. Remote and landlocked countries trade less than coastal economies. Countries with a poor transport and communications infrastructure have limited participation in global trade.

Earlier empirical work on the cross-country relationship between city size and trade openness does not take into account the implications of using different definitions of trade openness, where trade share in GDP and import barriers have been the standard measures.[21] In this paper, three other measures are used: weighted share of trade with the U.S.; and the share of trade with Japan, Germany and the U.S. jointly; and an instrumental variable.

5. Data

[21] (Anderson & van Wincoop, 2004) survey the measurement of trade costs. They acknowledge that tariffs are less important than other policies.

The data set covers information on 84 countries over two time periods: 1970-1985 as in (Ades & Glaeser, 1995) and Nitsch (2003), and 1985-2000 as in Nitsch (2003).[22] Table 11 shows the cities used in this paper. Both the dependent and explanatory variables for period *t* are constructed by averaging observations over 5 year intervals. For example, the 1970-1985 period averages information for the years 1970, 1975, 1980 and 1985. However, for some variables information is not always available for all years.

Three sample criteria are applied to validate the hypotheses of this paper. The first sample consists of the 5 most populous cities in 2000, and consists of 355 observations. This ranking is invariable over time with the exception of two countries. Holland's main city in the period 1970-1985 was Rotterdam and Amsterdam in the 1985-2000 period. Syria's main city in the former period was Aleppo and Damascus in the latter period. In both periods the largest city is Tokyo and the smallest one is Tipitapa in Nicaragua in the 1970-1985 period. The second contains information on 224 cities with a population over a million in 2000. Faridabad in India and Sana'a in Yemen are the smallest cities of the sample for the first and second period, respectively. The third sample contains 183 cities that represent a fraction larger than 0.05 with regard to urban population in 2000. African cities are the smallest cities in this sample.

Table 1.

Information at the country level changes for three countries: Germany, Yemen and Ethiopia. The first two countries experienced a process of unification, West and East

[22] (Ades & Glaeser´s, 1995) sample covers 85 countries; however, in the appendix only 84 countries are listed. In addition, former European communist countries are not included because their size heavily depended upon central planner decisions, see (Clayton & Richardson, 1989). In the case of China, from 1953 to 1978 industrial location depended upon three principles: geographical proximity to mountains, dispersion and concealment, see Wen (2004).

Germany, and South and North Yemen; and the last one split into Ethiopia and Eritrea. For the first period, information on West Germany, South Yemen and Ethiopia is used. In the second period, information for these "new" countries is used.[23] For panel data estimation these countries are not included. Some countries do not have complete information on their most important cities. For example, there is only information for one city in Costa Rica. Furthermore, information on cities is not clearly defined. A natural question is what are the city bounds? For example, in the case of Germany or Japan there is information on a system of cities that jointly are considered as a single city. In other words the political or administrative divisions do not coincide with the actual economic bounds. This is considered a nuisance in spatial econometrics. For that reason, we assume in one of the model specifications a stochastic process in the spatial error structure. The OECD dummy excludes Turkey and Mexico because they are outliers in terms of income and other economic and social indicators. The central location dummy is 1 when the distance between the city and the country's central point is less than the square root of the land area. Dummies related to central location and access by sea are important determinants of agglomeration as natural advantages of locations, see Kim (1999) and (Ellison & Glaeser, 1999). The lack of political rights and civil liberties dummy is 1 when each component is above 3.5, and 0 otherwise. The road index denotes the ratio of road network over the square root of land area.

We use five definitions of trade openness: share of trade in GDP (STG); weighted by distance share of trade with the U.S. in GDP (WUS); share of trade with Japan, the U.S. and Germany (JUG); import duties as a fraction of total imports (ID), and an

[23] Eritrea is neglected in this sample.

instrumental variable (IV). The weights related to bilateral trade with the U.S. are the distance between the centers of the U.S. and the corresponding country. Therefore, a dollar exported (imported) to (from) Canada has less weight than a dollar exported (imported) to (from) Australia. Trade with Japan, the U.S. and Germany is not weighted by distance because it is assumed that they are equidistant and their volume of trade is similar.[24] The instrumental variable is constructed by following Frankel and Romer's, (1999) estimation strategy and information of bilateral trade between 165 countries (see appendix 2.2). This is a way to overcome endogeneity problems that arise from the correlation between the error term and the trade openness variable. Telephone mainlines is a proxy variable of information technologies (IT).

The main data sources are the U. N. Prospects of World Urbanization, World Bank Indicators, The CIA World Factbook, Vernon Henderson´s Web page, Freedom in the World, and Yanikkaya (2003) and John Helliwell´s bilateral trade data set. See table 13 for details.

Stylized facts on trade openness and urbanization

In figure 3, we observe a clear positive correlation between exports of goods and services as percentage of GDP and urban population as percentage of total population at world level. From 19970 to 1985 the former variable change from 13 percent to 25 percent, the later from 36 percent to 47 percent. Currently, most people live in urban areas.

6. Results

[24] For observations related to cities from Japan, Germany and the U.S., trade information with economies of similar

The results from estimating (12), (13) and (15) with and without spatial dependence are reported in tables 2-10. The analysis is conducted by sample.

Sample 1: main cities

By construction, there is no spatial dependence regarding the sample consisting of only main cities around the world. In this case, (12) given $\rho = 0$ is estimated by OLS and the results are reported in column 1 of tables 2-5. The must noteworthy results are that a 10 percent increase in the share of trade in GDP reduces city size by 6.6 and 5.3 percent in the 1970-1985 and 1985-2000 periods, respectively. However, both estimates are not statistically significant. On the other hand, panel data estimates show that a 10 percent share of trade of GDP causes a city size reduction by 5.6 per cent. In the first period, lack of political rights and civil liberties on average increase the size of a city by 28 percent and they are 39 percent larger if they are capitals, and similar results arise for the 1985-2000 period, however, these coefficients show a lower value. Both sort of variables respectively summarize political instability and rent seeking opportunities. In sum, the Ades and Glaeser, and Henderson (1974) results are confirmed.

The OECD main cities are smaller in both periods, which might suggest that a higher level of taste heterogeneity in OECD countries attenuates urban agglomeration as Murata (2003) suggests. Cities of OECD countries are 25 percent smaller. There is evidence that main cities' size is positively related to nonurbanized population outside of the city. This could be explained by agricultural workers flowing to cities as (Gaviria & Stein; 2000), Puga, (1998) and (Picard & Zeng, 2005) claim. With respect to geographic

size of these countries is used, respectively.

variables, main cities at ports or close to the center of the country are expected to be larger. In both periods, cities' size reaction to trade openness is slightly positive if they fall within the port category, which is consistent with (Fujita & Mori, 1996). And their reaction is negative if the city is close to the center, which concides with Hanson's (1998) results and the (Frankel & Romer's, 1999) rationale. The variable related to IT indicates that by doubling up the telephone lines per 1000 people, city size increases by 22 and 32 percent in each period respectively. It is worth pointing out that within the regional science literature there is no a consensus on the effects of IT on urban structure, see Sohn *et al.* (2002). When using panel data main cities are on average 13 percent larger in the second period. Only under this sample the log of urbanized population outside the city is taken as an explanatory variable because in the other models the equivalent to this variable is ***WY***.

Sample 2: the five largest cities.

The estimates without assuming spatial dependence show that city size is positively related to trade openness. On the other hand, the impact of international trade on city size for different definitions of trade openness barely changes from our benchmark trade openness definition. In particular, using STD, WUS, JGU and ID, we find that main cities decrease in size and secondary cities increase in size in the both periods as a result of openness to trade.[25] But a higher value of ID for the second period implies that all cities increases in size as well. However, using IV the estimation predicts that both main and

[25] Recall that higher ID means lower levels of trade openness.

secondary cities decrease in size for higher levels of trade openness for the first and second periods, and panel data as well.

MLE is the method of estimation when the sample is selected by city ranking and the specification model is spatial lag, whose results are reported in tables 2-5. In sum, a 10 percent increase in the share of trade in GDP increases the size of top 5 cities by 3 percent for the 1970-1985 period and 2 percent for the 1985-2000 period, after controlling for the main city status. Both main and secondary cities are larger if they have access by water. But if they are located close to the center of the country such a condition does not have a significant impact on their size. Political liberties and civil rights negatively impact on the size of cities in the 1970-1985 period but not in the 1985-2000 period. It is worth mentioning that countries in Latin America have turned to democratic regimes since 1985. Even some OECD countries such as Spain, Portugal, Greece, Korea, Turkey and Mexico have noticeably increased their level of civil liberties since the mid-1970s as well. A positive ρ can be interpreted as that people leaving the main city went to cities of immediate lower ranking as a consequence of international trade. OECD countries have smaller cities. Over time cities grew 12 percent. Regarding main cities trade openness have a negative net impact on main cities´ size. In the first period a 10 per cent increase in trade openness reduce the size approximately 1.7 per cent and 4 percent in the second period.

For the error lag specification, MLE is also the method of estimation. The results are similar to the spatial lag specification. Here we focus our attention on the trade openness variables. The results are consistent over all definitions except the IV where secondary cities are negatively related to trade openness. Regarding ID, restrictive policies shrinks the size of secondary cities but increases the size of main cities. The instrumental variable associated with the 1970-1985 period must be carefully taken because it is weakly correlated (0.5) with the actual share of trade in GDP and its explanatory power is relatively low (R^2=0.24).

Rao tests show that the error lag model is the more appropriate because in the Spatial Lag model we fail to reject the null hypothesis $\rho = 0$ given $\lambda \neq 0$. Besides we reject the null hypothesis $\lambda = 0$ given $\rho \neq 0$. This happens to be true with a 0.975 confidence for all definitions of trade openness in both periods and panel data.

Tables 2-5

Sample 3: cities that represent over 5 percent of the urban population

When the sample includes cities whose population is above 5 percent of the urban population the effects of trade openness are not clear. The results of this sample are reported in tables 6 and 7. By analyzing the first model the effects of international trade openness on city size are mixed over time. For the 1970-1985 period is positive, but negative for the second. Lack of political rights and civil liberties positively affects city size in both periods. The IT variable little affects city size. A similar pattern is observed in the spatial lag model. In the spatial error model trade openness positively affects city size except main cities. The coefficient associated with the central location times STG dummy is negative in the first period and positive in the second period under the three basic specifications. Using other definitions of trade openness, the results are also mixed.

The message is that under this sample there is little support for saying anything about secondary cities. There is empirical support for a negative impact on main cities.

Tables 6-7

Sample 4: cities with a population over a million

The results related to the sample with cities that have a population over a million in 2000 are reported in tables 8 and 9. Regarding the linear specification with no spatial dependence, main cities reduce their size and secondary cities increase their size if a country experiences a process of trade liberalization. A 10 percent increase in the share of trade in GDP pushes the population up of cities by around 22 and 13 percent in the first, second period, respectively; however, in both periods main cities reduce their size. OECD cities are smaller Port and central cities on average are larger. Populous cities are more sensitive to trade openness versus the previous samples. These results are significant at the 10 per cent level. The lack of political rights and civil liberties positively affects the size of cities.

The results are similar for the spatial lag and spatial error models, however, the effects of trade openness on city size are attenuated. With respect to city interaction the parameter is not significant. Recall that $\boldsymbol{W}$ is not symmetric at the country level: the number of cities in the sample is not equal across countries.

The results are consistent with different definitions of trade openness except ID and WUS. In this case, cities reduce their size for higher levels of trade openness but main cities. Regarding the model that fits better, the spatial lag has the maximum likelihood. Besides we fail to reject the null hypothesis $\lambda = 0$ given that $\rho \neq 0$.

Tables 8-9

Testing Krugman (1991)

In table 10, we report the coefficient associated with road index. A higher road index implies lower trade costs. Therefore, it positively affects city size as Krugman (1991) claims. The estimates are using the second sample (city ranking from 1 to 5) and are positive. Again the spatial lag model seems to be the most appropriate due to Rao tests results and the value of log – likelihood is the maximum under this model.

Tables 10

7. Final remarks

In the literature there are several ways to explain agglomeration. One of them is through non-price interactions where technological externalities are generated in a perfectly competitive environment. In the NEG approach, however, it is justified by micro foundations where the effects of concentration are transmitted through prices and wages. By increasing the degree of openness of an economy the incentives of firms and workers to cluster are weakened and a balanced urban system is generated. Several predictions of Fujita *et al.*(1999) have been tested in this paper. The hypothesis that main cities reduce in size and secondary cities increase in size can be validated provided that they are top ranked. The implication of this result is that poverty, crime, pollution and congestion associated with top ranked cities can be partially attacked by fostering international trade. Besides, urban planners must pay attention to urban growth in secondary cities.

For different definitions of trade openness, big cities, in terms of urban primacy are not clearly affected by trade openness. The other results related to hypotheses 3 is that populous cities are more sensitive to trade because economies of scale play a more important role. In this case, results are similar and significant to the sample consisting of top ranked cities with the exception of IV. An advantage of assuming spatial dependence opens the possibility that cities compete for workers. In this paper, the coefficients related to city interaction are positive suggesting that a struggle arises in the labor market. In Puga, however, city size is also explained as a result of migration from rural areas. Da Mata *et al.*(2005), for example, find that city growth in Brazil is driven by rural population supply and inter-regional transport improvements and spillover effects of knowledge accumulation.

