A Close Look into Economic Growth Sources in Japanese Cities

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Abstract

Japanese per capita national income had grown at the average rate of around 2.0% in the last two decades, while most of the 13th largest cities in our sample grew in the range of 2.04% (Osaka) to 3.43% (Tokyo) with only exceptions of Sendai(-0.03%), Kawasaki(1.02%) and Kitakyushu (1.56%). This paper attempts to look into the growth sources of the most advanced capitalistic but idiosyncratic Japanese society. Cross-urban data sets of Japan are put on the macro-anatomical table using both panel data of 13 largest cities covering 1994-2004 and time-series data of 10 cities for 1984-2004 plus one additional city Yokohama (1985-2005). Despite some mutually incongruous and diversified data sets for those cities over years, efforts for both congruent economic analysis and econometric experiments are made to identify the marginal effects of theoretically relevant key factors on the urban growth. Accounting for the urban growth and growth source analysis using Japanese urban data conforms fairly well to the conventional theory related to production function. One aspect of cultural diversity, namely the ethnic diversity partakes to produce statistically significant contribution to the growth of cities in Japan. But limited and internally inconsistent data of other important cultural factors such as religion, sports, and other cultural activities does not allow us to test their effects on urban growth, but future supplement of these data promises to be interesting path to explore further.

Key words: City Growth, Cultural Diversity, Panel, Accounting, Factor Productivity Growth,
JEL Classification: 011, 040, R11, R50, Z10

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I. Introduction and Literature Overview

Economic growth theory has steadily evolved to serve cyclical fluctuations in popularity and interest. Its debates have, though, survived from 1960s neoclassical model that later patched it up by deviating from exogenous constant technology progress to a new wave of incorporating endogenous one, as extended from the older model to include the discovery of new ideas, human capital, government policies and thus continuing technology change so as to avoid the tendency for diminishing returns to capital inherent to the earlier neoclassical model[1] of Solow (1956) and Swan (1956). Indeed, with continuing follow-up works of Arrow (1962), Shesinski(1967), Romer(1986, 1990), Lucas(1988), and Barro and Saa-i-Martin (1995, chaps. 6,7) and many others, the tendency for diminishing returns to per capita capital accumulation could be remedied by either accommodating endogenous growth or providing that productivity creation is possible through investment, new ideas, R&D activities and other product factors such as government actions (i.e., taxation and expenditure, maintenance of law, and other aspects of the economy). More recently, some efforts are under way to do with determination of both absolute and relative rates of growth across countries as well as across regions within a country, taking account of economic, social and cultural factors into consideration (see R.J. Barro, 1997, 2002, F.Caslli, 2004, R. Guo, 2004, 2006, Hwang and Ahn, 2007, Knack and Keefer, 1997, Nopo, Saavedra and Torero, 2007, B.R. Robinson,2003, G.S. Tolley, 2006, etc.).

The common framework for the determination of growth follows the extended version of the neoclassical model represented by $Dy=f(y, y^*)$, where Dy is the growth rate of per capita output, y is the current level of per capita output, and y^* is the long-run or potential level of per capita output. The growth rate, Dy, is diminishing in y for given potential output and rising in y^* for given y. The potential growth y^* depends on an array of choice variables of private sector and government sector as well as environmental and social variables[2]. This general framework is variously extended to draw any relevant inferences from probable factors about the causes of economic growth in a region or across regions over time. Empirical findings rely on results from regression that use the various versions of the general framework above. In spite of recent increasing works to quantify the effects of those qualitative cultural and value-related factors on economic growth relying on cross-country data sets, the results would always remain "something unsatisfactory or missing" as they are far short to reach the expectations of not only the researcher worker(s) but also those serious readers and policymakers as well. Indeed, there involve shortages of availability and, even if available as rude forms of raw data, there exist both internal inconsistency and measurement errors of these relevant data sets.

Data problem is more serious in case of international cross-national statistics than data of cross cities or regions within any single country. What should we also be

[1] A production function , F(T, K, L) is defined as "neoclassical" if properties of (1) constant returns to scale, (2) positive and diminishing returns to private inputs, and (3) Inada conditions are satisfied. (See R. J. Barro and Xavier Sala-i-Martin, 2004, pp. 26-27).

[2] See Robert J. Barro, 1997, pp. 8-47.

cautious is related to the use and misuse of regressions in explaining economic phenomena. For example, if any researcher found statistical correlation between external trade and cultural variables such as diversity or similarity of language or religion per se in the cross country relations, is the result reflective of a simple spurious correlation or real causality in this global trade age?

In the regression analysis, another question to ask about is whether the way that variables are measured corresponds to the policy tools that the country is considering to use. For example, much of the trade-growth literature uses the trade share (the ratio of imports plus exports to GDP) as its measure of openness, even though policymakers are more interested in the effect of lowering policy barriers. The researcher's choice of indicators as a measure of openness can make a huge difference: while there is usually a positive relationship between growth and trade shares, but there is virtually no or negative relationship between growth and tariffs. It goes also without saying that the results do not remain unaltered," robust", in response to changing the sample or adding or omitting variables.

This paper is an empirical analysis, in two parts, of accounting for economic growth in major 13 Japanese cities for the period of 1994-2004 with focus on relevant factors along with the cultural diversity. The second part looks into the decomposition of the sources of growth rates of real per capita GDP in 11 major cities over the period of 1984(5)-2004. The reason of differing number of cities and time periods included will be explained in section III for data. This paper has two distinctive features in that firstly, it attempts to analyze the marginal contribution of relevant economic variables using Japanese cross-city data while voluminous literatures have so far mostly focused on cross-country statistical analysis. Secondly, this paper introduces a cultural diversity score along with other important factors in the local production function, which will also be discussed in section III on data.

