A Close Look at the Urban Growth Sources in Japan, South Korea and China

Eui-Gak Hwang
Professor emeritus of economics, Korea University and
Senior Research Professor of The International Centre
for the Study of East Asian Development (ICSEAD),Japan

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Eui-Gak Hwang
The International Centre for the Study of East Asian Development (ICSEAD)
Kitakyushu, Japan
e-mail: hwang@icsead.or.jp

Abstract: This paper attempts to look into the urban growth sources of major cities in Japan, Korea, and China, using separate panel data of respective countries. Available data sets across cities as well as across countries are mutually incongruous and diversified so widely. Nevertheless, efforts are made to selectively choose useful data and thus to identify the marginal effects of theoretically relevant variables on the urban growth in each respective country. The panel data set (consisting of 13 cities and 20 years) of Japan is relatively "long and wide" as compared to the Korean panel (7 cities and 21 years) which is called "long and narrow". The Chinese panel set is "short and wide" with 64 cross-sectional units and two-year time series observations. Accounting for the urban growth source analysis using each country's panel may provide us with some understanding of divergent contributions of factors in each country. The growth source analysis if founded on reliable data can be also used for making quantitative projections of future growth, taking account of causal interrelations between the growth sources. The contributions of factor productivity growth, physical capital, human capital, private and government spending, intra competitiveness, and cultural (ethnic) diversity are analyzed to prove quite robustness for both Japan and South Korea but for somewhat suspicious Chinese date.

Keywords: City growth, Decomposition, Ethnicity, Factor productivity, Fixed effects, Heteroskedacity, Human capital, Mediation, Panel.

JEL Categories: 011, 040, R11, R50, Z10.

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I. Introduction

Traditional urban growth economics focuses on the distribution of population density with distance from the centre of the city as a way to explain the urban growth and city structure as well as the costs of sites (Muth, 1961 ; Clark, 1951, 1957, Stewart and Warntz, 1958). The development of a city in terms of its size, income level, and structure is in fact affected by external conditions of two types: (1) demand for the city's outputs, and the supply of inputs to the city's productive activity. As well, the impact of these external factors is conditioned by the size and maturity of the city and by the internal relationships of its various activities in the form of vertical, horizontal, and complementary linkages. Since all cities except the pure homogeneous type contain a variety of activities and differential resource and comparative advantage (or disadvantage), it is to be expected that some of these activities will be determined by many internal and external factors related to demand and supply conditions. In a word, the city economy is always subject to a variety of growth determinants. Growth determinants are immediately associated with those changes in input supplies (i.e., capital , labor, and resources) and interactivity relationships, which are subject to both public and private choice and action as well as various exogenous conditions. The causal relationship between economic growth and input variables could be both one-to-one direct mapping and chain mechanism via a mediation variable. The quality of the labor input (alternatively, human capital) can be enhanced by a variety of education and training programs and by removal of barriers to occupational mobility and technical change (including racial and ethnic discrimination, restrictive work rules, and job entry requirements). Cultural or ethnic diversity can either enhance or degrade the economic growth via such a mediation channel as revealed in its effects on productivity (creativity), work harmony and mutual complements, and social and political conflicts, etc.

Taking account of all such inter-relationships among many factors into consideration will make our analytical methods very complicated and burdensome. Therefore, this paper attempts simply to look into the marginal (direct) role of some important key variables on urban growth in Japan, South Korea and China respectively based on each country's availability of common data contents. The structure of each country's panel data set is not consistent one another in terms of cross-sections and time-series across countries. We use a conventional production function to relate urban economic growth to various inputs, among which a cultural variable represented by ethnicity is additionally included as an explanatory variable in the urban production function of these three countries. It is generally understood that China is more diverse in the number of ethnic groups than both Japan and Korea, but the Chinese city data sets do not have good order of statistics which in turn does limit us to derive cultural factor score equally just as the cases of both Japan and Korea.

We have cultural factor enter directly into the production function, not in the way of mediation channel. The reason is that there is not available such information and data on both cultural factors and their mediation variables as enough to tell how and how much the cultural diversity or similarity affects the endogenous variable in the whole direct and chain reaction[1]. Further collection of data to test the hypothesis on affirmative role of cultural factors promises to be very interesting path to explore further.

This paper is an empirical analysis, in two parts, of accounting for urban growth in Japan, Korea, and China respectively. The second part looks into the decomposition of the sources of economic growth in the three countries observing inputs used to produce the output over time. This paper seeks to find if there are any similar or non-similar facts in the pattern of urban growth and growth sources among the countries, although the data sets used are not uniform one another in terms of cross-section and time-series of each country. Lastly it is followed by policy issues facing cities across the countries.

Section II briefly discusses the analytical framework in terms of production function and its varieties of estimation equations as well as theoretical methodology for deriving Solow residual (factor productivity). In section III, data will be discussed. The methods of actually deriving human capital and cultural (ethnic) diversity score as well as factor productivity (named "A") applied for estimation are also to be provided. In section IV, we will discuss the empirical estimation of both the marginal contributions of selected variables and the growth source decomposition. The growth source analysis will provide a framework for

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[1] Cultural variables include ethnicity, language, religion, history of life, and other inherent traits, etc., as well as the people and family consciousness across regions. These factors may influence the productivity and creativity of the society directly and indirectly. Most economic and econometric research deals with direct causal relations between two variables, X (a cause) and Y (the outcome). However, the influence of a variable (X) may occur via mediation channel. Mediation in its simplest form represents the addition of a third bridge variable to this X→Y relation, whereby X causes the mediator M and M causes Y, so X→M→Y. Mediation is only one of several static and dynamic relations that may present when a third variable, say, Z is involved in the analysis of a two-variable interaction system. If causality works among X, Z, Y in multiple ways, ignoring Z will lead to incorrect inferences. .

making quantitative projections of future growth, taking account of causal interrelations between the growth sources. Last section V concludes with discussions about limitation and further research area related to this study.