The consequences of using different definitions of trade openness is that those related to volumes of trade affect city size but a clear link to tariffs is not robust. One answer is that tariffs are biased, in other words, they do not entirely capture real trade costs. Another explanation is that tariff elasticities of imports and exports are low. Trade deflated by distance is a significant explanatory variable. But joint trade with Germany, Japan and the U.S. might not affect city size because it does not necessarily imply trade openness.

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TABLES

Sample	Period	Max	Min	Median	Mean
By Ranking (Top 5)	1970-1985	27,192 (Tokyo, Jap.)	13 (Tipitapa, Nic.)	463	1,346
	1985-2000	32,718 (Tokyo, Jap.)	37 (Carnot, C.A.R.)	722	1,821
Main City	1970-1985	27,192 (Tokyo, Jap.)	111 (Kigali, Rw.)	1,005	2,675
	1985-2000	32,718 (Tokyo, Jap.)	260 (Bujumbura, Bur.)	1,558	3,624
Over million	1970-1985	27,192 (Tokyo, Jap.)	223 (Sana'a, Yem.)	1,126	2085
	1985-2000	32,718 (Tokyo, Jap.)	706 (Faridabad, Ind)	1,712	2,846
Over 5 % of total urban population	1970-1985	27,192 (Tokyo, Jap.)	20 (Mzuzu, Mal.)	621	1739
	1985-2000	32,718 (Tokyo, Jap.)	67 (Mzuzu, Mal.)	988	2,359

Data source: U.N. Prospects of World Urbanization (2003).

Table 1. City size (in thousands)

Dependent variable: Log of city population	OLS					Lag-ML				Err-ML			
	1	1 to 2	1 to 3	1 to 4	1 to 5	1 to 2	1 to 3	1 to 4	1 to 5	1 to 2	1 to 3	1 to 4	1 to 5
1) Intercept	2.024*	-3.855***	-3.913***	-4.123***	-3.295***	-3.604***	-3.443***	-3.307***	-2.431**	-3.780***	-3.687***	-4.065***	-2.869*
	(1.21)	*(1.31)*	*(1.16)*	*(1.10)*	*(1.08)*	*(1.22)*	*(1.08)*	*(1.02)*	*(0.99)*	*(1.39)*	*(1.37)*	*(1.37)*	*(1.48)*
2 Main city dummy		1.145***	1.287***	1.516***	1.554***	1.296***	1.461***	1.695***	1.702***	1.130***	1.341***	1.551***	1.569***
		(0.27)	*(0.25)*	*(0.26)*	*(0.26)*	*(0.27)*	*(0.24)*	*(0.24)*	*(0.24)*	*(0.22)*	*(0.21)*	*(0.22)*	*(0.21)*
3) Capital city dummy	0.390***	0.646***	0.603***	0.580***	0.601***	0.711***	0.659***	0.653***	0.677***	0.680***	0.606***	0.607***	0.652***
	(0.12)	*(0.15)*	*(0.14)*	*(0.15)*	*(0.15)*	*(0.14)*	*(0.13)*	*(0.13)*	*(0.14)*	*(0.13)*	*(0.12)*	*(0.12)*	*(0.12)*
4) Log of nonurbanized population	0.242**	0.736***	0.746***	0.744***	0.715***	0.651***	0.599***	0.556***	0.498***	0.734***	0.737***	0.741***	0.701***
	(0.09)	*(0.06)*	*(0.05)*	*(0.05)*	*(0.05)*	*(0.07)*	*(0.06)*	*(0.06)*	*(0.06)*	*(0.06)*	*(0.06)*	*(0.06)*	*(0.07)*
5) Log of land area	-0.027	0.132***	0.123***	0.131***	0.125***	0.121***	0.105***	0.101***	0.091***	0.138***	0.129**	0.139***	0.130**
	(0.04)	*(0.05)*	*(0.04)*	*(0.04)*	*(0.04)*	*(0.04)*	*(0.04)*	*(0.04)*	*(0.03)*	*(0.05)*	*(0.05)*	*(0.05)*	*(0.05)*
6) Log of real GDP per capita	0.137	0.269**	0.333***	0.325***	0.297***	0.237**	0.280***	0.241***	0.198**	0.262**	0.317***	0.307***	0.266**
	(0.10)	*(0.11)*	*(0.10)*	*(0.09)*	*(0.08)*	*(0.11)*	*(0.09)*	*(0.08)*	*(0.08)*	*(0.12)*	*(0.12)*	*(0.11)*	*(0.12)*
7) Share of the labor force outside the agriculture	0.845*	2.246***	1.926***	1.795***	1.654***	2.001***	1.510***	1.381***	1.192***	2.278***	1.972***	1.888***	1.727***
	(0.46)	*(0.47)*	*(0.41)*	*(0.39)*	*(0.36)*	*(0.46)*	*(0.40)*	*(0.37)*	*(0.34)*	*(0.50)*	*(0.49)*	*(0.49)*	*(0.50)*
8.1) Share of trade in GDP	-0.667	0.852	0.497	0.740*	0.418	0.774	0.393	0.642*	0.308	0.686	0.296	0.661	0.229
	(0.51)	*(0.58)*	*(0.42)*	*(0.41)*	*(0.37)*	*(0.54)*	*(0.38)*	*(0.37)*	*(0.34)*	*(0.57)*	*(0.44)*	*(0.43)*	*(0.41)*
9.1) Share of trade in GDP x main city dummy		-0.490	-0.421	-0.471	-0.383	-0.562	-0.537	-0.613	-0.472	-0.501	-0.523	-0.572	-0.471
		(0.47)	*(0.43)*	*(0.44)*	*(0.44)*	*(0.43)*	*(0.40)*	*(0.41)*	*(0.41)*	*(0.38)*	*(0.35)*	*(0.37)*	*(0.36)*
10) Port city dummy	0.098	0.755**	0.419*	0.397	0.391*	0.711**	0.351	0.324	0.343	0.659**	0.308	0.292	0.342
	(0.28)	*(0.31)*	*(0.25)*	*(0.25)*	*(0.23)*	*(0.28)*	*(0.24)*	*(0.23)*	*(0.21)*	*(0.29)*	*(0.25)*	*(0.24)*	*(0.22)*
11) Port city dummy x share of trade in GDP	0.153	-1.079**	-0.787*	-0.806*	-0.652	-0.974**	-0.611	-0.622	-0.499	-0.841	-0.474	-0.514	-0.358
	(0.52)	*(0.53)*	*(0.44)*	*(0.44)*	*(0.41)*	*(0.50)*	*(0.40)*	*(0.41)*	*(0.38)*	*(0.53)*	*(0.44)*	*(0.43)*	*(0.39)*
12) Central location dummy	0.245	0.037	-0.211	0.013	0.044	-0.001	-0.251	-0.002	0.029	-0.002	-0.257	0.037	0.025
	(0.28)	*(0.30)*	*(0.24)*	*(0.23)*	*(0.21)*	*(0.28)*	*(0.22)*	*(0.21)*	*(0.19)*	*(0.29)*	*(0.23)*	*(0.22)*	*(0.20)*
13) Central location dummy x share of trade in GDP	-0.285	-0.095	0.154	-0.184	0.005	-0.017	0.265	-0.133	0.030	0.016	0.359	-0.141	0.103
	(0.50)	*(0.54)*	*(0.42)*	*(0.41)*	*(0.38)*	*(0.50)*	*(0.39)*	*(0.38)*	*(0.34)*	*(0.51)*	*(0.40)*	*(0.40)*	*(0.36)*
14) Lack of political rights and civl liberties dummy	0.286*	0.005	-0.101	-0.179	-0.254*	-0.017	-0.093	-0.143	-0.195	-0.003	-0.118	-0.191	-0.289
	(0.15)	*(0.18)*	*(0.16)*	*(0.15)*	*(0.14)*	*(0.17)*	*(0.15)*	*(0.13)*	*(0.13)*	*(0.19)*	*(0.19)*	*(0.18)*	*(0.19)*
15) OECD country dummy	-0.246	-0.299	-0.381**	-0.355**	-0.302*	-0.260	-0.297*	-0.270	-0.203	-0.287	-0.359	-0.336	-0.263
	(0.19)	*(0.22)*	*(0.19)*	*(0.18)*	*(0.17)*	*(0.21)*	*(0.18)*	*(0.17)*	*(0.15)*	*(0.24)*	*(0.23)*	*(0.23)*	*(0.23)*
16) Log of telephone mainlines (per 1000 people)	0.032	0.003	0.002	0.008	0.003	-0.003	-0.005	0.003	0.001	-0.001	0.000	0.004	-0.003
	(0.04)	*(0.05)*	*(0.04)*	*(0.04)*	*(0.04)*	*(0.05)*	*(0.04)*	*(0.04)*	*(0.03)*	*(0.05)*	*(0.05)*	*(0.05)*	*(0.05)*
17) Log of urbanized population	0.454***												
	(0.09)												
18) City interaction parameter (*rho*)						0.115	0.199	0.252	0.300				
						(2.09)	*(3.60)*	*(4.71)*	*(5.77)*				
19) City interaction parameter (*lambda*)										0.138	0.242	0.282	0.366
										(2.45)	*(4.24)*	*(5.02)*	*(6.96)*
RS*rho*						3.77	11.42	23.70	36.01				
RS**rho*						0.90	0.89	0.02	1.64				
RS*lambda*										4.89	15.48	27.31	50.99
RS**lambda*										2.01	4.94	3.63	16.63
RS*lambdarho*						5.78	16.36	27.33	52.64	5.78	16.36	27.33	52.64
Log-likelihood	-35.96	-139.06	-200.17	-269.79	-323.88	-136.59	-194.18	-259.27	-308.90	-135.90	-191.87	-257.49	-302.89
R2	0.89	0.84	0.83	0.80	0.78								
Number of obsevations	84	152	207	260	305	152	207	260	305	152	207	260	305

Standard deviation reported below the estimated coefficients. ***significant at 1% level; ** significant at 5% level; *significant at 10% level.

Table 2. Cities by ranking (1970-1985)