Many economists, anthropologists, and sociologists have tried to assess the influence of cultural factors on economic and social development. The primary argument suggests that diverse states are more susceptible to growth-inhibiting internal strife than their homogeneous counterparts are (Lijphart, 1977; and Lemico, 1991; Adelman and Morries, 1967; Haug, 1967). But there are many others who argue that cultural and social diversity plays a driving force for both the change and creative society as well as economic development (R. Florida, 2002; Harrison and Huntington, 2000; J.V. Jesudason, 1989; Thomas and Darnton, 2006; A.J. Scott, 2006; C.Landry, 2006, 2007). On the in-between zone, there are Lian and Oneal (1997) who calculated that a country's ethnic, linguistic and religious diversity score using the formula as follows: Diversity=$\{ (\sum_i \rho_i^2) - \rho_i^2\} / (\sum_i \rho_i^2)^2$ where ρ_i is the percentage of the ith group and ρ_i equals the percentage of the largest ethnic, linguistic, or religious group in the country[3]. Using the data of 98 countries from 1960 to 1985, they found that the cultural diversity is neither related to the per capita growth rate, nor is it related to political instability and social conflict. But there is a critical flaw in the methodology and data employed by

[3] For its formulation, see Juan Molinar, Counting the Number of Parties: An alternative Index, American Political Science Review 85 (December 1991):1383-91.

Brad Lian and John R. Oneal (1977) as well as others. The former authors used the residuals from Barro's cross national study published in 1991 in the *Quarterly Journal of Economics* , to regress their diversity score on economic growth . R. Guo (2002, 2006) also used Barro's (2000) cross-country economic growth regression's residuals as his dependent variable to assess diversity and income inequality effects on economic development. They implicitly assumed that Barro's estimates have "omitted variable bias". Omitted variable bias is the bias in the OLS estimator that arises firstly when one or other included regressors are correlated with an omitted variable (cultural diversity score in their cases).

Secondly the bias occurs when the omitted variable is a determinant of the dependent variable. But it is not clear if the residual owes to the omitted variable or it is purely random variation in the regressend (dependent variable) In addition, the residual, the difference between the observed dependent variable and the estimated regression line varies in numerical signs between" positive (plus)"and "negative (minus)". Thus when it is estimated in log-linear form, about a half of the degrees of freedom loss occurs. They have presented very " plausible" conclusions, but "suspicion on their estimates" cannot be ruled out. Anyhow the puzzle regarding the effects of cultural factors on growth has widely remained " unsolved" or "divided " in agreement among researchers, not to mention of specification errors problem cited above.

We propose, however, that cultural factors affect economic development positively through direct and indirect interaction and assimilation among different social values, creative ideas, work ethics, mutual learning and competition. We think many conflicting and problematic results are mostly due to inaccurate methodology used in measuring and quantifying the various characteristics of cultural factors and products. Arbitrarily earned econometric results might also have something to do with those use and misuse of regressions (and data) far from being soundly backed by economic facts, as pointed out above. Indeed, any cultural factor is hardly accurate to grasp in terms of quantification or numerical score. Keeping all these facts in mind, we attempt to analyze the roles of the major contributors including cultural factor, if such data could be available, to the growth of major cities in Japan.

There are numerous factors attributing to the production of each city or region within a country. To list a few, major policy targets of both central and local government as well as locality traits would significantly influence the pace and speed of any region's development. Accessibility to comparatively advantage factors and demand markets would also add to the differential growth potentials of the locality. Leadership factor is no exception as well. Inclusion of all different characteristic factors relevant to individual city may need formulation of separate production function for each city which is beyond the limits of our toil at the moment. In this study, we choose firstly to analyze the pooled cities using longitudinal data sets, though this pooling makes it unavoidable to lose large degrees of freedom (from maximum 249 actual observations to 164 usable observations) due to internal data mismatch across cities over time.

This paper is organized as follows. Section II briefly discusses the analytical framework in terms of production function and its varieties of estimation models. In

Section III, data will be presented and discussed. The methods of deriving alternative human capital and cultural diversity score are to be provided. In Section IV, based on the available data of both the panel of 13 cities covering 1994-2004 period and individual 10 cities for time series covering 1984-2004 period, we will estimate both the marginal contributions of selected variables to the average growth of the included cities and also the growth source decomposition. The growth source analysis will provide a framework for making quantitative projections of future growth, taking account of casual interrelations between the growth sources. Last section V concludes with discussions about further research related to this subject.

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 recognize four-plus factors of production along with endogenous productivity parameter A. The factors are labor L and physical composite 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 Japan. 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. Our baseline two equations are as follow:

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

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

which can be rewritten in natural linear log form as

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

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's residuals could be measured from the following aggregate growth accounting equation:

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

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

$$\gamma = (\partial Y/\partial L)(L/Y) = A(\partial f/\partial L)(L/Y) \quad (8)$$

$$\text{and } \theta_i = (\partial Y/\partial X_i)(X_i/Y) = A(\partial f/\partial X_i)(X_i/Y) \quad (9)$$

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

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

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 ($5^{'}$). In the next section, the definition of our sought-about variables and sources of data will be briefly introduced.