II. Analytical Framework

As documented well in most growth literatures, the process of economic growth or its accounting can be analyzed using the shape of endogenous production function. Following Romer (1990), Barro (1997) and many others in the tradition of neoclassical economists, we assume that growth is driven in part by technological change that arises from continuing investment and supplements of other productive factors such as human capital, R&D, various private and public choice variables, and environmental variables. Environmental variables may include state of art encompassing cultural factors, rule of law and property rights, openness of the economy, degree of political freedom, etc.

As usual we will begin with the neo-classical production function. For simplicity, we wish to accommodate four-plus factors of production along with endogenous productivity parameter called "A". The factors are labor L and physical capital K and human capital H and other factor products vector X, which encompasses all important resource and environmental variables (i.e., $X=\Sigma_i X_i$). Then the production function looks in its simplicity form as follows:

$$Y= A(\cdot)\, F(K, L, H, X)\ , \text{ where } X =\Sigma_i X_i =X_1+X_2+ \cdots +X_n \qquad (1)$$

The generalization of it into the Cobb-Douglass production function is:

$$Y= A(\cdot)\{K^{\alpha} H^{\beta} L^{1-\alpha-\beta-\delta i}\, \Sigma_i X_i^{\delta i}\} \qquad (2)$$

This may be expressed in labor-intensive form:

$$y = Y / L = A(\cdot)\{(K^{\alpha}H^{\beta} L^{1-\alpha-\beta-\delta i}\, \Sigma X_i^{\delta i}) / (L^{\alpha} L^{\beta} L^{\delta i} L^{1-\alpha-\beta-\delta i})\}$$

$$= A(\cdot)\, k^{\alpha} h^{\beta}\, \Sigma_i x_i^{\delta i} \quad \text{(here i goes from 1 to n)} \qquad (3)$$

The goal of this paper is first to explain the variation in real income per capita (or per worker) y across sample cities in each country. According to the labor-intensive form of the production function, this depends on physical capital per capita, k, and human capital per capita, h, and other factor products per capita, x_i. The population (labor force) continues to be specified as growing exogenously at rate n.

An aggregate production function relates output of an economy or part of an economy to the inputs used to produce the output. So, if the measure of multifactor productivity, A(·), could be obtained, the above equation (3) can be used to estimate the marginal contributions of each relevant variables along with factor productivity change to real per capita income growth as well as growth accounting equation. Observing factor and product inputs over time shows the proximate contribution of each input to growth of the economy. Based on equation (3), our baseline two equations are rewritten in per capita logarithm linear form (4) and growth rate expression (5) as follow:

$$\ln y = \ln A + \alpha \ln k + \beta \ln h + \delta_1 \ln x_1 + \delta_2 \ln x_2 + \delta_3 \ln x_3 + \delta_4 \ln x_4 + \cdots \qquad (4)$$

$$\frac{\Delta y}{y} = \frac{\Delta A}{A} + \alpha \frac{\Delta k}{k} + \beta \frac{\Delta h}{h} + \delta_1 \frac{\Delta x1}{x1} + \delta_2 \frac{\Delta x2}{x2} + \cdots \qquad (5)$$

The growth equation (5) can be rewritten in natural linear log form as

$$d \ln y = d\ln A + \alpha\, d\ln k + \beta\, d\ln h + \delta_1\, d\ln x_1 + \delta_2\, d\ln x_2 + \delta_3\, d\ln x_3 + \delta_4\, d\ln x_4 + \cdots \qquad (5)'$$

The functional form (4) will be used basically to estimate the marginal contribution of theoretically relevant variables to per capita income growth. Equation (5) or (5)' will be used for estimation of growth source decomposition.

First of all we need here to suggest a way to derive the measure of productivity variable "A". Usually we may think about changes in the quality of inputs such as capital and labor in production due to technical changes. In this case, a production function shift comes from change in technology. Solow (1957, p. 316)) proposed a way of deriving a measure of the level of technology by factoring out technology out of production function such that technical change is treated to be Hicks neutral. The implication of this separable form is that function shifts are pure scale changes, leaving marginal rates of substitution unchanged at given capital-labor ratios in the production function, Y(t)=A(t) f(K(t), L(t), X(t)). Given K/L ratio is unrelated to the rate of technical change, the so-called Solow residual (TFP) could be measured from the following aggregate growth accounting equation:

$$\frac{\Delta Y}{Y}=\frac{\Delta A}{A}+\varepsilon\frac{\Delta K}{K}+\gamma\frac{\Delta L}{L}+\theta\frac{\Delta X}{X}\ \text{, Here } \theta=\Sigma_i\,\theta_i \text{ and } X=\Sigma_i X_i \ (i=1\cdots n), \tag{6}$$

$$\text{and } \varepsilon = (\partial Y/\partial K)(K/Y), \tag{7}$$

$$\gamma = (\partial Y/\partial L)(L/Y), \tag{8}$$

$$\text{and } \theta_i = (\partial Y/\partial X_i)(X_i/Y), \tag{9}$$

From (6), (7), (8), and (9), a measure of technology change rate can be easily obtained as follows:

$$\frac{\Delta A}{A}=\frac{\Delta Y}{Y}-\varepsilon\frac{\Delta K}{K}-\gamma\frac{\Delta L}{L}-\theta\frac{\Delta X}{X} \tag{10}$$

Once the implied rate of technical progress $\Delta A/A$ is computed by equation (10), an index of technology A(t), can be deduced to use in our estimation for equations (4) and (5').