Dependent variable: Log of city population	OLS					ML-Lag				Err-ML			
	1	1 to 2	1 to 3	1 to 4	1 to 5	1 to 2	1 to 3	1 to 4	1 to 5	1 to 2	1 to 3	1 to 4	1 to 5
1) Intercept	2.752***	-2.687**	-2.409**	-2.924***	-3.067***	-2.678***	-2.072**	-2.111***	-2.088***	-2.591**	-1.975*	-2.594**	-2.470**
	(1.04)	*(1.05)*	*(0.96)*	*(0.88)*	*(0.86)*	*(0.95)*	*(0.88)*	*(0.80)*	*(0.77)*	*(1.16)*	*(1.17)*	*(1.16)*	*(1.25)*
2 Main city dummy		1.171***	1.331***	1.611***	1.681***	1.361***	1.508***	1.814***	1.855***	1.106***	1.409***	1.653***	1.699***
		(0.24)	*(0.24)*	*(0.25)*	*(0.25)*	*(0.23)*	*(0.22)*	*(0.23)*	*(0.23)*	*(0.18)*	*(0.18)*	*(0.19)*	*(0.19)*
3) Capital city dummy	0.313**	0.536***	0.541***	0.501***	0.545***	0.632***	0.612***	0.588***	0.636***	0.645***	0.584***	0.562***	0.638***
	(0.13)	*(0.15)*	*(0.14)*	*(0.14)*	*(0.15)*	*(0.14)*	*(0.13)*	*(0.13)*	*(0.13)*	*(0.12)*	*(0.11)*	*(0.11)*	*(0.12)*
4) Log of nonurbanized population	0.165*	0.603***	0.610***	0.612***	0.614***	0.509***	0.471***	0.424***	0.400***	0.596***	0.595***	0.600***	0.600***
	(0.09)	*(0.05)*	*(0.05)*	*(0.04)*	*(0.04)*	*(0.06)*	*(0.05)*	*(0.05)*	*(0.05)*	*(0.06)*	*(0.06)*	*(0.06)*	*(0.06)*
5) Log of land area	0.015	0.165***	0.144***	0.151***	0.150***	0.145***	0.118***	0.111***	0.105***	0.172***	0.148***	0.162***	0.160***
	(0.04)	*(0.05)*	*(0.04)*	*(0.04)*	*(0.04)*	*(0.04)*	*(0.04)*	*(0.03)*	*(0.03)*	*(0.05)*	*(0.05)*	*(0.05)*	*(0.05)*
6) Log of real GDP per capita	0.239**	0.428***	0.465***	0.456***	0.481***	0.362***	0.362***	0.307***	0.276***	0.416***	0.432***	0.419***	0.410***
	(0.10)	*(0.11)*	*(0.09)*	*(0.08)*	*(0.08)*	*(0.10)*	*(0.09)*	*(0.08)*	*(0.07)*	*(0.12)*	*(0.11)*	*(0.11)*	*(0.11)*
7) Share of the labor force outside the agriculture	0.033	1.075**	0.956**	0.868**	0.645**	0.895**	0.760**	0.688**	0.602*	1.122**	1.069**	1.022**	0.888*
	(0.41)	*(0.44)*	*(0.39)*	*(0.37)*	*(0.35)*	*(0.41)*	*(0.37)*	*(0.34)*	*(0.31)*	*(0.49)*	*(0.49)*	*(0.50)*	*(0.51)*
8.1) Share of trade in GDP	-0.535	0.959*	0.179	0.461	0.294	0.944**	0.125	0.366	0.207	0.899	-0.050	0.295	0.084
	(0.48)	*(0.50)*	*(0.34)*	*(0.33)*	*(0.31)*	*(0.45)*	*(0.31)*	*(0.30)*	*(0.27)*	*(0.49)*	*(0.35)*	*(0.35)*	*(0.34)*
9.1) Share of trade in GDP x main city dummy		-0.411	-0.389	-0.502	-0.487	-0.494	-0.488	-0.653*	-0.607*	-0.438*	-0.556**	-0.650**	-0.643**
		(0.35)	*(0.35)*	*(0.37)*	*(0.37)*	*(0.32)*	*(0.32)*	*(0.34)*	*(0.33)*	*(0.26)*	*(0.26)*	*(0.29)*	*(0.28)*
10) Port city dummy	0.279	0.929***	0.349	0.396*	0.321	0.863***	0.271	0.301	0.257	0.876***	0.224	0.276	0.306
	(0.27)	*(0.28)*	*(0.24)*	*(0.24)*	*(0.23)*	*(0.26)*	*(0.22)*	*(0.22)*	*(0.20)*	*(0.27)*	*(0.22)*	*(0.22)*	*(0.20)*
11) Port city dummy x share of trade in GDP	-0.147	-1.333***	-0.693**	-0.846**	-0.689**	-1.185***	-0.487	-0.575*	-0.420	-1.140***	-0.327	-0.438	-0.299
	(0.42)	*(0.41)*	*(0.34)*	*(0.36)*	*(0.34)*	*(0.37)*	*(0.31)*	*(0.32)*	*(0.30)*	*(0.41)*	*(0.33)*	*(0.34)*	*(0.31)*
12) Central location dummy	0.041	0.161	-0.205	-0.016	-0.001	0.167	-0.210	-0.035	-0.019	0.236	-0.217	0.003	-0.065
	(0.26)	*(0.28)*	*(0.23)*	*(0.23)*	*(0.22)*	*(0.26)*	*(0.21)*	*(0.21)*	*(0.20)*	*(0.27)*	*(0.21)*	*(0.22)*	*(0.21)*
13) Central location dummy x share of trade in GDP	0.006	-0.248	0.149	-0.060	0.065	-0.257	0.174	-0.034	0.067	-0.370	0.255	-0.040	0.175
	(0.37)	*(0.40)*	*(0.33)*	*(0.35)*	*(0.34)*	*(0.36)*	*(0.31)*	*(0.32)*	*(0.30)*	*(0.39)*	*(0.31)*	*(0.34)*	*(0.31)*
14) Lack of political rights and civl liberties dummy	0.242	0.334	0.379*	0.461**	0.484***	0.280	0.280	0.289*	0.270*	0.338	0.364	0.433*	0.398
	(0.17)	*(0.22)*	*(0.21)*	*(0.19)*	*(0.17)*	*(0.20)*	*(0.19)*	*(0.17)*	*(0.16)*	*(0.24)*	*(0.25)*	*(0.25)*	*(0.25)*
15) OECD country dummy	-0.381*	-0.346	-0.373	-0.290	-0.256	-0.271	-0.265	-0.204	-0.142	-0.296	-0.303	-0.226	-0.194
	(0.22)	*(0.27)*	*(0.25)*	*(0.23)*	*(0.21)*	*(0.25)*	*(0.23)*	*(0.21)*	*(0.19)*	*(0.30)*	*(0.31)*	*(0.30)*	*(0.30)*
16) Log of telephone mainlines (per 1000 people)	0.022	0.006	0.020	0.040	0.037	0.000	0.008	0.022	0.022	0.001	0.016	0.033	0.030
	(0.05)	*(0.05)*	*(0.05)*	*(0.04)*	*(0.04)*	*(0.05)*	*(0.04)*	*(0.04)*	*(0.03)*	*(0.06)*	*(0.06)*	*(0.06)*	*(0.06)*
17) Log of urbanized population	0.455***												
	(0.09)												
18) City interaction parameter (*rho*)						0.159	0.224	0.297	0.349				
						(2.94)	*(4.15)*	*(5.83)*	*(7.13)*				
19) City interaction parameter (*lambda*)										0.209	0.291	0.348	0.425
										(3.81)	*(5.32)*	*(6.64)*	*(8.74)*
RS*rho*						6.70	13.75	29.16	44.57				
RS**rho*						2.24	2.41	0.10	1.14				
RS*lambda*										9.09	20.43	36.10	61.18
RS**lambda*										4.63	9.09	7.04	17.76
RS*lambdarho*						11.33	22.84	36.20	62.32	11.33	22.84	36.20	62.32
Log-likelihood	-34.46	-134.01	-194.79	-257.75	-309.69	-129.78	-187.40	-243.75	-289.84	-128.06	-183.11	-239.79	-281.49
R2	0.86	0.82	0.80	0.78	0.76								
Number of obsevations	84	152	207	260	305	152	207	260	305	152	207	260	305

Standard deviation reported below the estimated coefficients. ***significant at 1% level; ** significant at 5% level; *significant at 10% level.

Table 3. Cities by ranking (1985-2000)

Dependent variable: Log of city population	OLS					Lag-ML				Err-ML			
	1	**1 to 2**	**1 to 3**	**1 to 4**	**1 to 5**	**1 to 2**	**1 to 3**	**1 to 4**	**1 to 5**	**1 to 2**	**1 to 3**	**1 to 4**	**1 to 5**
1) Intercept	2.520***	-3.100	-2.906	-3.197	-2.904	-2.982***	-2.542***	-2.420***	-2.084***	-2.990***	-2.564***	-3.003***	-2.446***
	(0.75)	*(3.90)*	*(4.01)*	*(4.70)*	*(4.39)*	*(0.75)*	*(0.68)*	*(0.63)*	*(0.61)*	*(0.88)*	*(0.90)*	*(0.90)*	*(0.94)*
2 Main city dummy		1.137	1.281	1.545	1.605	1.319***	1.457***	1.735***	1.765***	1.101***	1.349***	1.583***	1.626***
		(6.38)	*(7.44)*	*(8.54)*	*(8.84)*	*(0.18)*	*(0.16)*	*(0.17)*	*(0.17)*	*(0.14)*	*(0.14)*	*(0.15)*	*(0.14)*
3) Capital city dummy	0.330***	0.591	0.564	0.534	0.561	0.674***	0.629***	0.613***	0.641***	0.655***	0.588***	0.571***	0.625***
	(0.09)	*(5.37)*	*(5.48)*	*(5.01)*	*(5.04)*	*(0.10)*	*(0.10)*	*(0.10)*	*(0.10)*	*(0.09)*	*(0.08)*	*(0.09)*	*(0.09)*
4) Log of nonurbanized population	0.201***	0.674	0.679	0.678	0.668	0.577***	0.530***	0.482***	0.449***	0.668***	0.665***	0.668***	0.653***
	(0.06)	*(17.61)*	*(19.71)*	*(21.08)*	*(22.32)*	*(0.04)*	*(0.04)*	*(0.04)*	*(0.04)*	*(0.04)*	*(0.04)*	*(0.04)*	*(0.04)*
5) Log of land area	-0.008	0.147	0.131	0.138	0.133	0.131***	0.109***	0.104***	0.096***	0.154***	0.137***	0.149***	0.142***
	(0.03)	*(4.52)*	*(4.49)*	*(5.02)*	*(5.16)*	*(0.03)*	*(0.03)*	*(0.03)*	*(0.02)*	*(0.04)*	*(0.04)*	*(0.04)*	*(0.04)*
6) Log of real GDP per capita	0.160**	0.298	0.352	0.347	0.342	0.255***	0.282***	0.238***	0.207***	0.285***	0.325***	0.317***	0.295***
	(0.07)	*(3.88)*	*(5.21)*	*(5.57)*	*(6.00)*	*(0.07)*	*(0.06)*	*(0.06)*	*(0.05)*	*(0.09)*	*(0.09)*	*(0.08)*	*(0.08)*
7) Share of the labor force outside the agriculture	0.328	1.606	1.367	1.254	1.032	1.377***	1.068***	0.969***	0.829***	1.654***	1.459***	1.388***	1.195***
	(0.30)	*(4.97)*	*(4.77)*	*(4.60)*	*(4.10)*	*(0.31)*	*(0.28)*	*(0.26)*	*(0.23)*	*(0.36)*	*(0.36)*	*(0.37)*	*(0.36)*
8.1) Share of trade in GDP	-0.563*	0.858	0.273	0.513	0.325	0.817**	0.207	0.434*	0.246	0.764**	0.070	0.410	0.151
	(0.32)	*(2.40)*	*(1.07)*	*(2.04)*	*(1.41)*	*(0.34)*	*(0.24)*	*(0.23)*	*(0.21)*	*(0.36)*	*(0.27)*	*(0.27)*	*(0.26)*
9.1) Share of trade in GDP x main city dummy		-0.407	-0.342	-0.431	-0.383	-0.486*	-0.442*	-0.568**	-0.481*	-0.427**	-0.483**	-0.546**	-0.504**
		(1.49)	*(1.28)*	*(1.52)*	*(1.35)*	*(0.26)*	*(0.25)*	*(0.26)*	*(0.26)*	*(0.22)*	*(0.21)*	*(0.23)*	*(0.22)*
10) Port city dummy	0.203	0.830	0.386	0.412	0.368	0.774***	0.315**	0.323**	0.306**	0.770***	0.274*	0.294*	0.331**
	(0.18)	*(4.36)*	*(2.33)*	*(2.43)*	*(2.32)*	*(0.18)*	*(0.15)*	*(0.16)*	*(0.14)*	*(0.19)*	*(0.16)*	*(0.16)*	*(0.15)*
11) Port city dummy x share of trade in GDP	-0.035	-1.198	-0.736	-0.826	-0.684	-1.067***	-0.547**	-0.596**	-0.469**	-1.012***	-0.398	-0.476*	-0.350
	(0.29)	*(3.97)*	*(2.87)*	*(3.03)*	*(2.68)*	*(0.28)*	*(0.24)*	*(0.25)*	*(0.23)*	*(0.31)*	*(0.26)*	*(0.27)*	*(0.24)*
12) Central location dummy	0.156	0.081	-0.223	-0.038	0.006	0.067	-0.231	-0.033	0.013	0.118	-0.225	0.016	-0.001
	(0.17)	*(0.41)*	*(1.38)*	*(0.23)*	*(0.04)*	*(0.18)*	*(0.15)*	*(0.15)*	*(0.14)*	*(0.19)*	*(0.15)*	*(0.16)*	*(0.14)*
13) Central location dummy x share of trade in GDP	-0.167	-0.184	0.148	-0.068	0.031	-0.154	0.201	-0.056	0.023	-0.213	0.279	-0.077	0.101
	(0.26)	*(0.60)*	*(0.58)*	*(0.26)*	*(0.13)*	*(0.29)*	*(0.24)*	*(0.24)*	*(0.22)*	*(0.31)*	*(0.24)*	*(0.26)*	*(0.23)*
14) Lack of political rights and civl liberties dummy	0.262**	0.141	0.090	0.071	0.054	0.108	0.055	0.029	0.009	0.134	0.065	0.051	0.006
	(0.11)	*(1.06)*	*(0.75)*	*(0.65)*	*(0.54)*	*(0.12)*	*(0.11)*	*(0.10)*	*(0.09)*	*(0.15)*	*(0.15)*	*(0.15)*	*(0.14)*
15) OECD country dummy	-0.286**	-0.327	-0.417	-0.394	-0.356	-0.270*	-0.307**	-0.275**	-0.213*	-0.295	-0.367**	-0.346*	-0.297*
	(0.14)	*(1.95)*	*(2.79)*	*(2.85)*	*(2.82)*	*(0.16)*	*(0.14)*	*(0.13)*	*(0.12)*	*(0.19)*	*(0.19)*	*(0.18)*	*(0.18)*
16) Log of telephone mainlines (per 1000 people)	0.066*	0.048	0.051	0.058	0.062	0.036	0.031	0.036	0.034	0.043	0.046	0.051	0.049
	(0.03)	*(1.23)*	*(1.52)*	*(1.87)*	*(2.17)*	*(0.04)*	*(0.03)*	*(0.03)*	*(0.03)*	*(0.04)*	*(0.04)*	*(0.04)*	*(0.04)*
17) Log of urbanized population	0.455***												
	(0.06)												
18) 1985-2000 dummy	0.131*	0.188	0.192	0.169	0.178	0.164**	0.158**	0.125**	0.125**	0.193**	0.199**	0.170*	0.188**
	(0.07)	*(2.40)*	*(2.73)*	*(2.53)*	*(2.85)*	*(0.07)*	*(0.07)*	*(0.06)*	*(0.06)*	*(0.09)*	*(0.09)*	*(0.09)*	*(0.09)*
19) City interaction parameter (*rho*)						0.146	0.219	0.282	0.325				
						(3.72)	*(5.58)*	*(7.49)*	*(8.89)*				
20) City interaction parameter (*lambda*)										0.175	0.282	0.326	0.388
										(4.36)	*(7.07)*	*(8.38)*	*(10.47)*
RS*rho*						11.29	25.37	54.41	77.64				
RS**rho*						2.55	3.37	0.03	3.40				
RS*lambda*										14.62	36.42	65.15	110.08
RS**lambda*										5.88	14.42	10.77	35.83
RS*lambdarho*						17.17	39.79	65.18	113.47	17.17	39.79	65.18	113.47
Log-likelihood	-68.85	-265.77	-382.31	-510.85	-605.73	-259.30	-369.18	-486.39	-572.76	-257.15	-362.61	-480.97	-559.21
R2	0.89	0.83	0.81	0.79	0.77								
Number of obsevations	162	292	396	496	580	292	396	496	580	292	396	496	580

Standard deviation reported below the estimated coefficients. ***significant at 1% level; ** significant at 5% level; *significant at 10% level.