III. The Data

The raw data sets are from both *Annual Statistics Book for Big City Comparison* published by the Association of Big City Statistics Cooperation and *Japan Statistical Yearbook* by Ministry of Internal Affairs and Communications. The data books include 15 largest cities over the period from 1984 to 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 data missing, though not all, that made it for them to be excluded from our panel data sets.

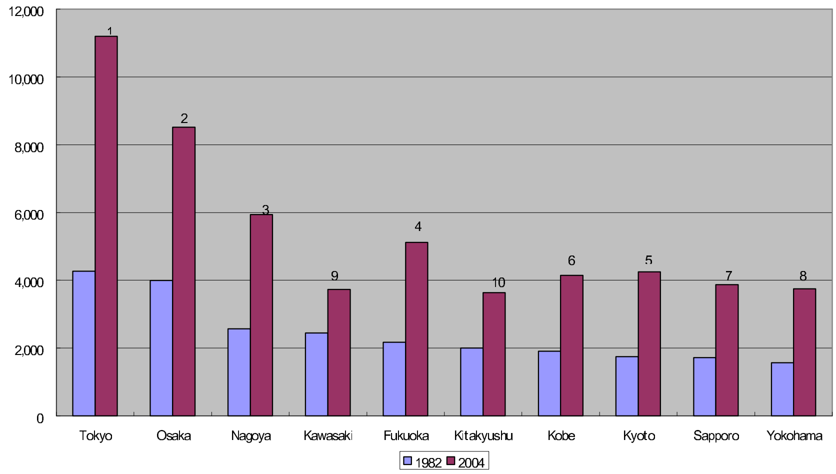
Furthermore, three cities provide only partial time series data: namely, Sendai (1994-2004), Saitama (1994-2004), and Yokohama (1985-2004). If we chose not to lose these three cities, our observations (before adjustment) would be at least 273 from total sample. But if we divorce from these three lovers and decide to live with only 10 remainders for longer period (1984-2004), we would enjoy at most 210 love affairs (number of observations before adjustment), though some would be further sacrificed in the course of data massage.

For panel analysis, we decide to include all thirteen cities for shorter time period (1994-2004). For individual city regressions, however, we chose 10 cities which could provide longer time periods (1984-2004) plus one additional city, namely, Yokohama (1985-2004), which would meet the minimum need in the number of observations for six to seven explanatory variables to be included..

In our equations in the previous section, capital lettered variables indicate aggregate and nominal values while small letters indicate per capita real values.

Firstly, y is per capita regional real income (GRP). Japanese average national per capita income had grown at the rate of 3.65 per annum in the decade of 1980, but it continued to stumble in the range of 1.09 percent growth from 1991 through 2005 with a record of "minus" growth in both 1998 and 1999 and "zero" growth in 1994. It is said that about one and a half decade was a "lost time" for the world second economic power, which has in turn implanted a deep feeling of future uncertainty in the minds of all Japanese populace. On the other hand, a new giant called China has bullishly been surfacing out with "rolling growth inertia" and " positive social ethos", while " Japan corporation" has been down road. However, most of the 13^{th} largest cities in our sample grew annually in the range of 2.04% (Osaka) to 3.43% (Tokyo) with only exception of Sendai (-0.03%), Kawasaki (1.02%) and Kitakyushu (1.56%), three of which have had competitively declining chimney industrial structures with larger aged population share than nation average. As shown in Figure 1, though, Japanese urban income has generally risen by more than double with some varieties across cities over the past two decades. GRP per capita is in the unit of 1000 Japanese yen.

Figure 1. GRP per capita



Secondly, " k " in the equation (3) is real per capita physical capital stock (to be denoted by CAPITAL), which is a composite index which is assumed to have a constant depreciation rate. Measures of the stock of physical capital come from cumulations of figures on gross physical investment along with estimates of depreciation of existing stocks: $K(t+1)= K(t) - \ell K(t) + I(t)$, where ℓ is constant depreciation rate (approximately around 0.25 to 0.30)

Next, "h" in the production function is human capital (HUMAN), which is derived in two ways. HUMAN1 is simply considered to be the share of highly educated people to total residents in a city. Alternatively HUMAN2 is derived like a physical capital as follows: ΔHUMAN2 =[(Z_2/ GRP) *Y * (1 +dlog(Y)) – 0.05 * X_{12} *(1+dlog(X_{12}))]/ POP, where Z_2/ GRP is per capita saving rate on education; Y is total regional income; 0.05 is an assumed constant depreciation rate of human capital and X_{12} is the aggregate monetary value of the stock of highly educated people in the city and POP is total regional residents. Thus, HUMAN2={(Z_2/GRP)*Y – 0.05*X_{12}}/POP. (Note that * indicates multiplication operator and / is division operator as usual.)