The baseline equations (4) and (5)' are used for the panel data regressions for Japan, South Korea, and China. To avoid possible large effects of the stochastic or purely random component of the regression equations on inferences about the deterministic portion, pooling cross-section data with time-series data is chosen to enlarge the number of degrees of freedom. In general, the regression equation for this type data on N cross-section units over T periods of time can be written in matrix notation as **y** = X**β** + **ε,** where

$$\mathbf{y}=\begin{bmatrix} y_{11}\\ \vdots \\ \\ y_{NT}\end{bmatrix}, X=\begin{bmatrix} x_{11,1} & \cdots & x_{11,K}\\ \vdots & & \\ & & \\ x_{NT,1} & \cdots & x_{NT,K}\end{bmatrix}, \boldsymbol{\beta}=\begin{bmatrix} b_1\\ \vdots \\ \\ b_K\end{bmatrix}, \text{ and } \boldsymbol{\varepsilon}=\begin{bmatrix} e_1\\ \vdots \\ \\ e_{NT}\end{bmatrix}$$

In many circumstances, the most questionable assumption in using longitudinal data model is that the cross-sectional units are mutually independent. When the cross-sectional units are geographical regions (like cities) with arbitrarily drawn boundaries, we would not expect this assumption to be well satisfied. Facing this possibility, we have to drop the assumption of mutual independence. Then we have what may be termed "a cross-sectionally correlated and time-wise autoregression model". For illustration of the case, $E(\varepsilon_{it}^2) = \sigma_{it}^2$ (heteroskedacity), $E(\varepsilon_{it,}\ \varepsilon_{jt)} = \sigma_{it}$ (mutual correlation), and $\varepsilon_{it} = \rho_i \varepsilon_{i,t-1} + \mu_{it}$ (autoregression).

The behavior of the disturbances over the cross-sectional units (cities in our study) is also likely to be different from the behavior of the disturbances of a given cross-sectional unit of time. In particular, the relationship between the disturbances of two cities in a country (i.e., Tokyo and Osaka, Seoul and Busan, and Beijing and Shanghai) at some specific time (say, 2000 or 2005) may differ from the relationship between the disturbances of a specific city (say, Tokyo) at two different periods of time (i.e., 2000 and 2005). Clearly, various kinds of prior specifications with respect to the disturbances will lead to various kinds of restrictions on both variance $E(\varepsilon_{it}^2)$ and covariance $E(\varepsilon_{it,}\varepsilon_{jt}) = \Omega$.

To account for correlation of errors across cities in a particular country as well as different variances, *cross-section and period SUR (Seemingly Unrelated Regression*) model can be chosen if the panel data sets are *balanced samples*. When the panel data set is "*long and narrow*", meaning that we have only a few cross-sectional units over long time periods, the ordinary SUR model can be used. However, the SUR model (i.e., N separate equations for N cross-sectional observations) is no longer of practical value (because of so many individual equations) if we have a panel data set that is "*short and wide*", like the case of our Chinese data set (64 cross-sections and two time periods) to be explained later in the data section. To capture all behavioral differences between individual cities and over time, *the fixed effects model* as well as *the random effects model*(often called *an error components model*) is also used in the analysis, using *Eviews* (version 6) package program.

III. The Data

The data sets consist of mutually independent three panels respectively for three countries. Firstly, the Japanese data sets are from (1) *Annual Statistics Books for Big City Comparison*

(Dai Toshi Hi Kaku Tou Kei Nenpyo) published by the Association of Big City Statistics Cooperation (Dai Toshi Tou Kei Kyogikai) and (2)*Japan Statistical Yearbook* published by Ministry of Internal Affairs and Communications. The *Annual Statistics Books* contain somewhat systematically consistent numbers and contents of major cities data only from 1985. The most recent volume available was for 2004. Included cities are Sapporo, Sendai, Saitama, Chiba, Tokyo, Kawasaki, Yokohama, Shizuoka, Nagoya, Kyoto, Osaka, Kobe, Hiroshima, Kitakyushu, and Fukuoka. But two cities, Saitama and Shizuoka, do have some relevant variables missing, which made it for them to be excluded from the panel data. Furthermore, three cities provide only partial time series: namely, Sendai and Saitama only for 1994-2004 and Yokohama for 1985-2004. Therefore, we have N=13 and T=20 in terms of unbalanced panel samples, but N=13 and T=10 (namely, 1985-2004) in balanced panel data for Japan.

Secondly, for South Korea , data are compiled from (1) *Korea Statistical Yearbook* published by Korea National Statistical Office (www.nso.go.kr), (2) *Comparative Statistics of Major Cities* (in Korean) by Seoul Metropolitan Government, (3) *National Income Statistics* by the Bank of Korea (www.bok.or.kr), and (4) *Gross Regional Domestic Product and Expenditure* by Korea National Statistical Office . The panel includes 7 cities (Seoul, Busan, Daegu, Kwangju, Daejun, Inchon, Jeju) over 21 years (1985-2005), that is N=7 and T=21 in balanced samples.

Thirdly, Chinese city data are from (1) *China City Statistical Yearbook* published by China Statistics Press, (2*) China Urban Life and Price Yearbook* compiled by Department of Urban Society and Economic Statistics and National Bureau of Statistics of China (2007),

(3) *Collection of Statistics (2006-2007)* by China Economic Monitoring & Analysis Center, National Bureau of Statistics, and (4) *China Statistical Yearbook* by State Statistical Bureau.

China has very *long and wide* data, but there are so deep discrepancy and internal inconsistency in terms of statistical items, contents and categories across cities and over time. For simplicity of handling raw data sources, we decide to take only two years (2000 and 2006) with 64 major cities (consisting of 37 cities in the east region, 27 cities in inland

China)[2]. The selection of these 64 cities is in accord with the very well compiled data sets given in *Collection of Statistics (2006-2007)* above.