Table 4. Cities by ranking (panel data: 1970-1985, 1985-2000)

Dependent variable: Log of city population	**OLS** 1970-1985	1985-2000	Panel Data	**Lag-ML** 1970-1985	1985-2000	Panel Data	**Err-ML** 1970-1985	1985-2000	Panel Data
8.1) Share of trade in GDP	0.418	0.294	0.325	0.308	0.207	0.246	0.234	0.083	0.146
	(0.37)	*(0.31)*	*(0.23)*	*(0.34)*	*(0.27)*	*(0.21)*	*(0.41)*	*(0.34)*	*(0.26)*
9.1) Share of trade in GDP x main city dummy	-0.383	-0.487	-0.383	-0.472	-0.607*	-0.481*	-0.469	-0.643**	-0.507**
	(0.44)	*(0.37)*	*(0.28)*	*(0.41)*	*(0.33)*	*(0.26)*	*(0.36)*	*(0.28)*	*(0.22)*
City interaction parameter				0.300	0.349	0.325	0.357	0.431	0.394
				(5.77)	*(7.13)*	*(8.89)*	*(6.72)*	*(8.94)*	*(10.72)*
RS*rho*				36.0	44.57	77.64			
RS**rho*				1.64	1.14	3.40			
RS*lambda*							50.99	61.18	110.08
RS**lambda*							16.63	17.76	35.83
RS*lambdarho*				52.64	62.32	113.47	52.64	62.32	113.47
Log-likelihood	-323.880	-309.690	-605.730	-308.90	-289.84	-572.76	-302.88	-281.50	-559.14
R2	0.778	0.764	0.770						
Number of obsevations	305	305	580	305	305	580	305	305	580
8.2) Weigthed share of trade with the U.S. in GDP	201.290	290.650	784.350	156.600	106.940	419.980	586.880	24.832	629.240
	(663.78)	*(385.30)*	*(630.56)*	*(608.86)*	*(343.14)*	*(577.45)*	*(733.84)*	*(412.99)*	*(678.44)*
9.2) Weighted share of trade with the U.S. in GDP x main city dummy	-667.280	-278.540	-699.970	-689.100	-388.510	-854.250	-681.110	-464.410	-945.410
	(846.85)	*(473.53)*	*(781.59)*	*(775.81)*	*(421.34)*	*(714.14)*	*(684.18)*	*(355.57)*	*(618.48)*
City interaction parameter				0.293	0.356	0.325	0.365	0.441	0.401
				(5.59)	*(7.27)*	*(8.86)*	*(6.93)*	*(9.28)*	*(11.01)*
RS*rho*				34.03	47.01	78.45			
RS**rho*				1.78	1.52	5.07			
RS*lambda*							48.32	64.23	112.81
RS**lambda*							16.07	18.74	39.43
RS*lambdarho*				50.10	65.74	117.88	50.10	65.74	117.88
Log-likelihood	-323.56	-313.17	-608.27	-309.39	-292.50	-575.28	-303.26	-283.06	-560.32
R2	0.78	0.76	0.77						
Number of obsevations	305	305	580	305	305	580	305	305	580
8.3) Share of trade with Jap+Ger+U.S. in GDP	-0.656	0.314	0.581**	-0.336	0.301	0.469*	-0.368	0.159	0.508
	(0.46)	*(0.28)*	*(0.29)*	*(0.42)*	*(0.25)*	*(0.26)*	*(0.55)*	*(0.36)*	*(0.37)*
9.3) Share of trade with Jap+Ger+U.S. in GDP x main city dummy	-1.160	-0.775	-0.744	-1.174	-0.817*	-0.815*	-1.053	-0.675*	-0.726*
	(0.83)	*(0.49)*	*(0.52)*	*(0.76)*	*(0.44)*	*(0.47)*	*(0.70)*	*(0.39)*	*(0.41)*
City interaction parameter				0.295	0.355	0.328	0.355	0.425	0.399
				(5.65)	*(7.25)*	*(8.99)*	*(6.66)*	*(8.74)*	*(10.92)*
RS*rho*				34.08	46.86	80.51			
RS**rho*				1.76	0.36	4.20			
RS*lambda*							48.60	59.83	114.25
RS**lambda*							16.28	13.33	37.93
RS*lambdarho*				50.36	60.19	118.45	50.36	60.19	118.45
Log-likelihood	-323.12	-312.02	-608.83	-308.82	-291.42	-575.01	-302.79	-283.84	-561.26
R2	0.78	0.76	0.77						
Number of obsevations	305	305	580	305	305	580	305	305	580
8.4) Import duties as percent of Imports	-0.225	0.235	0.055	-0.099	0.450	0.191	-0.520	-0.223	-0.256
	(1.18)	*(1.09)*	*(0.81)*	*(1.09)*	*(0.98)*	*(0.74)*	*(1.36)*	*(1.32)*	*(0.95)*
9.4) Import duties x main city dummy	2.138*	2.455**	2.026**	2.316**	2.541**	2.130***	2.144**	2.360***	1.942***
	(1.25)	*(1.16)*	*(0.87)*	*(1.14)*	*(1.04)*	*(0.80)*	*(1.03)*	*(0.92)*	*(0.71)*
City interaction parameter				0.285	0.332	0.313	0.352	0.411	0.375
				(5.12)	*(6.23)*	*(8.00)*	*(6.25)*	*(7.87)*	*(9.50)*
RS*rho*				28.88	36.09	67.23			
RS**rho*				0.31	0.19	1.71			
RS*lambda*							37.76	45.77	90.35
RS**lambda*							9.19	9.86	24.84
RS*lambdarho*				38.07	45.96	92.06	38.07	45.96	92.06
Log-likelihood	-290.51	-276.16	-552.84	-278.40	-260.18	-524.91	-273.95	-254.19	-514.18
R2	0.79	0.78	0.78						
Number of obsevations	275	275	530	275	275	530	275	275	530
8.5) Constructed share of trade in GDP	-3.111	-1.739	-1.978	-1.852**	-1.118	-1.121	-2.888	-2.165	-2.116
	(1.43)	*(1.12)*	*(1.60)*	*(0.92)*	*(0.79)*	*(0.97)*	*(1.11)*	*(1.15)*	*(1.46)*
9.5) Constructed share of trade in GDP x main city dummy	-1.071	-1.318	-0.956	-1.367**	-1.546	-1.190	-1.143	-1.436	-1.266
	(0.42)	*(0.74)*	*(0.66)*	*(0.58)*	*(0.95)*	*(0.89)*	*(0.54)*	*(1.02)*	*(1.09)*
City interaction parameter				0.271	0.318	0.296	0.334	0.402	0.365
				(0.05)	*(0.05)*	*(0.04)*	*(0.06)*	*(0.05)*	*(0.04)*
RS*rho*				25.66	36.03	60.29			
RS**rho*				0.98	0.09	0.98			
RS*lambda*							36.84	46.38	83.44
RS**lambda*							12.16	10.43	23.92
RS*lambdarho*				37.82	46.47	83.31	37.82	46.47	84.55
Log-likelihood	-302.65	-301.88	-582.88	-291.46	-285.63	-556.66	-286.55	-279.28	-553.42
R2	0.78	0.78	0.78						
Number of obsevations	290	305	570	290	305	570	290	305	580

Standard deviation reported below the estimated coefficients. ***significant at 1% level; ** significant at 5% level; *significant at 10% level.

Table 5. Cities by ranking 1 to 5 (other definitions of trade openness)

Dependent variable: Log of city population	**OLS** 1970-1985	**OLS** 1985-2000	**OLS** Panel Data	**Lag-ML** 1970-1985	**Lag-ML** 1985-2000	**Lag-ML** Panel Data	**Err-ML** 1970-1985	**Err-ML** 1985-2000	**Err-ML** Panel Data
1) Intercept	-2.278**	-1.153	-2.045***	-2.299**	-1.178	-2.058***	-2.111*	-0.808	-1.629**
	(1.03)	*(0.91)*	*(0.65)*	*(0.99)*	*(0.87)*	*(0.63)*	*(1.14)*	*(0.96)*	*(0.74)*
2 Main city dummy	0.514**	0.653***	0.601***	0.504**	0.630***	0.589***	0.585***	0.615***	0.666***
	(0.23)	*(0.21)*	*(0.14)*	*(0.22)*	*(0.21)*	*(0.14)*	*(0.19)*	*(0.18)*	*(0.12)*
3) Capital city dummy	0.804***	0.728***	0.755***	0.795***	0.707***	0.743***	0.813***	0.761***	0.743***
	(0.11)	*(0.11)*	*(0.08)*	*(0.11)*	*(0.11)*	*(0.08)*	*(0.09)*	*(0.09)*	*(0.06)*
4) Log of nonurbanized population	0.689***	0.582***	0.678***	0.692***	0.586***	0.680***	0.681***	0.575***	0.658***
	(0.05)	*(0.05)*	*(0.03)*	*(0.05)*	*(0.05)*	*(0.03)*	*(0.06)*	*(0.05)*	*(0.04)*
5) Log of land area	0.135***	0.139***	0.117***	0.135***	0.140***	0.117***	0.130***	0.139***	0.116***
	(0.04)	*(0.03)*	*(0.02)*	*(0.04)*	*(0.03)*	*(0.02)*	*(0.04)*	*(0.04)*	*(0.03)*
6) Log of real GDP per capita	0.179	0.406***	0.286***	0.181**	0.406***	0.287***	0.204**	0.397***	0.286***
	(0.09)	*(0.09)*	*(0.06)*	*(0.09)*	*(0.08)*	*(0.06)*	*(0.10)*	*(0.10)*	*(0.07)*
7) Share of the labor force outside the agriculture	2.516***	1.257***	1.466***	2.524***	1.273***	1.474***	2.427***	1.240***	1.551***
	(0.39)	*(0.39)*	*(0.28)*	*(0.37)*	*(0.38)*	*(0.27)*	*(0.44)*	*(0.44)*	*(0.33)*
8.1) Share of trade in GDP	0.254	-0.203	-0.097	0.245	-0.214	-0.105	0.071	-0.339	-0.310
	(0.39)	*(0.30)*	*(0.22)*	*(0.37)*	*(0.29)*	*(0.22)*	*(0.39)*	*(0.30)*	*(0.23)*
9.1) Share of trade in GDP x main city dummy	0.113	-0.156	-0.064	0.125	-0.129	-0.050	-0.108	-0.187	-0.117
	(0.37)	*(0.29)*	*(0.21)*	*(0.36)*	*(0.28)*	*(0.21)*	*(0.31)*	*(0.24)*	*(0.17)*
10) Port city dummy	0.762***	0.610***	0.641***	0.755***	0.601***	0.633***	0.596**	0.556***	0.460***
	(0.24)	*(0.22)*	*(0.15)*	*(0.24)*	*(0.21)*	*(0.15)*	*(0.24)*	*(0.21)*	*(0.15)*
11) Port city dummy x share of trade in GDP	-0.931**	-0.605**	-0.723***	-0.923**	-0.603**	-0.718***	-0.569	-0.444	-0.402*
	(0.40)	*(0.30)*	*(0.22)*	*(0.39)*	*(0.28)*	*(0.21)*	*(0.40)*	*(0.29)*	*(0.22)*
12) Central location dummy	0.185	-0.079	-0.227	0.177	-0.092	-0.233	0.059	-0.143	-0.283*
	(0.24)	*(0.23)*	*(0.15)*	*(0.23)*	*(0.22)*	*(0.15)*	*(0.23)*	*(0.22)*	*(0.15)*
13) Central location dummy x share of trade in GDP	-0.375	0.146	0.191	-0.362	0.162	0.200	-0.171	0.194	0.260
	(0.39)	*(0.30)*	*(0.22)*	*(0.38)*	*(0.29)*	*(0.22)*	*(0.38)*	*(0.30)*	*(0.22)*
14) Lack of political rights and civl liberties dummy	0.013	0.331**	0.126	0.017	0.343**	0.132	0.033	0.260	0.117
	(0.14)	*(0.16)*	*(0.10)*	*(0.14)*	*(0.15)*	*(0.10)*	*(0.16)*	*(0.18)*	*(0.12)*
15) OECD country dummy	-0.359**	-0.480**	-0.526***	-0.359**	-0.474**	-0.524***	-0.371*	-0.511**	-0.513***
	(0.17)	*(0.21)*	*(0.13)*	*(0.16)*	*(0.20)*	*(0.12)*	*(0.19)*	*(0.23)*	*(0.15)*
16) Log of telephone mainlines (per 1000 people)	-0.008	-0.030	0.062*	-0.008	-0.030	0.062*	-0.010	-0.023	0.051
	(0.04)	*(0.04)*	*(0.03)*	*(0.04)*	*(0.04)*	*(0.03)*	*(0.04)*	*(0.05)*	*(0.04)*
17) 1985-2000 dummy			0.243***			0.242***			
			(0.06)			*(0.06)*			
18) City interaction parameter (*rho*)				-0.002	-0.005	-0.003			
				(0.21)	*(0.47)*	*(0.40)*			
19) City interaction parameter (*lambda*)							0.225	0.235	0.255
							(3.50)	*(3.68)*	*(0.08)*
RS*rho*				0.04	0.22	0.16			
RS**rho*				0.44	0.90	1.76			
RS*lambda*							8.82	11.12	41.06
RS**lambda*							9.22	11.80	42.67
RS*lambdarho*				9.26	12.02	42.83	9.26	12.02	42.83
Log-likelihood	-152.38	-146.34	-284.76	-151.99	-145.86	-284.47	-147.12	-140.04	-263.35
R2	0.83	0.81	0.83						
Number of obsevations	183	183	352	183	183	352	183	183	352

Standard deviation reported below the estimated coefficients. ***significant at 1% level; ** significant at 5% level; *significant at 10% level.