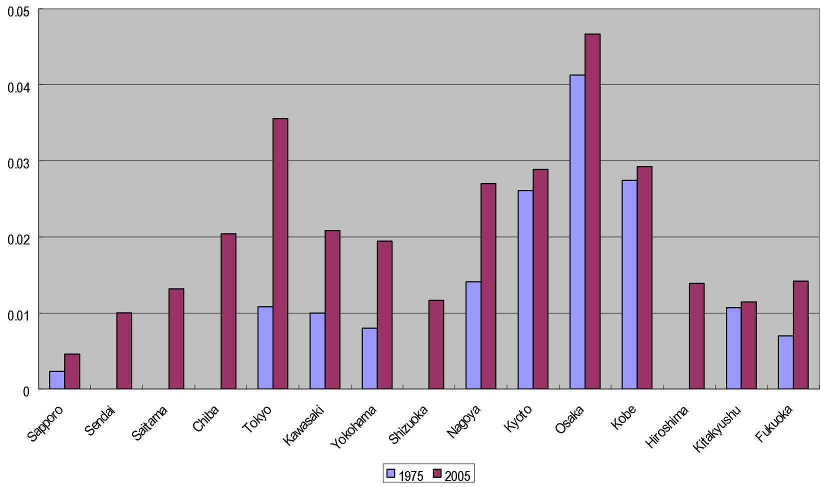
We will let X_1 represent per capita private consumption expenditure (PCONS); X_2 is share of private consumption expenditure per capita on recreation and entertainment activities (RCENT); X_3 is per capita government consumption expenditure (GCONS); X_4 is an indicator for each city's competitiveness represented by net domestic trade between the city and the rest of the country (NETRA).

X_5 represents a cultural diversity score (DIVERSITY), which is also derived in two ways: one measure to be named as DIVERSITY1 is simply share of foreigners to total residents and another measure DIVERSITY2 is derived as follows. DIVERSITY2= $N^{(1-r_i)} - 1$, where N is the number of cultural (ethnic in this study) groups and r_i is the population ratio of the largest cultural group in each city. Diversity is positively related to N but negatively related to r_i. Specifically, when N=1 (or r_i=1), DIVERSITY2 =0. This measure is exactly similar to Herfindahl-Hirschman[4] index approach applied to deriving cultural diversity in such formula as follows: Diversity= $1- \Sigma_i (S_i)^2$ where S_i is the share of people born in a 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 0, there is no diversity meaning all individuals born in the same country. If it reaches its maximum value 1, there are no individuals born in the same country. For general reference, Figure 2 shows the shares of foreigners in major Japanese cities in both 1975 and 2005. Of course, there could be many other locality-characteristic culture traits to be considered, but cardinal measures of culture traits are very iniquitous. Using "dummy variables" for some of culture traits is also inhibitive in our analysis, because their reckless use like data torturing could lead to an empirical confession of a great distance from the real facts.

Lastly, X_6 in the equation (3) indicates welfare expenditure per capita (to be denoted by WELFARE). Other environmental variables used in Barro's regressions (1997, 2000) are not imported in this analysis, because omission of them does not cause significant omitted variable bias. The monetary values of all variables per capita are also in 1000 yen of constant prices based on the year 2000=100.

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

Figure 2 . Shares of Foreigners to total Residents



IV. Empirical Results

(1) Panel Data Analysis

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), which are good enough to offset any possible large effects of the stochastic or purely random component on inferences about the deterministic portion. In many circumstances, however, the most questionable assumption in using longitudinal data model is that the cross-sectional units are mutually independent. For instance, when the cross-sectional units are geographical regions with arbitrarily drawn boundaries, we may doubt if this assumption is well satisfied. If we drop the assumption of mutual independence, then we have what may be termed " a cross-sectionally correlated and time-wise autoregression model ", which can be described as $E(\varepsilon_{it}^2) = \sigma_{it}^2$ (heteroskedasticity), $E(\varepsilon_{it}\varepsilon_{jt}) = \sigma_{ij}$ (mutual correlation), and $\varepsilon_{it} = \rho_i\varepsilon_{i,t-1}+ \mu_{it}$ (autoregression).

The behavior of the disturbance over the cross-sectional units (cities in our sample) 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 joint disturbances of two cities (say, Kitakyushu and Fukuoka) at some specific time (say, 1995 or 2004) may differ from the relationship between the disturbances of a specific city (say, Kitakyushu) at two different periods of time (say, 1995 and 2004). Clearly, various kinds of prior specifications with respect with the disturbances will lead to various kinds of restrictions on both variance $E(\varepsilon_{it}^2)$ and covariance $E(\varepsilon_{it},\varepsilon_{jt}) =\Omega$. The discussion on different specifications and models designed to deal with pooled cross-section and time-series observations needs a lengthy space. However, many advanced econometric package programs such as EViews provide improved Aitken's generalized least square estimator adopted for the so-called "error component model".

The base line equations (4) and (5') are used for this panel data regression, using EViews package (version 5) program.

Before presenting the regression results, in Table 1 we show the summary of descriptive statistics of all the variables used for our estimation.

Table 1. Descriptive Statistics for the Explanatory Variables (1984-2004)

Varaible	Number of Obs.	Minimum	Maximum	Mean	Std. Deviation
A[a]	206	0.203594	2.030824	0.912224	0.388896
CAPITAL	249	209.0086	2809.200	1050.387	432.5374
HUMAN1[b]	249	0.110095	11.00051	0.792438	0.775848
HUMAN2[a]	206	-0.002430	0.056702	0.018201	0.014055
HUMAN2	206	516.1053	5758.551	1876.614	1417.607
PCONS	249	1253.200	4035.832	2091.831	532.4927
GCONS	249	37.49436	1383.338	466.4242	245.4935
RECENT	249	23.29226	1214.911	198.3594	110.4578
NETRA	249	0.041527	7481.184	1120.376	1270.358
DIVERSITY1[a]	249	0.002422	0.047513	0.018982	0.011666
DIVERSITY2[b]	249	0.004838	0.092768	0.037468	0.022770
WELFARE	249	7.564197	83.30421	25.03199	12.49229

Note: a denotes the variable expressed in terms of "change" that is, Δ of the varaible. b denotes the variable in terms of "share (ratio)". All others are in terms of "unit values" Note that HUMAN2 is derived as net value of human capital as follows: HUMAN2={(Z_2/GRP)*Y – 0.05 *X_{12} }/ POP where Y is aggregate regional GDP and X_{12} is total value of existing human capital (that is, number of human stocks times average wage) and POP is the number of regional population.