As are in the equations of the previous section, so here capital lettered variables mostly indicate aggregate and nominal values while small letters indicate per capita and real values. The names and measures of variables included in both the production function (equation 3 in the previous section) and the baseline regression equations (4 and 5') are as follow: **y** is per capita regional real income (to be denoted by **grp**). **k** is real per capita physical capital stock (**capital**), which is a composite index with a constant depreciation rate. The measure of capital stock comes from cumulation of figures on gross physical (or physical asset) investment along with estimates of depreciation of existing stock: $K(t+1)= K(t) - \delta K(t) + I(t)$, where δ is constant depreciation rate (around 0.25-0.30) and I denotes investment.

h is the real value of human capital stock, which is derived in two ways. Firstly, HUMAN (index of human capital) may be simply considered to be the share of highly educated people to total residents in a city. Alternatively, H is derived like a physical capital as follows: $H(t+1)=H(t) - 0.05\,H(t) + EDUSP(t)$, where H is the monetary value of human capital stock, and 0.05 is annual depreciation rate assumed for existing human capital stock; EDUSP is nominal value of aggregate spending for education . Let **human** (or **h)** be the real value of per capita human capital while **H** is aggregate value of human capital. Human capital can be approximated in terms of aggregate value as follows: **H=**(1-0.05)*grad*grp +(per capita real expenditure for education)*(employed person) =(1-0.05)*grad*(grp)+edusp*grad, and **h** = **H** / **grad,** where **grp** is real per capita regional income, which is also regarded as a proxy for average real wage income**. edusp** is per capita real expenditure for education; and 0.05 is approximated depreciation rate of human capital; **grad** is number of highly educated persons (high school graduates and plus) or all employed workers.

$\mathbf{x_1}$ represents per capita private consumption expenditure (to be denoted by **pcons**); $\mathbf{x_2}$ is share of private consumption expenditure per capita on recreation and entertainment activities **(rcent)**; $\mathbf{x_3}$ is per capita government consumption expenditure (**gcons**); $\mathbf{x_4}$ is an indicator for each city's competitiveness represented by net domestic trade (**netra**). Let $\mathbf{x_5}$

[2] List of Chinese cities is in the appendix of this paper.

represent a cultural diversity score (**Diversity**), which is also derived in two ways as follows: One measure to be named as **diverse1** is simply share of foreigners (including annual average number of visitors) to total residents and another measure **diverse2** is derived as follows.

diverse2= $\mathbf{N^{(1-si)} - 1}$, where N is the number of cultural (ethnic in this study) groups and s_i is the population ratio of the largest cultural group in each city. Diversity is positively related to N but negatively related to s_i. Specifically, when N = 1 or s_i = 1, **diverse2** = 0. This measure is exactly similar to Herfindahl-Hirschman index[3] approach applied to deriving ethnic diversity in such formula as {$\mathbf{Diversity = 1 - \Sigma_i(r_i)^2}$ }, where r_i is the share of people born in country "i" among total people residing in the city at a given year. And " i " goes from 1 to nth countries. If the index is zero, there is no diversity meaning all individuals born in the same country. If it reaches its maximum value one, there are no individuals born in the same country. In sensitivity analysis, some other explanatory variables (such as **welfare** and some environmental variables), if available, were included in the relevant country regressions but were turned out generally to be insignificant in the most of cases. Omission of them proves not to cause any significant omitted variable bias at all. Lastly, factor productivity (**A**) growth rate to be used for our analysis of urban growth sources decomposition is approximated as follows:

ΔA/A=(1+dlog(grp))-(log(grp)/log(capital))*dlog(capital)-(log(grp)/log(h))*dlog(h)-(log(grp)/log(k))*dlog(k)-(log(grp)/log(diverse2))*dlog(diverse2)-(log(grp)/log(netrade))*dlog(netrade), as given by equation(10) in section(II).

(Note that the "small letters" indicate *real per capita* variables wherever appropriate, and * and / indicate multiplication and division operator respectively. And d is derivative operator. $\Delta \log x = \log x_t - \log x_{t-1}$, which is approximately equal to Δx/x, and log is natural log. Price index and grp deflators used are all based on 2000=100 for all countries.)

[3] The Herfindahl index, also known as Herfindahl-Hirschman index (HHI), is a measure of the size of firms in relationship to the industry and an indicator of the amount of competition among them.

IV. Empirical Results

(I) Estimation of Production Function

(I-A) Japan

A panel data consisting of thirteen major cities (Sapporo, Sendai, Chiba, Tokyo, Kawasaki, Yokohama, Nagoya, Kyoto, Osaka, Kobe, Hiroshima, Kitakyushu, and Fukuoka) over 1994-2004 annual time periods provides us with a total of maximum 164 observations (after adjustments in terms of balanced panel date set), which are long and wide enough to offset any possible large effects of the stochastic or purely random component on inferences about the deterministic portion. Using the balanced panel data set, firstly we estimate the marginal effects of relevant variables on the Japanese urban growth. Because of many missing (not available) of sequentially dated observations across entities (cities) and time, our pooled data in balanced form has limited degrees of freedom to include every seemingly influential variables in the estimation. Therefore some important and relevant variables could not be included in the estimation because there are some "missing (not available)" in the stacked data set. In our employed equations for empirical estimation, therefore, there might be omission of some important variables which are correlated with those included regressors, that determine, in part, dependent variable. To control for omitted (unobserved) variables in panel data, the *fixed effects regression method*[4] is employed, when the omitted variables are suspected to vary across entities (cities) but is constant over time. Similarly, to control for unobserved variables that are constant across entities but evolve over time, time fixed effects regression model is applied if deemed appropriate. Likewise, the *random effects model* (often called an *error components model*) is additionally tried to treat the individual entity differences as *random* rather than *fixed*.

Using those available variables and methods, the sensitivity analysis is made to find the best fitting equations with inclusion of different sets of explanatory variables. We include an

[4] The fixed effects regression model is $Y_{it} = \beta_1 X_{1,it} + \cdots + \beta_k X_{k,it} + \alpha_i + u_{it}$, where i =1…..n and t = 1….T, where $X_{1,it}$ is the value of the first regressor for entity I in time period t, $X_{2,it}$ is the value of the second regressor, and so forth, and $\alpha_1 \ldots\ldots \alpha_n$ are entity-specific intercepts. The results of fixed effects are captured by those intercepts deviation from the common intercept value. By passing, note that omitted variable results in bias in the estimator if (1) the omitted variable is correlated with one or more of the included regressors and (2) the omitted variable is a determinant of the dependent variable.

interaction term between diversity (ethnicity) score and human capital to see if the use improves estimators and statistics based on sensitivity analysis. However, such efforts do not improve the estimated statistics even though the pooled panel data is relatively a little better (in terms of coherence) than individual city's time series regressions (results not reported in the paper).