Table 6. Share of urban population over 5 percent

Dependent variable: Log of city population	OLS			Lag-ML			Err-ML		
	1970-1985	1985-2000	Panel Data	1970-1985	1985-2000	Panel Data	1970-1985	1985-2000	Panel Data
8.1) Share of trade in GDP	0.254	-0.203	-0.097	0.245	-0.214	-0.105	0.071	-0.339	-0.310
	(0.39)	*(0.30)*	*(0.22)*	*(0.37)*	*(0.29)*	*(0.22)*	*(0.39)*	*(0.30)*	*(0.23)*
9.1) Share of trade in GDP x main city dummy	0.113	-0.156	-0.064	0.125	-0.129	-0.050	-0.108	-0.187	-0.117
	(0.37)	*(0.29)*	*(0.21)*	*(0.36)*	*(0.28)*	*(0.21)*	*(0.31)*	*(0.24)*	*(0.17)*
City interaction parameter				-0.002	-0.005	-0.003	0.223	0.235	0.256
				(0.21)	*(0.47)*	*(0.40)*	*(3.46)*	*(3.68)*	*(0.08)*
RS*rho*				0.04	0.22	0.16			
RS**rho*				0.44	0.90	1.76			
RS*lambda*							8.82	11.12	41.06
RS**lambda*							9.22	11.80	42.67
RS*lambdarho*				9.26	12.02	42.83	9.26	12.02	42.83
Log-likelihood	-152.38	-146.34	-284.76	-151.99	-145.86	-284.47	-147.12	-140.04	-263.34
R2	0.83	0.81	0.83						
Number of obsevations	183	183	352	183	183	352	183	183	352
8.2) Weigthed share of trade with the U.S. in GDP	210.230	51.061	401.660	211.880	60.375	410.970	186.230	-20.258	204.990
	(423.92)	*(236.43)*	*(376.51)*	*(404.62)*	*(225.37)*	*(367.04)*	*(417.47)*	*(228.16)*	*(366.51)*
9.2) Weighted share of trade with the U.S. in GDP x main city dummy	-250.000	23.061	-447.300	-238.670	45.926	-426.530	-365.800	-110.250	-475.310
	(392.92)	*(226.62)*	*(365.77)*	*(375.42)*	*(216.84)*	*(357.32)*	*(350.11)*	*(190.81)*	*(296.72)*
City interaction parameter				-0.006	-0.010	-0.006	0.240	0.284	0.210
				(0.56)	*(1.00)*	*(0.84)*	*(3.77)*	*(4.62)*	*(0.08)*
RS*rho*				0.32	0.99	0.69			
RS**rho*				1.24	2.50	3.55			
RS*lambda*							13.06	15.76	51.97
RS**lambda*							13.98	17.27	54.83
RS*lambdarho*				14.30	18.26	55.52	14.30	18.26	55.52
Log-likelihood	-155.11	-155.26	-295.00	-154.58	-154.39	-294.44	-148.17	-146.07	-268.49
R2	0.83	0.79	0.82						
Number of obsevations	183	183	352	183	183	352	183	183	352
8.3) Share of trade with Jap+Ger+U.S. in GDP	-0.816	0.175	0.165	-0.836*	0.176	0.160	-0.521	0.274	0.158
	(0.53)	*(0.23)*	*(0.21)*	*(0.51)*	*(0.22)*	*(0.21)*	*(0.50)*	*(0.22)*	*(0.22)*
9.3) Share of trade with Jap+Ger+U.S. in GDP x main city dummy	0.170	-0.071	0.073	0.195	-0.073	0.077	0.041	-0.155	-0.010
	(0.58)	*(0.20)*	*(0.21)*	*(0.55)*	*(0.19)*	*(0.20)*	*(0.51)*	*(0.16)*	*(0.19)*
City interaction parameter				-0.008	-0.009	-0.006	0.234	0.296	0.202
				(0.75)	*(0.87)*	*(0.78)*	*(3.66)*	*(4.86)*	*(0.08)*
RS*rho*				0.56	0.75	0.60			
RS**rho*				1.57	2.18	3.39			
RS*lambda*							10.82	17.44	52.68
RS**lambda*							11.82	18.87	55.47
RS*lambdarho*				12.39	19.62	56.07	12.39	19.62	56.07
Log-likelihood	-154.19	-154.44	-296.26	-153.54	-153.69	-295.74	-148.28	-144.53	-269.83
R2	0.83	0.79	0.82						
Number of obsevations	183	183	352	183	183	352	183	183	352
8.4) Import duties as percent of Imports	2.441	3.173*	2.765**	3.232*	3.516**	3.313***	1.125	1.872	1.237
	(1.77)	*(1.63)*	*(1.28)*	*(1.71)*	*(1.56)*	*(1.27)*	*(1.72)*	*(1.67)*	*(1.31)*
9.4) Import duties x main city dummy	-0.005	1.010	0.403	-0.302	0.790	0.127	1.378	1.626*	1.012
	(1.41)	*(1.28)*	*(0.91)*	*(1.33)*	*(1.22)*	*(0.90)*	*(1.19)*	*(0.97)*	*(0.75)*
City interaction parameter				-0.008	-0.013	-0.014	0.271	0.385	0.205
				(0.75)	*(1.15)*	*(1.70)*	*(4.15)*	*(6.42)*	*(0.08)*
RS*rho*				3.36	1.29	2.84			
RS**rho*				5.77	3.76	6.58			
RS*lambda*							12.44	27.28	32.81
RS**lambda*							14.85	29.75	36.56
RS*lambdarho*				18.21	31.03	39.39	18.21	31.03	39.39
Log-likelihood	-138.73	-133.38	-254.92	-136.58	-132.29	-253.24	-131.17	-117.42	-237.11
R2	0.84	0.80	0.83						
Number of obsevations	164	158	310	164	158	310	164	158	310
8.5) Constructed share of trade in GDP	-4.318*	-2.915	-3.245**	-4.387**	-2.980*	-3.283**	-4.174*	-2.621	-3.794**
	(2.31)	*(1.82)*	*(1.47)*	*(2.22)*	*(1.75)*	*(1.44)*	*(2.40)*	*(1.87)*	*(1.59)*
9.5) Constructed share of trade in GDP x main city dummy	0.851	0.517	-0.638	0.934	0.593	-0.598	-0.046	0.083	-0.943
	(2.13)	*(1.50)*	*(1.28)*	*(2.05)*	*(1.44)*	*(1.25)*	*(1.76)*	*(1.23)*	*(1.04)*
City interaction parameter				-0.003	-0.003	-0.002	0.233	0.235	0.302
				(0.25)	*(0.33)*	*(0.23)*	*(3.51)*	*(3.68)*	*(0.09)*
RS*rho*				0.06	0.11	0.05			
RS**rho*				0.57	0.69	1.24			
RS*lambda*							11.55	11.81	32.66
RS**lambda*							12.05	12.39	33.85
RS*lambdarho*				12.11	12.50	33.90	12.11	12.50	33.90
Log-likelihood	-136.05	-146.67	-283.29	-135.61	-146.24	-283.03	-129.95	-140.07	-265.94
R2	0.84	0.81	0.81						
Number of obsevations	168	183	330	168	183	330	168	183	330

Standard deviation reported below the estimated coefficients. ***significant at 1% level; ** significant at 5% level; *significant at 10% level.

Table 7. Share of urban population over 5 percent (other definitions of trade openness)

Dependent variable: Log of city population	OLS			Lag-ML			Err-ML		
	1970-1985	**1985-2000**	**Panel Data**	**1970-1985**	**1985-2000**	**Panel Data**	**1970-1985**	**1985-2000**	**Panel Data**
1) Intercept	4.556***	4.371***	4.279***	5.782***	5.696***	5.398***	4.461***	4.578***	4.358***
	(1.49)	*(1.23)*	*(0.90)*	*(1.45)*	*(1.20)*	*(0.88)*	*(1.46)*	*(1.16)*	*(0.87)*
2 Main city dummy	2.150***	2.128***	2.033***	2.053***	1.992***	1.905***	2.141***	2.130***	2.037***
	(0.28)	*(0.27)*	*(0.19)*	*(0.26)*	*(0.25)*	*(0.18)*	*(0.27)*	*(0.26)*	*(0.19)*
3) Capital city dummy	0.296**	0.264**	0.368***	0.430***	0.397***	0.519***	0.304**	0.250*	0.365***
	(0.14)	*(0.13)*	*(0.10)*	*(0.14)*	*(0.13)*	*(0.10)*	*(0.14)*	*(0.13)*	*(0.10)*
4) Log of nonurbanized population	0.407***	0.343***	0.424***	0.320***	0.267***	0.348***	0.410***	0.337***	0.422***
	(0.06)	*(0.05)*	*(0.04)*	*(0.06)*	*(0.05)*	*(0.04)*	*(0.06)*	*(0.04)*	*(0.04)*
5) Log of land area	-0.039	0.002	-0.017	-0.038	-0.003	-0.022	-0.037	-0.003	-0.019
	(0.04)	*(0.04)*	*(0.03)*	*(0.04)*	*(0.04)*	*(0.03)*	*(0.04)*	*(0.04)*	*(0.03)*
6) Log of real GDP per capita	0.077	0.366***	0.159**	0.075	0.321***	0.147**	0.078	0.359***	0.156**
	(0.10)	*(0.11)*	*(0.07)*	*(0.10)*	*(0.10)*	*(0.06)*	*(0.10)*	*(0.10)*	*(0.06)*
7) Share of the labor force outside the agriculture	2.397***	0.677	1.848***	1.850***	0.340	1.455***	2.411***	0.701	1.859***
	(0.57)	*(0.54)*	*(0.39)*	*(0.57)*	*(0.51)*	*(0.38)*	*(0.56)*	*(0.51)*	*(0.38)*
8.1) Share of trade in GDP	2.229***	1.379***	1.543***	1.922***	1.157***	1.269***	2.214***	1.397***	1.553***
	(0.63)	*(0.48)*	*(0.38)*	*(0.60)*	*(0.45)*	*(0.37)*	*(0.61)*	*(0.45)*	*(0.37)*
9.1) Share of trade in GDP x main city dummy	-2.850***	-2.320***	-2.394***	-2.249***	-1.719***	-1.759***	-2.823***	-2.331***	-2.411***
	(0.57)	*(0.47)*	*(0.36)*	*(0.56)*	*(0.46)*	*(0.36)*	*(0.55)*	*(0.45)*	*(0.35)*
10) Port city dummy	0.586***	0.431**	0.4639***	0.597***	0.466**	0.488***	0.578***	0.448**	0.470***
	(0.19)	*(0.20)*	*(0.14)*	*(0.18)*	*(0.18)*	*(0.13)*	*(0.19)*	*(0.19)*	*(0.13)*
11) Port city dummy x share of trade in GDP	-1.145**	-0.557	-0.621*	-1.112**	-0.627	-0.633**	-1.114**	-0.604	-0.638**
	(0.49)	*(0.42)*	*(0.32)*	*(0.46)*	*(0.39)*	*(0.30)*	*(0.48)*	*(0.40)*	*(0.31)*
12) Central location dummy	0.320*	0.151	0.221*	0.405**	0.241	0.312**	0.315*	0.165	0.226*
	(0.19)	*(0.18)*	*(0.13)*	*(0.18)*	*(0.17)*	*(0.12)*	*(0.18)*	*(0.17)*	*(0.13)*
13) Central location dummy x share of trade in GDP	-0.708	-0.266	-0.470	-1.047**	-0.537	-0.801***	-0.689	-0.312	-0.488
	(0.48)	*(0.39)*	*(0.30)*	*(0.46)*	*(0.37)*	*(0.30)*	*(0.46)*	*(0.38)*	*(0.30)*
14) Lack of political rights and civl liberties dummy	0.039	0.362**	0.159*	0.001	0.326**	0.143*	0.038	0.360**	0.159*
	(0.13)	*(0.16)*	*(0.09)*	*(0.12)*	*(0.15)*	*(0.08)*	*(0.13)*	*(0.15)*	*(0.08)*
15) OECD country dummy	-0.185	-0.337*	-0.405***	-0.120	-0.247	-0.348**	-0.188	-0.328*	-0.404***
	(0.19)	*(0.20)*	*(0.15)*	*(0.18)*	*(0.19)*	*(0.14)*	*(0.19)*	*(0.19)*	*(0.14)*
16) Log of telephone mainlines (per 1000 people)	-0.059	-0.067	-0.111**	-0.049	-0.058	-0.119***	-0.059	-0.070	-0.113***
	(0.06)	*(0.06)*	*(0.04)*	*(0.06)*	*(0.06)*	*(0.04)*	*(0.06)*	*(0.06)*	*(0.04)*
17) 1985-2000 dummy			0.205***			0.235***			0.206***
			(0.07)			*(0.06)*			*(0.06)*
18) City interaction parameter (*rho*)				0.049	0.049	0.051			
				(3.37)	*(3.96)*	*(5.24)*			
19) City interaction parameter (*lambda*)							0.029	-0.057	-0.026
							(0.31)	*(0.59)*	*(0.37)*
RS*rho*				10.83	15.13	26.58			
RS**rho*				10.85	15.83	27.51			
RS*lambda*							0.06	0.16	0.05
RS**lambda*							0.08	0.86	0.98
RS*lambdarho*				10.91	15.99	27.57	10.91	15.99	27.57
Log-likelihood	-209.04	-188.46	-375.04	-203.26	-180.56	-361.50	-208.70	-188.04	-374.82
R2	0.48	0.43	0.49						
Number of obsevations	224	224	417	224	224	417	224	224	417

Standard deviation reported below the estimated coefficients. ***significant at 1% level; ** significant at 5% level; *significant at 10% level.