Our baseline panel regressions of both marginal contributions of variables to growth and growth accounting do surprisingly yield very satisfactory results. Results of some sensitivity analysis for per capita real income growth are given in Tables 2. Based on the representative outcomes from those sensitivity analyses, we selectively present estimation results. In fact, all explanatory variables we include in our production function have turned out to be significantly meaningful with expected signs of the coefficients. Only exception is the case of variable NETRA (net trade) which was meant to reveal any possible competitiveness measure of the city in question.

But the estimated results with negative signs in most sensitivity equations teach us that the causality is the other way. In other words, net trade of a city within the country is usually affected by the size of the urban economy, but not the other way. It is not irrelevant variable, but it is endogenous variable that is affected by income of the city in question. When an irrelevant variable is included, it usually increases the variances of the included variables' estimated coefficients, thus lowering their t-values and lowering R-barred square. Surely it is not the case in our equations.

Welfare variable (X_6 or WELFARE) also produces very poor result and its inclusion contributes to reduce other's t-values in our sequential specification search. It must be an irrelevant factor for growth and it is already included as a portion of government spending (GCONS).

Note that we include an interaction term which is the multiple of human capital (HUMAN) and cultural diversity (DIVERSITY). Each interaction terms has its own regression coefficient, and such interaction term is used assuming that the change in income growth (GRP) with respect to one independent variable (DIVERSITY) depends jointly on the level of another independent variable (HUMAN) or vice versa. The results are all significantly positive.

The overall robustness of significant contributors to Japanese urban growth, when NETRA and WELFARE are dropped, are shown in the estimates for human capital (HUMAN2), recreation and entertainment (RECENT) or private consumption (PCONS), ethnic diversity (DIVERSITY), productivity change (A), physical capital (CAPITAL), and government consumption (GCONS), as well as the interaction term (HUMAN*DIVERSITY) as shown in Table 2. An interaction term is an independent variable in a regression equation in which the change in dependent variable with respect to one independent variable depends on the level of another independent variable.

We include an interaction term whenever the use improves our estimators and statistics based on sensitivity analysis. The overall effects of including interaction between diversity score and human capital (as compared to an interaction of diversity score with other variables) do appear to have been much significant in general on our enlarged panel data analysis. But to be explained later, an interaction term does not improve the estimated statistics in time series individual city regressions except for a few of cities. The difference may perhaps be ascribed to the intensity of ethnic characteristics which is not fully assimilated into human capital formation in the smaller sample than the enlarged one.

By passing, it must also be noted that in Japan, the majority of the citizens does not define itself as a heterogeneous category even though they are people of mixed (largely pacific Asian) race who might actually have had some different cultural characteristics in the beginning but now the intensity has mitigated up with no other observable and perceivable characteristics than common Confucius cultural background. Furthermore, recent comers from other countries are relatively few in numbers as compared to the majority of its indigenous citizens. This very fact is most likely being ascribed to the overall weak influence from our ethnic-related cultural diversity variable.

Our confidence on regressions is based on five criteria for choosing the independent variables (that are, economic theory, R^2-barred, the t-values, and the test of bias in the coefficients, and specification criteria[5]). Additional specification criterion values, namely Ataike's Information Criterion (AIC) and Schwarz Criterion (SC)[6], are also checked by our sensitivity analysis. Note, however, the use of formal specification criteria is not without problems. No test, no matter how sophisticated, can "prove" that a particular specification is the true one. The use of specification criteria, therefore, must be tempered with a healthy dose of economic theory and common sense, and we choose to apply the same specification to both panel and individual city analysis.

In case of some panel data analysis, if it deems necessary to control for any unobserved variables that may vary across entities (cities in our case) but not change over time, the fixed effect regression model is often chosen for the estimation of explanatory variables' coefficients. And if some unobserved variables that are assumed to exist, are constant over time but vary across entities, while others are constant across entities but vary over time, then it needs to employ the combined *entity and time fixed effects regression model*. But we do not have any necessity of using either *fixed effects regression or Generalized Method of Moments (GMM) approach* since we do not have in our specification tests any problems related to either entity fixed omitted variables (such as 'cultural norms') that would vary across entities, or time fixed variables (such as an individual entity's "regulations and laws") that would vary over time. So our coefficients are simply obtained by OLS by not including either entity binary variables or time binary variables, or both.

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[5] Three of the most popular specification criteria we use include(a) Ramsey's RESET test, (b)Akaike's Information Criterion and (3) the Schwarz Criterion. (See J.B.Ramsey, 1969 pp.350-371 and H.Akaike, 1981, pp.3-14 and G.Schwarz, 1978,pp.461-464.

[6] AIC = Log (RSS/N) + 2 (K +1)/N
SC = Log (RSS/N) + Log (N)(K + 1)/N, where RSS is the summed squared residuals, N the sample size, and K the number of independent variables. The lower AIC or SC, the better the specification.