The minor difference results of the interaction term in between pooled data and each single city data may perhaps be ascribed to the intensity of cultural characteristics which is not fully assimilated into human capital formation in the smaller sample than the enlarged one[5]. The results of the panel regressions on the marginal effects of explanatory variables on urban growth are presented in Table 1.

As shown in Table 1, our baseline panel regressions for marginal contributions of variables to growth do surprisingly yield very satisfactory results whether we use ordinary panel OLS method or effects specified methods such as cross-section fixed regression (equation 4 and 5), period fixed regression (equation 5) and cross-section random effects regression(equation 6). The signs of estimates are all as expected. Most influential factor affecting urban growth is the private sector consumption expenditure **(pcons**), followed by government spending **(gcons)** and physical capital investment (**capital)**. The effects of human capital (**human),** intra-city trade (**netra),** ethnic diversity (**diverse2)** are generally significant. But the interacted regressor (**human* diverse2)** is not significant, implying that the change in urban growth with respect to human capital (or presence of foreigners) does not significantly depend on the level of ethnic diversity (or human capital). It is interesting to note that cultural diversity (ethnicity in this paper) turns out to be statistically significant and positive, even though the mediation channels could not specifically be considered in this analysis.

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[5] For the regression results for individual cities as compared to urban panel data in Japan for the period of 1984-2004, see *Exploiting Bright Pearls Hidden in the Pandora's Box of Japanese Urban Growth: Sources of Economic Growth* (by Eui-Gak Hwang, et al), either in forthcoming Journal of Asian Economics or in ICSEAD working paper series vol. 2008-02 (February 2008): www.icsead.or jp. Readers may also find Japanese urban growth source results for individual cities in the above reference. The growth source analysis for each city can be used to show factors responsible for differences in incomes between cities.

Table1. Japanese Urban Panel Regressions for Economic Growth

Variables	(1)	(2)	(3)	(4)	(5)	(6)
Methods	OLS	OLS	Entity fixed	Entity fixed	Period fixed	Random
No.of obs	249	249	249	249	249	249
C	0.632861	0.740365	0.0009711	0.040399	1.818056	0.013683
	(2.341945)	(2.610058)	(0.085851)	(0.332511)	(5.4922141)	(0.120104)
capital	0.126587	0.125847	0.031026	0.030907	0.198674	0.034396
	(4.003870)	(4.023810)	(2.897977)	(2.883251)	(4.717449)	(3.222086)
human	0.031058	0.101317	0.025852	0.042463	0.001673	0.029072
	(2.295368)	(1.730724)	(3.650205)	(1.708166)	(0.127415)	(4.232802)
gcons	0.123022	0.121619	0.027577	0.027377	0.247839	0.028919
	(5.436400)	(4.987645)	(2.927847)	(2.902014)	(7.507617)	(3.135843)
pcons	0.452831	0.447572	0.581709	0.582303	0.497930	0.561911
	(5.436400)	(5.372004)	(14.78850)	(14.78359)	(5.061406)	(15.43923)
netra	0.052519	0.022122	0.014316	0.014451	0.059176	0.015726
	(5.881338)	(1.233514)	(4.443231)	(4.471954)	(6.506911)	(4.900361)
diverse2	0.116109	0.159201	0.135909	0.145115	0.110997	0.150322
	(5.814147)	(3.95786)	(4.538486)	(4.429791)	(6.040499)	(6.376348)
h*div	-	0.022122	-	0.004990	-	-
		(1.233514)		(0.697170)		
Adj. R-sq.	0.77111	0.771603	0.975227	0.975171	0.822376	0.8457780
F-Stat.	140.2491	120.6899	543.3738	513.6505	45.16197	231.2037
H-Q crt.	-0.606159	-0.598734	-2.715865	-2.70467	-0.671626	-

Note: Numbers in parenthesis are "t-statistics". Variables in real terms are all natural log. The interaction term is (log human*log diverse2). The cross-section random estimation (equation 6 in the table) produces SD (standard deviation) of 0.086201 with Rho of 0.6970. The fixed effects for each of the 13 cities is given (based on equation 3) as : Sapporo (0.019340), Sendai (0.051312), Chiba (-0.163011), Tokyo (0.248908), Kawasaki (-0.131066), Yokohama (-0.293671), Nagoya (0.160294), Kyoto (-0.243899), Osaka (0.393575), Kobe (-0.147952), Hiroshima (0.006095), Kitakyushu (-0.064138), and Fukuoka (0.090178). These figures for each city are expressed in terms of deviations from the mean intercept of 0.0009711. So, to get the original fixed effects of each city, it needs to add the number of each city to the mean intercept (0.0009711).

In general, we can assume that cultural diversity or alternatively the heterogeneous living background may bring to the society both positive effects and negative effects. For illustration, cultural diversity (including religion, language, and race) may reduce the effectiveness of democratic institutions and aggravate the chance of agreeing on common public goods and public policies. On the other pole, cultural diversity may enhance creativity of the society. Diverse creative talents can come from heterogeneous abilities, experiences, and living environments. If we had such data as to estimate the causality between cultural factors and technological innovation, for example, then we could estimate the role of a good mediation channel linking cultural diversity to innovation and then to economic growth. Under data availability constraint, however, we regrettably have only direct one-to-one mapping between a cultural factor (ethnic diversity) and urban economic growth. By passing, it must be noted that in Japan, the majority of the citizens does not define Japan as a heterogeneous society. But they have been historically people of mixed races, clans (called "*uji*") and religions. They had diverse religious characteristics in the beginning but now the intensity has mitigated up with no observable and perceivable characteristics other than common Shinto (rooted in the religious beliefs and practices of *uji*) religious culture mixed with Buddhism and Confucianism. However, insufficient data on religious diversity does not allow us to estimate the effects of a religion diversity score on the economic activity in Japan and in other two countries as well.