Table 8. Population over a million

Dependent variable: Log of city population	**OLS** 1970-1985	**OLS** 1985-2000	**OLS** Panel Data	**Lag-ML** 1970-1985	**Lag-ML** 1985-2000	**Lag-ML** Panel Data	**Err-ML** 1970-1985	**Err-ML** 1985-2000	**Err-ML** Panel Data
8.1) Share of trade in GDP	2.229***	1.379***	1.593***	1.922***	1.157***	1.323***	2.213***	1.397***	1.594***
	(0.63)	*(0.48)*	*(0.38)*	*(0.60)*	*(0.45)*	*(0.37)*	*(0.61)*	*(0.45)*	*(0.37)*
9.1) Share of trade in GDP x main city dummy	-2.850***	-2.320***	-2.362***	-2.249***	-1.719***	-1.757***	-2.821***	-2.332***	-2.383***
	(0.57)	*(0.47)*	*(0.36)*	*(0.56)*	*(0.46)*	*(0.36)*	*(0.55)*	*(0.45)*	*(0.35)*
City interaction parameter				0.049	0.054	0.051	0.030	-0.055	0.007
				(3.37)	*(4.47)*	*(5.18)*	*(0.32)*	*(0.57)*	*(0.10)*
RS*rho*				10.83	15.13	26.11			
RS**rho*				10.85	15.83	26.62			
RS*lambda*							0.06	0.16	0.00
RS**lambda*							0.08	0.86	0.51
RS*lambdarho*				10.91	15.99	26.62	10.91	15.99	26.62
Log-likelihood	-209.04	-188.46	-379.25	-203.26	-180.56	-365.14	-208.70	-188.04	-378.20
R2	0.48	0.43	0.48						
Number of obsevations	224	224	418	224	224	418	224	224	418
8.2) Weigthed share of trade with the U.S. in GDP	-404.640	-0.843	407.790	-380.950	-103.410	99.346	-461.560	-61.100	216.540
	(662.10)	*(462.94)*	*(721.42)*	*(609.71)*	*(421.38)*	*(675.36)*	*(659.08)*	*(451.66)*	*(727.11)*
9.2) Weighted share of trade with the U.S. in GDP x main city dummy	-496.270	-121.320	-684.590	-467.850	-51.904	-573.680	-452.530	-92.712	-582.060
	(701.03)	*(480.88)*	*(754.18)*	*(645.52)*	*(437.49)*	*(702.12)*	*(660.17)*	*(460.86)*	*(730.48)*
City interaction parameter				0.064	0.062	0.063	0.150	0.072	0.118
				(4.59)	*(5.22)*	*(6.66)*	*(1.68)*	*(0.78)*	*(1.79)*
RS*rho*				20.02	25.10	42.29			
RS**rho*				18.58	24.83	40.41			
RS*lambda*							1.92	0.29	2.15
RS**lambda*							0.48	0.02	0.27
RS*lambdarho*				20.50	25.12	42.56	20.50	25.12	42.56
Log-likelihood	-225.48	-205.46	-407.62	-215.11	-192.33	-385.88	-224.04	-204.95	-405.80
R2	0.40	0.33	0.41						
Number of obsevations	224	224	418	224	224	418	224	224	418
8.3) Share of trade with Jap+Ger+U.S. in GDP	1.844*	0.963	1.710***	1.269	0.591	1.299**	1.683	0.970	1.682***
	(1.08)	*(0.71)*	*(0.61)*	*(1.00)*	*(0.66)*	*(0.57)*	*(1.07)*	*(0.68)*	*(0.61)*
9.3) Share of trade with Jap+Ger+U.S. in GDP x main city dummy	-3.240***	-1.429*	-1.935***	-2.533**	-0.816	-1.292**	-3.051***	-1.436**	-1.880***
	(1.12)	*(0.74)*	*(0.66)*	*(1.05)*	*(0.70)*	*(0.62)*	*(1.09)*	*(0.72)*	*(0.65)*
City interaction parameter				0.061	0.058	0.059	0.115	-0.009	0.073
				(4.39)	*(4.75)*	*(6.23)*	*(1.27)*	*(0.09)*	*(1.08)*
RS*rho*				18.15	21.01	37.15			
RS**rho*				17.30	21.46	36.37			
RS*lambda*							0.95	0.00	0.78
RS**lambda*							0.10	0.45	
RS*lambdarho*				18.25	21.46	37.15	18.25	21.46	37.15
Log-likelihood	-220.15	-201.83	-400.90	-210.67	-190.82	-381.66	-219.24	-201.53	-399.82
R2	0.43	0.35	0.43			0			
Number of obsevations	224	224	418	224	224	418	224	224	418
8.4) Import duties as percent of Imports	0.130	0.171	0.469	-0.173	0.033	0.329	0.181	0.177	0.569
	(1.37)	*(1.16)*	*(0.89)*	*(1.27)*	*(1.05)*	*(0.83)*	*(1.41)*	*(1.13)*	*(0.91)*
9.4) Import duties x main city dummy	0.809	1.305	1.020	1.701	2.295**	1.739*	0.866	1.328	1.103
	(1.27)	*(1.14)*	*(0.89)*	*(1.19)*	*(1.05)*	*(0.90)*	*(1.21)*	*(1.09)*	*(0.92)*
City interaction parameter				0.067	0.066	0.065	0.163	0.046	0.124
				(4.27)	*(5.05)*	*(6.25)*	*(1.72)*	*(0.46)*	*(1.75)*
RS*rho*				17.37	23.54	37.31			
RS**rho*				16.04	23.60	35.45			
RS*lambda*							1.75	0.09	2.20
RS**lambda*							0.43	0.14	0.34
RS*lambdarho*				17.79	23.69	37.65	17.79	23.69	37.65
Log-likelihood	-211.87	-190.80	-379.56	-202.84	-178.47	-360.73	-210.45	-190.40	-378.07
R2	0.38	0.33	0.40						
Number of obsevations	206	205	382	206	205	382	206	205	382
8.5) Constructed share of trade in GDP	20.198***	9.929***	10.337***	18.144***	9.326***	8.269***	20.040***	9.938***	10.191***
	(4.81)	*(2.97)*	*(2.69)*	*(4.59)*	*(2.75)*	*(2.57)*	*(4.65)*	*(2.84)*	*(2.66)*
9.5) Constructed share of trade in GDP x main city dummy	-22.267***	-10.383***	-12.259***	-18.112***	-7.692***	-7.847***	-22.087***	-10.434***	-12.029***
	(4.23)	*(2.55)*	*(2.29)*	*(4.22)*	*(2.43)*	*(2.29)*	*(4.06)*	*(2.47)*	*(2.23)*
City interaction parameter				0.044	0.054	0.058	0.030	-0.048	0.050
				(3.00)	*(4.47)*	*(5.72)*	*(0.32)*	*(0.50)*	*(0.73)*
RS*rho*				8.57	18.75	31.47			
RS**rho*				8.57	19.50	31.27			
RS*lambda*							0.06	0.11	0.30
RS**lambda*							0.05	0.86	0.10
RS*lambdarho*				8.63	19.62	31.57	8.63	19.62	31.57
Log-likelihood	-205.28	-192.16	-385.86	-200.64	-182.34	-369.58	-204.94	-191.77	-385.20
R2	0.48	0.41	0.46						
Number of obsevations	222	224	416	222	224	416	222	224	416

Standard deviation reported below the estimated coefficients. ***significant at 1% level; ** significant at 5% level; *significant at 10% level.

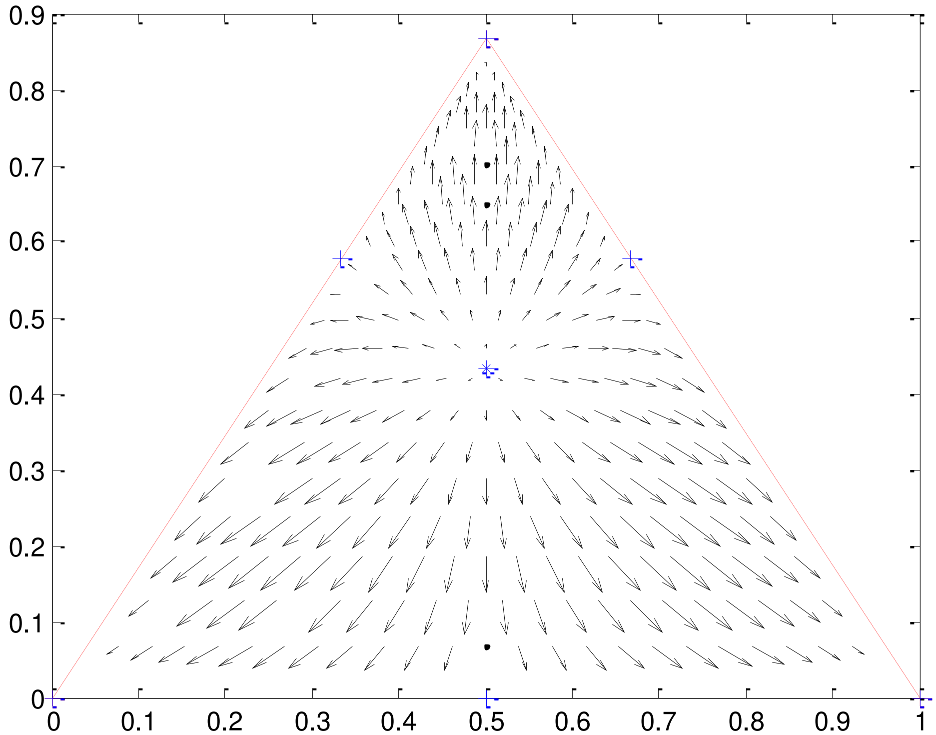
Table 9. Population over a million (other definitions of trade openness)