Table 2. Urban Panel Regression for GRP Growth
(13 cities for 1994-2004 Periods)

Variables [a]	(1)	(2)	(3)	(4)
No. of Obs.	164	163	163	163
C	0.6625 (4.1424)	8.7140 (35.2964)	8.7140 (35.2964)	8.6847 (35.3246)
A	0.0300 (5.8414)	0.0263 (2.7394)	0.0263 (2.7394)	0.0286 (2.9692)
CAPIATL	0.0140 (1.6020)	0.0572 (3.8235)	0.0572 (3.8235)	0.0661 (4.2042)
△HUMAN2	–	0.5762 (30.2941)	0.5714 (12.5387)	0.5585 (12.1741)
HUMAN2	0.4072 (46.8087)	–	–	–
PCONS	0.5567 (26.6379)	0.5801 (35.5839)	–	–
RCENT	–	–	0.2202 (9.7804)	0.2171 (9.6781)
GCONS	0.0846 (12.4191)	0.0765 (14.1922)	0.1009 (7.8158)	0.1016 (7.9169)
NETRA	-0.0051 (-2.0200)	–	–	-0.0085 (-1.7412)
DIVERSITY1	–		0.2900 (4.8939)	–
DIVERSITY2	0.0352 (5.7980)	0.2816 (11.3320)	–	0.2682 (4.4543)
HUMAN2*DIVERSITY	–	0.0586[b] (10.3238)	0.0591[b] (4.3650)	0.0525[b] (3.7564)
$\bar{R}^2$	0.9815	0.9887	0.9356	0.9365
D-W stat	1.8139	1.4763	1.0102	1.0425
F-stat	1236.656	2016.857	337.420	299.538
Akaike Crit.	-3.5088	-3.9925	-2.2574	-2.2646
Schwarz Crit.	-3.3579	-3.8407	-2.1055	-2.0938
Prob (F-stat)	0.0000	0.0000	0.0000	0.0000

* Numbers in parenthesis are "t-statistic".

a) Variables are all in natural log except the variables in "change (△)" or in "percentage".

b) In the interaction term, DIVERSITY indicates the one included in the regression.

(2) Time-series Data Analysis for Individual Cities

As shown in Table 3, the growth regression results of most individual cities over the time period of 1984-2004 and Yokohama (1985-2004) are extraordinary good. With the exceptions of Tokyo and Kobe, the "A factor" (factor productivity) has all positive and significant effects on per capita real income growth. In case of Tokyo, the productivity factor appears to make the use of human capital, private and public consumption, and cultural diversity more profitable than its direct contribution.

The regression results also show that Kobe is a peculiar city where physical capital, private consumption, and factor productivity are not significant contributors to the city growth, but the human capital and government spending are jointly wag the entire city along with a weakly positive contribution of ethnic diversity. In general, cultural diversity (ethnic diversity in this study) does show somehow perplexing results in terms of the difference in the estimate signs (positive and negative) across cities, and they are also statistically not so significant except for Yokohama. Some cities can be ascribed to having more foreign born people, but the contributions of ethnic diversity are not so clearly explainable, just as contemporary local slang is hard to prove if it does matter to differing local economic growth from others.

For example, Japanese words commonly used by local people in Kyoto, Kobe, and Osaka are quite different from those of other prefectures, but it is not clearly identifiable if those dialects do really matter to differing economic growth among regions under *ceteris paribus* conditions. Furthermore, it must be noted that Japan is more or less homogeneous in ethnicity (and languages as well) and quite cliquish society in which any persistent cultural diversity can hardly sustain to bloom new creativity contributable to economic growth. Under such a unique cultural society, it is quite stimulating for the regression results to have some positive numerical values for the cultural diversity variable in both panel and individual city analysis, if they are not merely spurious correlations.

It is also very interesting to notice that human capital have negative effects in those cities like Kawasaki (not significant), Yokohama (very significant), Nagoya (insignificant), Hiroshima (insignificant) and Fukuoka (insignificant),which all have strongly positive and significant effects in both "A" factor and physical capital (CAPITAL). They are capital intensive industrial cities in which "A" factor seeks the profitability of substituting physical capital for human capital. In other words, physical capital is an endogenous result of the increase in productivity (A) in these cities. An interaction term, log(DIVERSITY)*log(HUMAN), is included in our sensitivity analysis, but it produces significant results only for Sapporo, Yokohama, Hiroshima, and Fukuoka, though the estimated signs turn out to be negative in the income growth regressions.