(I-B) South Korea

The longitudinal data of South Korea is composed of seven major cities (Seoul, Busan, Daigu, Inchon, Kwangju, Daejon and Jeju[6]) and twenty-one years (1985-2005). As in the Japanese analysis above, the effects of major economic and social variables (which are available in systematic series) on the urban growth are experimented by sensitivity analysis using various estimation methods. More than twenty-five categories of variables were compiled from the original data source, but only limited variables are in consistent and complete forms to enable to use for regressions. So, only the important variables, which are mostly similar in nature and conformable with those employed for Japanese urban analysis, are chosen for Korean cities[7] as will be for Chinese cities. Results of the regressions are presented in Table 2[8]. Results reveal that the private consumption expenditure (**pcons)** is significantly negative against our prior expectation. If we add an interaction term (**h*div),** the estimated sign of **pcons** turns out to be positive, but statistically insignificant. This might be because a larger portion of household spending in each locality is not much related to local activities, but to activities outside of own local boundaries. Probably, Korean citizens were *way-worn* during the sample period to spend much of their savings on traveling to both outside of their home cities and foreign countries. The estimator of ethnic diversity is also negative, though not significant, partially implying that Korean society are extremely homogenous in ethnic composite[9], while the living cost has over last two decades continued to rise so expensively as not to be attractive for foreigners.

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[6] Jeju province data instead of Jeju city data is chosen, because it is an isolated island.

[7] Results of additional variables inclusion are referred to read *A Pilot Search for Urban Growth Sources and the Role of Culture: Case of Korean Urban Growth* (Eui-Gak Hwang and Kyung-Ae Ahn), ICSEAD working paper series vol. 2007-26 (December, 2007).

[8] The results are those selective ones obtained by the sensitivity analysis among a variety of alternative specifications and functional forms. The specification criteria for additional inclusion of variables can be either Akaike's Information Criterion (AIC) or the Schwarz Criterion (SC) given below:
AIC= log(RSS/N) +2(K+1)/N and SC=log(RSS/N)+log(N)(K+1)/N, where RSS stands for the summed squared residuals; N is the sample size; and K is the number of independent variables. (see H. Akaike, 1981, and C. Schwarz, 1978). These criterions detect the specification errors and help to decide if the improved fit caused by an additional variable is worth the decreased degree of freedom and increased complexity caused by the addition.

[9] Many Chinese residents had migrated out of Korea to the United States or other countries in years after the Korean war (1950-3).

Table 2. Korean Urban Panel Regressions for Economic Growth

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Methods	OLS	OLS	Entity fixed	Entity fixed	Entity fixed	Period-fixed	Random
No. of Obs.	140	140	140	141	140	140	140
C	-0.389179	-0.768068	-1.134155	-1.365520	-1.191683	0.186916	-0.389179
	(-1.737364)	(-3.144205)	(-5.140464)	(-5.261628)	(-5.552027)	(0.495216)	(-4.931907)
capital	0.327318	0.321926	0.049453	0.071653	0.055507	0.354626	0.327318
	(8.017108)	(8.170053)	(2.650335)	(3.301948)	(3.051392)	(7.464641)	(22.75841)
human	0.106376	0.204440	0.090852	0.090405	0.118182	0.128799	0.106376
	(6.912692)	(6.186795)	(6.261307)	(5.220311)	(7.081436)	(6.499011)	(19.62327)
gcons	0.388482	0.321926	0.263448	0.109299	0.198321	0.549468	0.388482
	(6.672635)	(4.192089)	(4.625719)	(1.756052)	(3.349921)	(5.192633)	(18.94181)
pcons	-0.167042	0.028310	0.178164	0.273933	0.284566	-0.201889	-0.167042
	(-2.249703)	(0.305522)	(3.388934)	(4.523616)	(4.604003)	(-2.400567)	(-6.386300)
netra	0.047548	0.043039	0.020819	0.013936	0.020322	0.050204	0.047548
	(4.231918)	(3.941642)	(5.019372)	(3.098921)	(5.051949)	(3.872296)	(12.01327)
diverse2	-0.002006	-0.118809	-0.034574	-	-0.077194	-0.007298	-0.002006
	(-0.163760)	(-3.202619)	(-6.479354)	-	(-5.166188)	(-0.488083)	(-0.464872)
h*div2	-	0.026459	-	-	0.009720	-	-
	-	(3.321341)	-	-	(3.040199)	-	-
Adj. R-sq.	0.869410	0.878569	0.983795	0.977071	0.984782	0.854099	0.869410
F-Stat.	155.2335	144.6688	704.1968	543.3356	692.9282	32.29624	155.2335
Akaike Info.	-1.716163	-1.782138	-3.763324	-3.423421	-3.819828	-1.482544	-
Schwarz Cr.	-1.569080	-1.614045	-3.490172	-3.172463	-3.525664	-0.915227	-
H-Q Cr.	-1.656393	-1.713830	-3.652323	-3.321440	-3.700289	-1.252004	-

Note: Numbers in parenthesis are t-statistics. All variables are in natural log of real values.

Equally prejudices or some degree of xenophobia might have caused the negative effect in attracting variety of foreigners to settle down and to enhance the creativity in Korean cities. However, it is very interesting to have very probable interaction between human capital and ethnic diversity. This is an example of the more general situation in which the effect on urban growth (**grp**) of a change in one independent variable (say, **human**) depends on the value of another independent variable (**diverse2**). This is very contrasted with the contrary results of Japanese regressions. The **rcent** (recreation and entertainment spending as ratio to private final consumption expenditure) variable was also additionally tried as a proxy variable representing "urban cultural demand conditions" in the Korean panel regressions. Interestingly, the estimated coefficients of **rcent** were positive and significant, but we do not report the results of the equation containing **rcent** here in order to make the results of three countries as much comparative one another[10] as possible. Instead we report here the cross-section fixed effects (intercept effects) for individual cities in form of deviations from the average intercepts, based on equation 3 in Table 2 ; Seoul (0.093078), Busan (-0.137101), Daigu (-0.166902), Kwangju (-0.044935), Daejon (0.037780), Inchon (0.152971), and Jeju (0.060078). By adding the average intercept value of -1.134155 in equation 3 (if it is the best one), for example, to each city deviation figures given in the parenthesis, we can get the original fixed effects of each city, which can be used to analyze the extent of city heterogeneity if that may be of interest.