Dependent variable: Log of city population	OLS					Lag-ML				Err-ML			
	1	**1 to 2**	**1 to 3**	**1 to 4**	**1 to 5**	**1 to 2**	**1 to 3**	**1 to 4**	**1 to 5**	**1 to 2**	**1 to 3**	**1 to 4**	**1 to 5**
1) Intercept	2.627**	-2.283**	-1.978**	-2.541***	-2.858***	-2.316**	-1.658*	-1.822**	-1.854**	-2.175*	-1.472	-2.208*	-2.145
	(1.08)	*(1.13)*	*(1.01)*	*(0.92)*	*(0.90)*	*(1.02)*	*(0.92)*	*(0.84)*	*(0.81)*	*(1.23)*	*(1.22)*	*(1.21)*	*(1.32)*
2 Main city dummy		1.124***	1.293***	1.562***	1.673***	1.303***	1.458***	1.749***	1.842***	1.061***	1.367***	1.604***	1.686***
		(0.24)	*(0.24)*	*(0.25)*	*(0.26)*	*(0.23)*	*(0.22)*	*(0.23)*	*(0.23)*	*(0.18)*	*(0.18)*	*(0.20)*	*(0.19)*
3) Capital city dummy	0.278**	0.491***	0.508***	0.469***	0.540***	0.586***	0.578***	0.558***	0.633***	0.605***	0.558***	0.543***	0.635***
	(0.13)	*(0.16)*	*(0.14)*	*(0.14)*	*(0.15)*	*(0.14)*	*(0.13)*	*(0.13)*	*(0.14)*	*(0.12)*	*(0.11)*	*(0.11)*	*(0.12)*
4) Log of nonurbanized population	0.184*	0.584***	0.583***	0.594***	0.590***	0.494***	0.447***	0.415***	0.375***	0.576***	0.563***	0.583***	0.568***
	(0.09)	*(0.06)*	*(0.06)*	*(0.05)*	*(0.05)*	*(0.07)*	*(0.06)*	*(0.06)*	*(0.05)*	*(0.07)*	*(0.07)*	*(0.07)*	*(0.07)*
5) Log of land area	0.004	0.151***	0.130***	0.131***	0.145***	0.134***	0.109***	0.101***	0.104***	0.157***	0.135**	0.141***	0.157***
	(0.05)	*(0.05)*	*(0.04)*	*(0.04)*	*(0.04)*	*(0.04)*	*(0.04)*	*(0.04)*	*(0.03)*	*(0.05)*	*(0.05)*	*(0.05)*	*(0.06)*
6) Log of real GDP per capita	0.266**	0.430***	0.466***	0.465***	0.478***	0.365***	0.361***	0.315***	0.266***	0.420***	0.432***	0.431***	0.399***
	(0.11)	*(0.11)*	*(0.09)*	*(0.09)*	*(0.08)*	*(0.10)*	*(0.09)*	*(0.08)*	*(0.08)*	*(0.12)*	*(0.12)*	*(0.11)*	*(0.12)*
7) Share of the labor force outside the agriculture	-0.123	0.956**	0.845**	0.720*	0.598*	0.802**	0.679*	0.606*	0.592*	1.000**	0.947*	0.861*	0.864
	(0.43)	*(0.45)*	*(0.40)*	*(0.38)*	*(0.35)*	*(0.41)*	*(0.37)*	*(0.34)*	*(0.31)*	*(0.50)*	*(0.49)*	*(0.50)*	*(0.53)*
8.1) Share of trade in GDP	-0.398	0.848*	0.093	0.398	0.292	0.845*	0.052	0.333	0.214	0.788	-0.136	0.228	0.072
	(0.50)	*(0.50)*	*(0.34)*	*(0.33)*	*(0.31)*	*(0.45)*	*(0.31)*	*(0.30)*	*(0.28)*	*(0.49)*	*(0.35)*	*(0.35)*	*(0.34)*
9.1) Share of trade in GDP x main city dummy		-0.320	-0.316	-0.414	-0.477	-0.395	-0.405	-0.560*	-0.596*	-0.354	-0.486*	-0.577**	-0.632**
		(0.35)	*(0.35)*	*(0.38)*	*(0.38)*	*(0.32)*	*(0.32)*	*(0.34)*	*(0.33)*	*(0.26)*	*(0.27)*	*(0.29)*	*(0.28)*
10) Port city dummy	0.399	0.903***	0.300	0.379	0.332	0.844***	0.229	0.303	0.271	0.855***	0.196	0.296	0.323
	(0.29)	*(0.28)*	*(0.24)*	*(0.24)*	*(0.23)*	*(0.26)*	*(0.22)*	*(0.22)*	*(0.20)*	*(0.27)*	*(0.22)*	*(0.22)*	*(0.20)*
11) Port city dummy x share of trade in GDP	-0.279	-1.278***	-0.616*	-0.824**	-0.690**	-1.143***	-0.424	-0.581*	-0.421	-1.096***	-0.282	-0.463	-0.299
	(0.43)	*(0.41)*	*(0.34)*	*(0.36)*	*(0.34)*	*(0.38)*	*(0.31)*	*(0.33)*	*(0.31)*	*(0.41)*	*(0.33)*	*(0.34)*	*(0.31)*
12) Central location dummy	0.142	0.267	-0.079	0.130	0.060	0.262	-0.092	0.083	0.037	0.321	-0.123	0.094	-0.019
	(0.27)	*(0.28)*	*(0.24)*	*(0.24)*	*(0.22)*	*(0.26)*	*(0.22)*	*(0.22)*	*(0.20)*	*(0.27)*	*(0.22)*	*(0.23)*	*(0.21)*
13) Central location dummy x share of trade in GDP	-0.097	-0.338	0.020	-0.226	0.007	-0.339	0.053	-0.167	0.013	-0.446	0.153	-0.147	0.129
	(0.37)	*(0.40)*	*(0.34)*	*(0.36)*	*(0.34)*	*(0.36)*	*(0.31)*	*(0.32)*	*(0.30)*	*(0.39)*	*(0.31)*	*(0.34)*	*(0.32)*
14) Lack of political rights and civl liberties dummy	0.250	0.356	0.425**	0.502***	0.500***	0.300	0.327*	0.330*	0.283*	0.358	0.403	0.457*	0.411
	(0.17)	*(0.22)*	*(0.21)*	*(0.19)*	*(0.17)*	*(0.20)*	*(0.19)*	*(0.17)*	*(0.16)*	*(0.24)*	*(0.25)*	*(0.25)*	*(0.25)*
15) OECD country dummy	-0.385*	-0.359	-0.372	-0.285	-0.303	-0.282	-0.264	-0.201	-0.166	-0.317	-0.322	-0.246	-0.242
	(0.23)	*(0.27)*	*(0.25)*	*(0.23)*	*(0.21)*	*(0.24)*	*(0.23)*	*(0.21)*	*(0.19)*	*(0.30)*	*(0.31)*	*(0.30)*	*(0.31)*
16) Log of telephone mainlines (per 1000 people)	0.054	0.010	0.012	0.036	0.039	0.003	-0.002	0.015	0.015	0.002	0.003	0.029	0.025
	(0.05)	*(0.06)*	*(0.05)*	*(0.05)*	*(0.04)*	*(0.05)*	*(0.05)*	*(0.04)*	*(0.04)*	*(0.06)*	*(0.06)*	*(0.06)*	*(0.06)*
17) Log of urbanized population	-0.040												
	(0.06)												
18) Road Index		0.026	0.050	0.034	0.052	0.023	0.054	0.036	0.052	0.031	0.065	0.032	0.069
		(0.07)	*(0.06)*	*(0.06)*	*(0.05)*	*(0.06)*	*(0.06)*	*(0.05)*	*(0.05)*	*(0.08)*	*(0.08)*	*(0.08)*	*(0.08)*
20) City interaction parameter (*lambda*)						0.156	0.218	0.281	0.349				
						(2.84)	*(3.94)*	*(5.31)*	*(7.03)*				
21) City interaction parameter (*rho*)										0.203	0.282	0.334	0.429
										(3.64)	*(5.03)*	*(6.17)*	*(8.81)*
RS*rho*						6.25	12.78	24.02	42.89				
RS**rho*						2.65	1.86	0.14	1.01				
RS*lambda*										8.70	18.40	29.89	58.10
RS**lambda*										5.10	7.49	6.02	16.22
RS*lambdarho*						11.35	20.26	30.03	59.11	11.35	20.26	30.03	59.11
Log-likelihood	-32.67	-128.93	-187.48	-247.46	-304.72	-124.89	-180.62	-235.71	-285.45	-123.09	-176.92	-232.20	-277.49
R2 Adjusted	0.86	0.82	0.80	0.78	0.77								
Number of obsevations	81	148	201	252	300	148	201	252	300	148	201	252	300

Standard deviation reported below the estimated coefficients. ***significant at 1% level; ** significant at 5% level; *significant at 10% level.

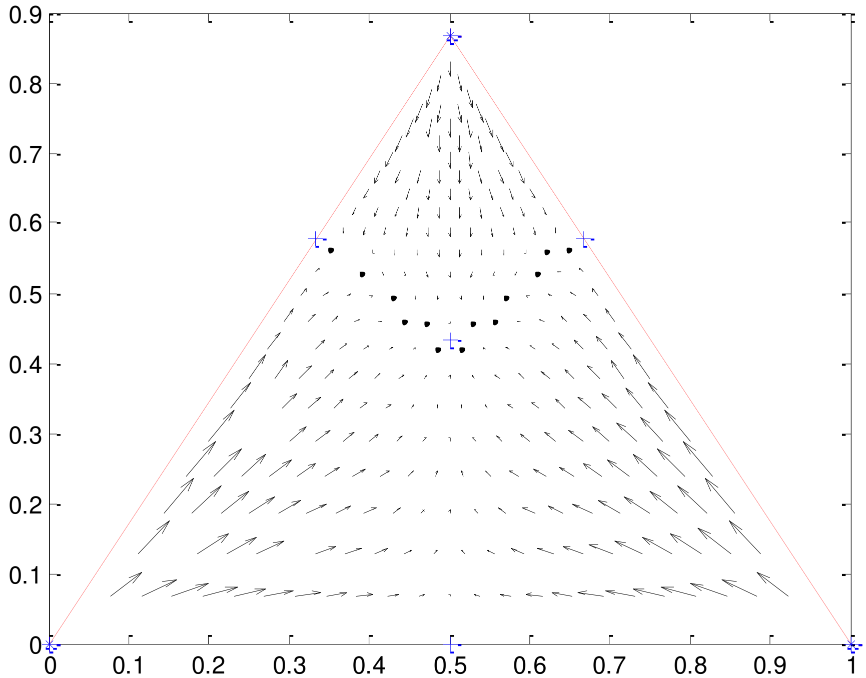
Table 10. Cities by ranking 1985-2000 (Testing Krugman´s 1991 hypothesis)

FIGURES



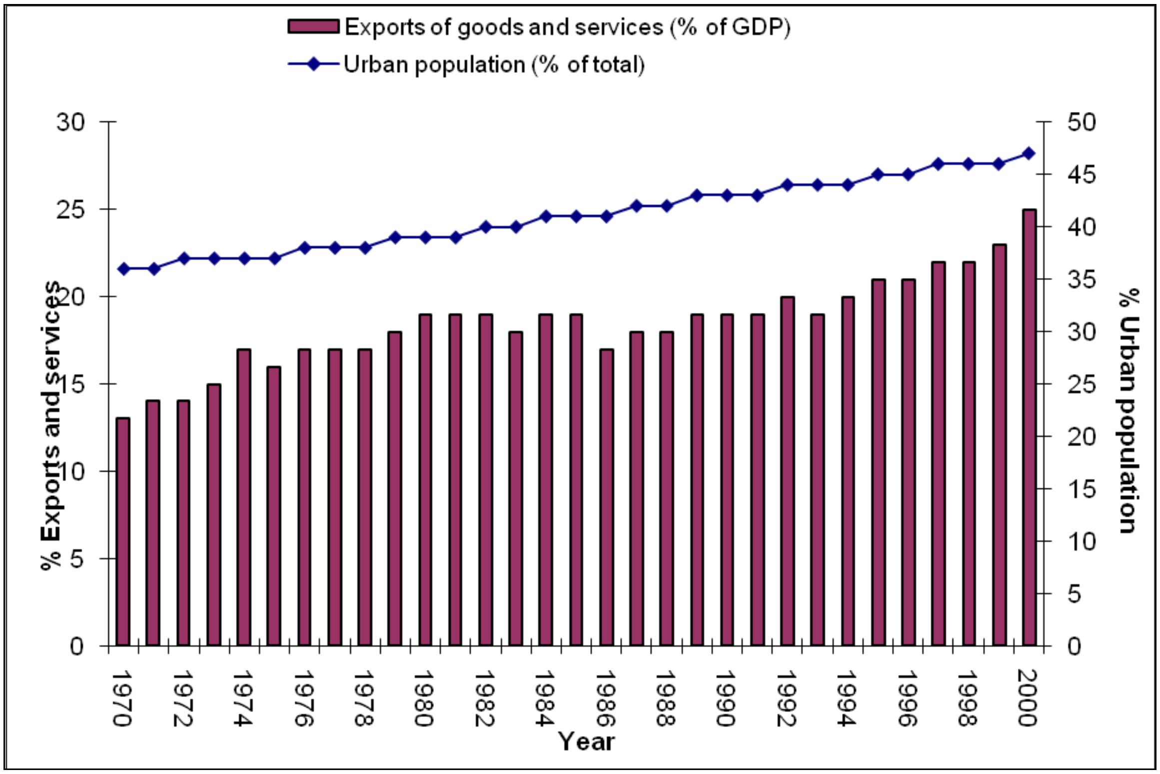
Calculations carried out in MATLAB

Figure 1. Long-run equilibria given 3 local cities and $T_0 = 1.9$



Calculations carried out in MATLAB

Figure 2. Long-run equilibria given 3 local cities and $T_0 = 1$



Source: World Bank Indicators

Figure 3. International trade vs. urbanization in the world

Appendix 1: World cities sample

Region	**Country:** Cities
North America	**1. Canada:** Toronto, Montreal, Vancouver, Ottawa and Calgary. **2. United States:** NY, LA, Chicago, Philadelphia, Miami, Dallas-Fort Worth, Boston, Washington, D.C., Detroit, Houston, Atlanta, San Francisco-Oakland, Phoenix-Mesa, Seattle, San Diego, Minneapolis, Baltimore, St. Louis, Tampa-St. Petersburg, Denver-Aurora, Cleveland, Pittsburgh, Portland, San Jose, Riverside-San Bernardino, Cincinnati, Sacramento, Virginia Beach, Kansas City, Las Vegas, San Antonio, Milwaukee, Indianapolis, Providence, Orlando, Columbus and New Orleans. **3. Mexico:** Mexico City, Guadalajara, Monterrey, Toluca, Puebla, Tijuana, Leon, Ciudad Juarez and Torreon.
Central America and the Caribbean	**4. Costa Rica:** San Jose. **5. Dominican Republic:** Santo Domingo, Santiago, Romana, San Pedro de Macoris and San Francisco de Macoris **6. El Salvador:** San Salvador, Apopa, San Miguel, Santa Ana and Nueva San Salvador. **7. Guatemala:** Guatemala City and Quetzaltenango. **8. Haiti:** Port-au-Prince and Cape Haitien. **9. Honduras:** Tegucigalpa, San Pedro Sula, La Ceiba and Choloma. **10. Jamaica:** Kingston. **11. Nicaragua:** Managua, Leon, Chinandega, Masaya and Tipitapa. **12. Panama:** Panama City, Colon and David**.**

Table 11. World's cities sample

Table 11. continued

Region	**Country:** Cities
South America	**13. Argentina:** Buenos Aires, Cordoba, Rosario, Mendoza, San Miguel de Tucumán. **14. Bolivia:** La Paz, Santacruz, Cochabamba, Oruro and Sucre. **15. Brazil:** Sao Paulo, Rio de Janeiro, Belo Horizonte, Porto Alegre, Recife, Salvador, Fortaleza, Brasilia, Curitiba, Campiñas, Belem, Goiania, Santos, Grande Vitoria, Manaus. **16. Chile:** Santiago, Concepcion, Viña del Mar, Antofagasta and Valparaíso. **17. Colombia:** Santa Fe de Bogota, Medellín**,** Cali, Barranquilla and Bucaramanga. **18. Ecuador:** Guayaquil, Quito, Cuenca, Santo Domingo and Machala. **19. Paraguay:** Asunción and Ciudad del Este. **20. Peru:** Lima, Arequipa, Trujillo, Chiclayo and Iquitos. **21. Uruguay:** Montevideo and Salto. **22. Venezuela:** Caracas, Maracaibo, Valencia, Maracay and Barquisimeto.