Table 3. Growth Regression by City

City	C	log(A)	log(K)	log(H)	log(PCON)	log(GCON)	log(DIVERSITY)	log(DIVERSITY) *log(H)	$\bar{R}^2$
Sapporo	-29.4149 (-11.0555)	18.7091 (14.3795)	1.0088 (15.3466)	1.6805 (10.0448)	1.0066 (13.9929)	1.0002 (16.2617)	-1.3040 (-4.3765)	0.12103 (4.4408)	0.9999
Tokyo	7.2218 (15.2332)	0.2394 (1.8951)	0.1207 (1.7923)	0.4786 (10.2106)	0.4179 (10.2106)	0.0778 (4.5699)	1.7106 (1.1015)	-0.0559 (-1.1283)	0.9992
Kawasaki	-20.9336 (-3.7556)	13.5404 (6.0936)	0.8551 (6.0959)	-0.1093 (-0.6727)	0.1056 (1.4312)	-0.0018 (-0.1517)	0.3372 (0.9848)	-0.0366 (-0.9945)	0.9963
Yokohama	92.4434 (6.1373)	0.6964 (5.9554)	0.3729 (5.5057)	-3.2992 (-6.3062)	-0.262 (-1.5827)	0.1106 (4.5584)	23.5948 (6.5930)	-0.8288 (-6.6250)	0.9955
Nagoya	36.9863 (-10.9118)	15.1861 (25.6809)	0.9609 (25.4811)	-0.1997 (-0.9620)	0.0256 (1.9885)	0.0051 (0.0088)	0.8411 (1.0702)	-0.0534 (-1.0711)	0.9997
Kyoto	-4.0233 (-9.2832)	1.7240 (1.9921)	0.2641 (1.9921)	0.2023 (5.5614)	0.4294 (5.4219)	0.1056 (4.3164)	-0.1009 (-1.1861)	-	0.9994
Osaka	-3.6051 (-1.0434)	0.1926 (5.9448)	0.0947 (5.6518)	0.3261 (1.5549)	0.2892 (29.4409)	0.0489 (17.6889)	0.7747 (1.4056)	-0.0471 (-1.4056)	0.9993
Kobe	-11.7717 (-5.9889)	-0.2249 (-1.3375)	-0.1249 (-1.4099)	0.9391 (10.1077)	-0.0130 (-0.2006)	0.1068 (5.2754)	0.0311 (0.1027)	-	0.9899
Hiroshima	-15.9827 (-0.4307)	14.5580 (12.0374)	0.9264 (12.0861)	-0.7298 (-0.6286)	-0.0035 (-0.1880)	-0.0024 (-1.5115)	5.1957 (0.6524)	-0.1793 (-0.6554)	0.9992
Kitakyushu	-15.6224 (-24.6944)	7.4922 (18.8133)	0.8480 (18.9362)	0.0639 (3.0574)	0.0844 (2.6313)	0.0113 (2.4295)	-0.0211 (-0.4490)	-	0.9974
Fukuoka	-37.7506 (-10.6547)	15.6650 (12.5077)	0.9937 (12.4585)	-0.1235 (-1.5535)	-0.00097 (-0.03308)	0.0018 (0.8469)	0.7777 (1.8944)	-0.0281	0.9998

Note: ① Figures in parenthesis are t-statistics

② All cities except Yokohama (1985-2004) covers data for 1984-2004

③ H= [1-(PCON+GCON)/y] *(grp/deflator)*100-0.05*grad*y, where grp=gross regional income, grad=number of highly educated persons, y=per capita regional income (real), which is a proxy for average wage income, and 0.05 is an assumed depreciation rate of human capital.

(3) Growth Source Decomposition by Major Japanese Cities

The growth source analysis provides us with an account of causal interrelations between the kinds of input variables and economic growth. The important variables that will accompany a given growth rate of each city are jointly estimated to identify their magnitude and importance in terms of percentage contribution to each city growth rate. Each city may have its peculiar conditions of many different kinds to increase the productivity of employing factors for production. For example, if there is no demand for a city to use physical capital and worker education, it will do no good to exogenously increase them. To see them, we have regressed each city's per capita real income growth rate on those shifts of variables included in our baseline production function, using equation (6). The estimated results are reported in Table 4.

Comparing the contributions of variables across cities is very interesting. In Tokyo and Osaka, "A" factor really remained as a mere "tail" without affecting the "body".

Even in Kobe, factor productivity ended up with negative (-2.048) contribution to its growth to our surprise. In addition to its direct negative contribution, it makes the use of capital less profitable perhaps due to the change in the industry composition began to occur and accelerated after the earthquake disaster in January 1995 in Kobe, where steel and iron production had traditionally been dominant. Human capital and cultural diversity do work there.

Table 4. Growth Source Decomposition by City

City[a]	$\frac{Y_t}{Y_{t-1}}$	$\frac{A_t}{A_{t-1}}$	$\frac{K_t}{K_{t-1}}$	$\frac{H_t}{H_{t-1}}$	$\frac{(PCON)_t}{(PCON)_{t-1}}$	$\frac{(GCON)_t}{(GCON)_{t-1}}$	$\frac{(DIVERSITY)_t}{(DIVERSITY)_{t-1}}$	$\bar{R}^2$
Sapporo	2.5016	18.3246	0.9825	1.5615	0.9740	0.9807	-1.0846	0.9988
Tokyo	3.4259	0.2119	0.2152	0.4094	0.4020	0.1013	1.0926	0.9968
Kawasaki	1.0157	13.5892	0.8541	0.0464	0.0739	-0.0077	0.0320	0.9931
Yokohama	2.811	0.7211	0.3789	-3.0750	-0.1758	0.0590	22.1496	0.8714
Nagoya	2.555	15.3537	0.9711	-0.2523	0.0252	-0.0028	0.9988	0.9939
Kyoto	2.845	2.7796	0.4250	0.1651	0.3654	0.0906	-0.1336	0.9868
Osaka	2.039	0.0223	0.6684	0.0097	0.2973	0.0489	-0.00196	0.9955
Kobe	2.159	-0.2049	-0.1079	1.0110	-0.0112	0.1120	0.2344	0.9224
Hiroshima	1.958	13.690	0.8689	-1.4775	0.0007	0.0002	10.5449	0.9987
Kitakyushu	1.563	7.3082	0.8242	0.0691	0.1325	0.0096	-0.0644	0.9718
Fukuoka	2.534	15.3446	0.9729	-0.1057	0.0077	0.0008	0.6983	0.9983
Pooled[b] City	-6.675	0.271	0.242	0.319	0.271	0.024	0.068	0.9198

a) All individual city covers 1984-2004 except for Yokohama (1985-2005)

b) Pooled cities include 13 cities (Sapporo, Sendai, Chiba, Tokyo, Kawasaki, Yokohama, Nagoya, Kyoto,Osaka, Kobe, Hiroshima, Kitakyushu and Fukuoka) of which Sendai has data for 1995-2004,Chiba1997-2004, Yokohama 1985-2004, and all others have data for 1985-2004.