(I-C) China

Chinese pooled urban data consists of total sixty four cities (of which 37 cities are from east coast and the remaining 27 are inland cities) and two years (2000 and 2006). Even at these two years sample period, contents of data are not well matching across cities. Due to observed inconsistency among cross-sectional and time-series data of Chinese cities, we selected only two years, while accommodating as many cities as possible.. Therefore, the data set is 'short and wide", meaning that there are many cross-sectional units (N=64) and relatively few time series (T=2) observations, of which many entries contain NA (not available) to make matters worse. After adjustment, therefore, only about 40 panel (balanced) observations depending upon numbers of included regressors could become available for use

[10] Interested readers refer to the paper cited in footnote 6 above.

in our regressions. In this kind of data set, panel least squares regressions using adjusted pooled data (which has smaller degrees of freedom) appear more appropriate than fixed effects regressions. The complete and longer time period data set need to be available for more efficient and consistent estimates. Two sample results from several Chinese urban sensitivity regressions are presented shortly, where numbers in parenthesis are t-statistics. Among Chinese available data, we find that foreign capital (denoted by **fcapital**) actually invested does show very robust contribution to urban growth. But many estimators turn out to be statistically insignificant, as shown below. (Note that ln stands for natural log).

(1) ln grp = 8.082745 + 0.360380 ln pcons +0.116243 ln gcons + 0.307818 ln capital

(3.266569) (1.666227) (0.874464) (2.755451)

-0.045526 ln human +0.022428 ln diverse1 +0.368868 ln netra

(-1.140878) (0.540202) (1.965758)

$\overline{R}^2$=0.842544; F-statistic= 34.88965; Akaike info criterion=-0.220362;

Schwarz criterion=0.078226; Hannan-Quinn criter.=-0.113232; P-value=0.000000.

(2) ln grp=6.855749+0.417082ln pcons+ 0.085160ln gcons +0.135998 ln capital

(3.479417) (2.013908) (0.673564) (1.100776)

+0.006978ln human +0.012426 ln diverse1+0.244870ln netra +0.129901 ln fcapital

(0.2620120 (0.301061) (1.337697) (2.253872)

$\overline{R}^2$=0.855832; F-statistic=33.22600; Akaike inf. criter.=-0.288996;

Schwarz criterion=0.052248; Hannan-Quinn criter.=-0.166560; P-value=0.000000.

As compared to both Japanese and Korean regressions, Chinese results reveal very poor and statistically insignificant estimates. The reasons are likely attributed to limited data availability, data quality and possible measurement errors in raw data, omitted variable bias (i.e., fewer number of control variables caused by smaller degrees of freedom), and , most importantly, high probability of being *large outliers* [11] (alternatively, inconsistency of the

[11] One source of large outliers- that is , observations with values of explanatory variable x_i and/or dependent variable y_i far outside the usual range of the data- is data entry errors, such as a typographical error or incorrectly using different units for different observations. Chinese local official statistics do not often

sample variance) in the cross-section data set. Using Chinese statistics, national or provincial, requires a caution.

(II) Urban Growth Source Decomposition

Each countries urban panel analysis decomposes **grp** (gross regional product) growth into factors including productivity factor, physical capital, human capital, and cultural diversity as well as those relevant economic factors like private consumption expenditure, government spending, and domestic competitiveness, etc. These factors include most of variables used to estimate the marginal contributions to urban growth in addition to factor productivity (that is a joint technology-quality-other inputs shift factor). The growth source analysis using panel data is just to compare the growth source works in the three countries, though the kind and the number of inputs (factors) do not conform exactly one another in terms of each country's cross-sectional sample contents, included regressors, as well as lengths of time periods. (The estimators of factors responsible for differences in incomes between Japanese major cities can be found in the reference paper cited in footnote 4.) As given in equations (5) and (5'), taking the ratio between periods gives income ratios attributable to each factor (input). The analysis provides a framework for making quantitative projections of future growth, taking account of causal interrelations between growth sources. Since aggregate amounts of inputs in a city (or region) that will accompany a given degree of growth are useful in planning for the future, it is more appropriate to compare across cities if we estimate the growth sources for city by city within a country. But that city by city estimation is not main concern of this paper. The results of the growth source decomposition respective for Japan, South Korea, and China are shown below.

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conform with the Central Government official statistics. If an outlier is due to a data entry error, then we can either correct the error or, if that is impossible, drop the observations from the data set. In the latter case, we end up with omitted variable bias.

Growth Source Decomposition (City Averages)

	$\frac{grp_t}{grp_{t-1}}$	$\frac{A_t}{A_{t-1}}$	$\frac{gcons_t}{gcons_{t-1}}$	$\frac{pcons_t}{pcons_{t-1}}$	$\frac{capital_t}{capital_{t-1}}$	$\frac{human_t}{human_{t-1}}$	$\frac{diverse_t}{diverse_{t-1}}$	$\frac{netra_t}{netra_{t-1}}$	$\frac{fcapital_t}{fcapital_{t-1}}$
Japan	2.22 =	1.34	1.41	31.70	-0.44	1.31	8.60	0.73	-
S. Korea	4.17 =	0.75	22.41	18.52	11.52	13.64	0.36	0.31	-
China	75.36 =	8.88	17.96	19.35	17.46	-6.98	-	3.33	-
China	75.36 =	11.47	11.78	15.17	17.47	-6.52	-	2.84	9.61

Note: Japan for 13 cities over 1984-2004; Korea for 7 cities over 1985-2005; China for 64 cities for two years including 2000 and 2006. Chinese grp growth rates are for six years (between 2000 and 2006). To get annual average rate, all the figures for China must be divided by number of years, that is 6.