Continued

Table 11. continued

Region	**Country:** Cities
Asia	**23. India:** Bombay, Calcuta, Delhi, Madras, Bangalore, Hyderabad, Ahmadabad,Pune, Surta, Kanpur, Jaipur, Lucknow, Nagpur, Patna, Indore, Vadodara, Bhopal, Coimbatore, Ludhiana, Kochi, Viskhapatnam, Agra, Varanasi,Madurai, Meerut, Nashik, Jabalpur, Jamshedpur, Asansol, Dhanbad, Allahabad and Faridabad,.
	24. Indonesia: Jakarta, Bandung, Surabaja, Medan and Palembang.
	25. Israel: Tel Aviv-Jaffa, Haifa, Jerusalem, Be´er Sheva ad Ashgelon.
	26. Japan: Tokyo, Osaka-Kobe, Nagoya, Fukuoka-Kitakyushu, Kyoto and Sapporo.
	27. Jordan: Amman, Zarqa, Irbid, Russeifa and Wad-as-Sir.
	28. Korea: Seoul, Pusan, Taegu, Inch´on, Taejon, Kwangju and Ulsan.
	29. Malaysia: Kuala Lumpur, Klang, JohoreBharu, Ipoh and Petaling Jaya.
	30. Nepal: Katmandu, Biratnagar, Lalitpur, Pokhara and Birgunj.
	31. Pakistan: Karachi,Lahore, Faisalabad, Rawalpindi, Multan, Gujranwala, Hyderabad and Peshawar.
	32. Philipines: Metro Manila, Davao, Cebu, Zamboanga and Cagayan de Oro.
	33. Saudi Arabia: Riyadh, Jidda, Mecca, Medina and Damman.
	34. Sri Lanka: Colombo, Dehiwala/Mt. Lavinia, Moratuwa, Jaffna and Negombo.
	35. Syria: Damascus, Aleppo, Homs, Lattakia and Hama.
	36. Thailand: Bangkok, Nontaburi, Nakhon-Ratchasima, Chon Buri and Chiang Mai.
	37. Yemen: Aden, Sana´a, Taiz, Al-Hudaydah and Ibb.

Continued

Table 11. continued

Region	**Country:** Cities
Europe	**38. Austria:** Vienna, Linz, Graz, Salzburg ad Innsbruck. **39. Belgium:** Brussels, Antwerpen, Liège, Cherleroi and Gent. **40. Denmark:** Copenhagen, Arhus, Odense and Aalborg. **41. Finland:** Helsinki, Tampere, Turku, Oulu and Lahti. **42. France:** Paris, Lyon, Marseille-Aix-en- Provence, Lille and Nice-Cannes. **43. Germany:** Rhein-Ruhr North, Rhein- Main, Berlin, Rhein-Ruhr Middle, Rhein-Ruhr South, Sttutgart, Hamburg, Munich, Rhein-Neckar, Bielefeld, Hannover, Nuremberg and Aachen. **44. Greece:** Athens, Thessaloniki, Pátrai, Irákilon and Vólos. **45. Ireland:** Dublin and Cork. **46. Italy:** Milan, Naples, Rome, Turin and Genoa. **47. The Netherlands:** Rotterdam, Amsterdam, The Hague, Ultrech and Eindhoven-Tivoli. **48. Norway:** Oslo, Bergen, Stavanger, Trondheim and Frederikstad. **49. Portugal:** Lisbon, Porto, Penisula of Setubal, Braga and Funchal. **50. Spain:** Madrid, Barcelona, Valencia, Sevilla and Málaga. **51. Swiss:** Zürich, Geneve, Basel, Bern and Lausanne. **52. Turkey:** Istambul, Ankara,Izmir, Bursa and Adana. **53. United Kingdom:** London, Birmingham, Manchester, Leeds and Tyneside.

Continued

Table 11. continued

Region	**Country:** Cities
Africa	**54. Argelia:** Algiers, Oran, Constantine, Annaba and Batna. **55. Benin:** Cotonou, Djougu, Porto- Novo and Parakou. **56. Burkina Faso:** Ouagadougu, Koudogou and Bobo- Dioulasso. **57. Burundi:** Bujumburi. **58. Camerun:** Douala, Yaoundé, Garova, Marova and Bamenda. **59. Central Afircan Republic:** Bangui, Berberati, Bouar, Carnot and Bambari. **60. Chad:** N´Djamena. **61. Egypt:** Cairo, Alexandria, Port Said, Suez, and Al-Mahalla al-Kubra. **62. Ethiopia:** Addis Ababa, Dire Dawa, Nazret, Gondar and Dessie. **63. Ghana:** Accra, Kumasi, Secondi Takoradi, Tamale ad Ashaiman. **64. Ivory Coast:** Abidjan, Bouake, Yamoussoukro, Daloa and Korhogo. **65. Kenya:** Nairobi, Mombasa, Kisumo, Nakuro and Eldoret. **66. Liberia:** Monrovia. **67.Madagascar:** Antananarivo, Toamasino, Antsirabe, Fianarantsoa ad Mahajanga. **68. Malawi:** Blantyre- Lymbe, Lilongwe and Mzuzu. **69. Mali:** Bamako and Sikasso. **70. Morocco:** Casablanca, Rabat, Fès, Marrakech ad Agadir. **71. Niger:** Niamey, Maradi and Zinder. **72. Nigeria:** Lagos, Kano, Ibadan, Kaduna and Benin City. **73. Rwanda:** Kigala. **74. Senegal:** Dakar, Thies, Kaolak, Ziguinchor and Saint Louis. **75. Sierra Leone:** Freetown. **76. Somalia:** Mogadishu and Merca. **77. Sudan:** Khartoum, Port Sudan, Nyala, Kassala and Al Obeid. **78. Tanzania:** Dar es Salaam, Arusha, Mbeya, Mwanza and Zanzíbar. **79. Togo:** Lomé. **80. Tunisia:** Tunis, Sfax,Sousse, Dejerba ad Kairouan. **81. Uganda:** Kampala, Gulu, Jinja and Lira. **82. Dem. Rep. Congo:** Kinshasa, Lubumbashi Mbuji-Mayi, Boma and Kisangani. **83. Zambia:** Lusaka, Kitwe, Ndola, Kabwe ad Chingola.
Oceania	**84. Australia:** Sydney, Melbourne, Brisbane, Perth and Adelaide.

Appendix 2: Construction of the instrumental variable

We construct the instrumental variable as follows. First, we estimate the coefficients of the gravity equation (6) from (Frankel and Romer, 1999).

(2 A. 1)
$$\ln(\tau_{ij} / GDP_i) = a_0 + a_1 \ln D_{ij} + a_2 \ln N_i + a_3 \ln N_j + a_4 (L_i + L_j) + B_{ij} a_5 + B_{ij} a_6 \ln D_{ij} + a_7 B_{ij} \ln N_i + a_8 B_{ij} \ln N_j + a_9 B_{ij} + a_{10} B_{ij} (L_i + L_j),$$

where τ_{ij}/GDP_i is the share of trade between country *i* and *j* in *GDP* at country *i*; D_{ij} is the distance between country *i* and country *j*; N_i and N_j denote the population in country *i* and country *j*, respectively; L_i and L_j denote a dummy if country *i* and *j* have access to sea, respectively. See (Anderson & Wincoop, 2003) for a critique of the gravity equation. The information is obtained for 1970 and 1985 and 165 countries. The potential number of observations is 165^2, however there are missing observations in both periods. Information was obtained from John Helliwell´s data set. The instrumental variable is then calculated using

(2 A.2)
$$\hat{T}_i = \sum_{j \neq i} e^{\hat{a} X_{ij}} .$$

Table 12 is a regression of the actual share of trade in GDP on the instrumental variable. The sample only includes the 84 countries. They are correlated and R^2 are relatively high.

Dependent variable: Actual share of trade in GDP	**1985**	**1970**
1) Intercept	3.220	3.016
	7.345	*4.892*
2) Constructed share of trade in GDP	0.355	0.33.8
	8.397	*7.656*
Coefficient of correlation	0.630	0.494
R^2	0.397	0.244
Number of observations	84	76

* Calculations carried out in MATLAB; t-values reported below estimated coefficients

Table 12. Regression on the constructed variable

Appendix 3: Data sources

Variable	Units	Period	Source
Capital city dummy.	1 or 0.	n.a.	1999 Encarta Encyclopedia
Central location dummy.	1 or 0		CIA World Factbook.
Distance from city i to city j.	Kms.	n. a.	Own calculations using longitude and latitude from Vernon Henderson's web site; and Heavens-above.com
GDP per capita in 2000 prices.	U.S. $	Average 1970, 1975, 1980 and 1985. Average 1985, 1990, …, 2000. Average 70, ..,2000.	World Bank Indicators
Import duties as a fraction of Imports.	(0, 1)	Average 1970 and 1980 Average 1980 and 1990. Average 1970,..,1990.	Yanikkaya (2003)

Continued

Table 14. Data sources

Table 14. continued

Variable	Units	Period	Source
Lack of Civil Liberties and Political Rights (goes from 1 to 7 each one) Dummy.	1 if both are higher than 3.5. And 0 otherwise.	Average 1972, 1973, …, 1985. Average 1985, 1986,…, 2000. Average 1970, 1971 .., 2000.	Freedom in the World of Freedom House.
Log of land area.	Thousands of Hectares.	Average 1970, 1975, 1980 and 1985. Average 1985, 1990, …, 2000. Average 70, ..,2000.	World Bank Indicators
Log of nonurbanized population.	Thousands.	Average 1970, 1975, 1980 and 1985. Average 1985, 1990, …, 2000. Average 70, ..,2000.	U. N. World Urbanization Prospectus: Revision 2003.
Log of urbanized population outside the i most populated cities.	Thousands.	Average 1970, 1975, 1980 and 1985. Average 1985, 1990, …, 2000. Average 70, ..,2000.	U. N. World Urbanization Prospects: Revision 2003.

Continued

Table 14. continued

Variable	Units	Period	Source
OECD dummy.	0 or 1.	n.a.	OECD web site.
Population in the 5 largest cities.	Thousands.	Average 1970, 1975, 1980 and 1985. Average 1985, 1990, …, 2000.	U. N. World Urbanization Prospectus: Revision 2003.
Port city dummy.	1 or 0.	n.a	1999 Encarta Enciclopedia.
Roads, total network	Kms	Average 1970, 1975, 1980 and 1985. Average 1985, 1990, …, 2000. Average 70, ..,2000.	World Bank Indicators
Share of Imports in GDP.	(0,1)	Average 1970, 1975, 1980 and 1985. Average 1985, 1990, …, 2000. Average 70, ..,2000.	World Bank Indicators.
Share of the non agricultural labor force.	(0, 1)	Average 1970, 1975, 1980 and 1985. Average 1985, 1990, …, 2000.	World Bank Indicators.

Continued

Table 14. continued

Variable	Units	Period	Source
Share of trade, imports and exports in GDP.	(0, 1)	Average 1970, 1975, 1980 and 1985. Average 1985, 1990, …, 2000. Average 70, ..,2000.	World Bank Indicators
Share of trade, imports and exports with Jap+U.S.+Ger in GDP.	(0, 1)	Average 1970, 1975, 1980 and 1985. Average 1985, 1990, …, 2000. Average 1970, 1975,.. ,2000.	Foreign Trade Statistics. U.S. Census Bureau. Federal Statistics Office of Germany. Trade Statistics of Japan. Ministry of Finance. John F. Helliwell´s data set
Telephone mainlines (per 1,000 people).	[0,)	Average 1970, 1975, 1980 and 1985. Average 1985, 1990, …, 2000. Average 70, ..,2000.	World Bank Indicators
World bilateral trade.	U.S.$	1970 and 1985	John F. Helliwell´s data set.
Weighted share of trade, imports and exports with US in GDP.	(0, 1)	Average 1970, 1975, 1980 and 1985. Average 1985, 1990, …, 2000. Average 1970, 1975, ..,2000.	Foreign Trade Statistics. U.S. Census Bureau. CIA The World Factbook.