After the earthquake, Kobe has greatly changed her industrial structure toward service sector including medical fields which demand human capital (whose contribution is 1.011) among others. The cultural (ethnic) diversity is a positive source of growth particularly in Yokohama, Hiroshima, Tokyo, Nagoya, Fukuoka, Kobe, and Kawasaki in order of magnitude, while it results in negative contributions in Sapporo, Kyoto, Kitakyushu and Osaka. Physical capital is also equally important source of growth in most cities except for Kobe.

The growth sources provide an organizing framework for arriving at effective policies suitable to each regional environment and condition. Promoting each city growth requires promoting conditions of many different kinds to increase the productivity of the city. There might be omitted variables (i.e., city size, governance, "procedural authoritarianism" and other locality traits) which could contribute to the growth of each city, but both the given number of observations (time period) and data availability restrict us to take account of all possible left-out factors in our regressions.

From cross-city growth source analysis, we could learn that low growing cities (Kawasaki, Kitakyushu, and Hiroshima) have such common similarity that their growth rate of human capital is more lagging than other cities in addition to relatively low government consumption expenditure (which in part reflects either government inactivity or supineness). On the contrary, these cities have relatively high factor productivity growth rate. This explains that low growing cities now face a smaller chance for rapid "catching up" through high rates of factor (specifically, physical capital) accumulation. Instead, the big challenge for them is to expedite their productivity growth via the increase of both investment in human capital and government diligence. The evidence shows that accumulating high-quality human capital is more important for both technology improvement and economic growth as new innovation become more human capital complementary.

V. Conclusions

In this article, we analyze the effects of important economic factors, together with cultural (ethnic) diversity, may have on economic growth in major Japanese cities, using both the panel data and individual city time series data. In Japan as in other Asian countries, various races have coexisted and mixed during several centuries, assimilating in almost homogeneous culture rooted in oriental-inherent Confucius tradition in life pattern and behavior. Nevertheless, cultural diversity is found contributing with statistical significance to the panel data of all orchestrated cities. Race composition has rather perplexing results, like other variables, in terms of its influence on either growth or de-growth of Japanese individual city. We construct two types of indicators of racial diversity using the diversity score method on one hand and simply calculating on the other hand the shares of foreigners to total residents in each city. Since Japan is exceptionally homogeneous in terms of racial intensities, there exists no significant divergence between two sticks measures.

Factor productivity, physical capital, human capital, private and public expenditures produce mostly expected results with only some exceptions across cities, as already explained in the above section.

Also different role of the same factors in our uniform production function for each individual city has been examined so as to provide a varying policy option for each city under study. This growth source decomposition by both individual city and all city together provides us with good guidelines for choosing factors affecting urban growth of Japan most highly in future.

One remaining pitfall in this paper is, however, related with the reality that there do not exist cardinally measurable scores for our thought-after important cultural traits that according to our intuition, would importantly matter for economic growth and development. Another shortcoming of this study is that many other cultural factors and traits could not be included in the analysis because of lack of quantifiable data sets. Even if the cultural variables are numerically (either in cardinal or ordinal form) available, cultural effects are to be revealed in both direct rout and mediation channel to dependent variable. Most economic and econometric research deals with relations between two variables, X (say, a cause) and Y (say, the outcome), and much has been analyzed about two-variables causality. However, the influencing role of any culture variable in enhancing productivity includes not only one-to-one mapping relation but also mediation channel, and accordingly the process requires gravidity and adaptation time. Mediation in its simplest form represents the addition of a third bridge agent to this $X \rightarrow Y$ relation, whereby X causes the mediator (say, M) and M causes Y, so $X \rightarrow M \rightarrow Y$. 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. Therefore, there are many complicated and difficult tasks involved when we take account of the role of cultural traits in productivity growth, not to mention the need for relevant quantifiable data. This homework is necessary to quantitatively explain how cultural variables work to affect productivity and creativity increase. This task is left for our continuing challenge.

In concluding, the author of this paper believes that one of deeply rooted and unique culture in Japanese society as a whole is the culture of "*the procedural authoritarianism*". It is one of interesting subjects to study if "this unwritten ritual with rules of its members, nesting itself deeply in Japanese society", can help Japan take-off again in this globalization age. To analyze if such various cultural factors really matter, further quantifiable information and data are badly in need. Our cross-section income decomposition normalized to any standard city (like Kyoto) over multiple time dimension could also be used to provide important information on the additional study of the process of both β-convergence (poor cities tending to grow faster than the rich ones) and σ- convergence (reduced dispersion of per capita real income unless the process does tend to increase new dispersion). We leave this task to keep on continuing path in the future to explore along with the role of other cultural factors on growth in Japan and elsewhere.

Whether you turn to the right or to the left, your ears will hear a voice behind you, saying: "This is the way; walk in it".

-Isaiah 30:21-

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