Cross-country comparison of economic growth sources shows that China has relatively large role of the " A" factor (factor productivity) as compared to other two countries, revealing that later comer has surely a bit edge in catching up. The "A" factor determines the profitability of using capital and other input factors, thus making the use of factors including capital endogenous results of factor productivity. The private consumption spending has bigger role in Japan than in Korea, while government role is much smaller in Japan than in Korea. This explains that Japanese economy is much more liberalized and open as compared to Korean society. Wording differently, government influence in Korean society is still stronger than in Japan. Likewise, Japanese cities are more attractive and diverse in aspects of activities and creative jobs of foreigners as compared to Korean cities. One interesting fact is that Japanese cities are overly invested or saturated with over use of fixed capital. Fixed capital expansion retracts growth in Japanese urban economy. This reflects the marginal diminishing rate of return to fixed capital in Japanese service oriented urban economy due to unbalanced match (mismatch of capital stock) with both labor forces and consumer demands. On the other hand, in China, the human capital growth rate does negatively contribute to income growth, reflecting too many redundant work forces everywhere. In addition, it needs to note that Chinese official statistics on intra-migration of workers, particularly from rural areas to urban cities are not properly recorded in the census of urban population. In fact, during last decade, a huge flows of farm workers into urban labor markets have continued and this surplus laborer from rural China has doubtlessly contributed to the urban economy. Without approximately one million of rural workers annually absorbed into Beijing's physical and low level service jobs, for example, Beijing could not have successfully constructed vast social overhead capitals ready for the 2008 Beijing Olympics. This plausible effects of unofficial rural labor exodus into Chinese cities could not be quantitatively possible to grasp in this analysis framework. Meanwhile, foreign direct capital investment into Chinese cities has very positive role in overall urban growth [12].

The growth source analysis, when disaggregated into growth source by cities within a country will provide a framework for making quantitative projections of future growth of each city within a country. As such, if further consistent date become available, cross-section income growth decomposition by region or city in China will pave a way for future research for arriving at effective policies for regional and city growth.

V. Conclusion

This paper attempts to empirically estimate urban growth determinants of three countries: Japan, South Korea, and China, respectively. The fundamentals of three economies are not the same. However in terms of pattern of progress as well as natural resource constraints, Korea and Japan are much more similar. Both countries with labor shortages (due to low birth rates for decades) have sought their developments on the basis of capital and technology intensive strategies. Japan has been so far ahead of Korea in both innovating and adopting newly advanced technologies in economy, though Korea is recently hard cutting edge utilizing benefits of later comer. Comparatively, China has huge surplus labor and vast land and various natural resource endowments, but it has large development gaps between rural sector and urban sector. With control on intra-migration lifted off, thousands of temporary exodus from farm to non-farm sector are on the way, though they are seldom correctly

[12] Chinese cities are listed in the appendix.

reflected in the published statistics. Chinese cities are seemingly experiencing during our sample period the stage of economic development that physical capital expansion and physical workers do play more crucial role than needing for highly educated human capital.

In terms of ethnicity, China is very heterogeneous with about 56 different minorities living in each clustered regions or provinces. But missing of recorded ethnic groups for cities in our sample statistics made it impossible to calculate and to include the diversity scores for each cities. On the contrary, Korea and Japan are more or less homogeneous societies.

In addition to conventional factors, this paper looks into the influence on economic growth of cultural diversity and human capital along with government spending, private consumption, physical capital, intra trade (intra-competitiveness), and other relevant variables of respective countries. Methodology of deriving secondary variables such as human capital, cultural diversity score, and factor productivity is provided and actually applied for the regressions. The results of regressions provide useful framework to compare the relative importance of factors in urban growth across countries. Along with growth regressions, factors affecting growth are also re-identified through use of growth source analysis. Observing inputs over time shows the proximate contributions of each factor to growth of the city. The growth source analysis if well made with reliable data, can provides a framework for making quantitative projections of future growth, taking account of causal interrelations between the growth sources.

In general, we have very satisfactory and statistically significant estimates in both Japan and Korean panel data analyses, but very insignificant outcome from Chinese urban panel data. Chinese panel data is very wide and short and many observations are missing or not available. The data availability, data quality and omitted variable bias are suspected to cause sources of poor results. Further complete and reliable cross-section data sets for Chinese cities along with long time periods will provide improved panel to produce better results that can be compared with the results of other countries. Analyzing the process of both β-convergence (less developed city and country tending to grow faster than the rich ones) and σ-convergence (reduced dispersion of per capita real income unless the process does not tend to increase new dispersion) is another remaining task to explore along with growth sources analysis across cities and across countries.

"Then they said, 'Come, let us build ourselves a city, with a tower that reaches to the heavens, so that we may make a name for ourselves and not be scattered over the face of the whole earth'. . . But the Lord said, 'If as one people speaking the same language they have begun to do this, then nothing they plan to do will be impossible for them. Come, let us go down and confuse their language so they will not understand each other'. So the Lord scattered them from there over all the earth, and they stopped building the city."

Genesis 11: 3-7

Appendix

The List of Chinese Cities Used for Chinese Urban Growth and Growth Source Analysis:

(East Coast Cities): Beijing, Tianjin, Shenyang, Shanghai, Nanjing, Hangzhou, Fuzhou, Jinan, Guangzhou, Nanning, Haikou, Tangshan, Qinhuangdao, Dalian, Wuxi, Xuzhou, Changzhou, Suzhou, Nantong, Yangzhou, Ningbo, Wenzhou, Jinhua, Xiamen, Quanzhou, Qingdao, Zibo, Yantai, Weifang, Jining, Linyi, Shenzhen, Zhuhai, Shantou, Foshan, Zhaoqing, Zhanjiang

(Inland China) :Shijazhuang, Taiyuan, Harbin, Hefei, Nanchang, Zhengzhou, Wuhan, Changsha, Chongqing, Chengdu, Guiyang, Kunming, Xian, Chengde, Mudanjiang, Luoyang, Pingdingshan, Xiangfan, Yueyang, Huizho

(Far West) : Hohhot, Chngchun, Lanzhou, Lhasa, Xining, Yinchuan, Urumqi.

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