Urbanization and Economic Growth: Testing for Causality

16th Annual Pacific Rim Real Estate Conference, January 24th – 27th 2010
Wellington, New Zealand

*Daniel Yet Fhang Lo
The Department of Real Estate and Construction, the University of Hong Kong, Hong Kong
Email: daniello@hkusua.hku.hk

Abstract

The study seeks to empirically test the Granger causality of urbanization and economic growth. By using co-integration and causality tests, it investigates the relationship between urbanization and economic growth for 28 countries for the period 1950-2000. The results are consistent with some previous research findings: There is a long-run stable relationship between the two variables. The causality tests further suggest that the urbanization variable Granger-causes the economic variable for developing nations, while the opposite holds for developed nations. It is therefore suggested that the causal relationship between the two variables is dependent upon the economic development status of a nation. Furthermore, the author posits that the change of the sign of the causal link as the nation's economy advances is due primarily to the changes in the major factors of production: from labour intensive production at the preliminary stage of development to capital- or technology-intensive production when it becomes more developed. Economies of scale, both internal and external, could be a reason for the time lag between the two variables.

Keywords: urbanization; economic growth; Granger-causality test

*Please send comments to
Daniel Yet Fhang Lo
Department of Real Estate and Construction
The University of Hong Kong, Hong Kong
Pokfulam Road
Hong Kong

1. Introduction

Urbanization and economic development have long been regarded as inter-connected processes. Urban economists sometimes determine the economic status of a nation by simply counting the number of large cities it has. In fact, the development history of many present-day developed nations has clearly demonstrated a dramatic rise in urbanization as their economies grew (Hughes and Cain, 2003). Studies have revealed that the simple correlation coefficient across countries between percentage of urban residents in a county and GDP per capita is about 0.85 (Henderson, 2003), which appears that urbanization is an inevitable part of a modern society.

There has been an enormous literature on the role of urbanization for promoting economic growth (see Davis and Henderson, 2003 for a summary). It has been widely recognized by economists that urban places exist largely because of some sort of agglomeration economies in production that is not present in rural environments. Thus, apart from firm-level internal scale economies, firms could also benefit from increasing returns to scale arising from larger urban concentrations. The term *agglomeration economies* can be further subdivided into two categories: localization economies (external to the firm but internal to the industry) and urbanization economies (external to the firm and external to the industry). The former exists because of industrial clustering in cities, whereas the latter arises due primarily to the overall size of the city. Some research studies have compared the two categories of agglomeration economies, measuring their relative significances on the economic performances of a country. Henderson (2003), and Ellison and Glaser (1997) suggested that both types of scale economies are vital to the growth of an economy, but localization, on the margin, seems to be more crucial to some mature industries. Hochman (1996) theorized that firms could benefit economically by spatially concentrated in a smaller area. They could reduce search costs and information costs for labour, suppliers and potential customers. Knowledge about productions, sales strategies, marketing etc. could be shared extensively among the producers. Viewing the society as a whole, by crowding population into large urban areas, urbanization can enhance efficiencies in terms of provision of infrastructures, law enforcement, social goods and services. (Abdel-Rahman et al., 2006) David Segal (1976) statistically found that cities with populations greater than 2 million are on average 8% more productive than cities less than 2 million.

Traditional debate on the relationship between urbanization and economic growth centre on whether urbanization level was excessive or "too disorganized" (Davis and Golden, 1954; Sovani, 1964; Kamerschen, 1969; McCoskey and Kao, 1998). Some traditionalists such as Todaro(1995) claimed that today-developing countries are over-urbanized, while the modernists as represented in the work of Wheaton and Shishido (1982) advocated developing large cities in order to achieve economies of scale. Other strand of literature focused more on modeling a "best" degree of urbanization which fosters an optimal productivity growth (Bertenelli and Strobl, 2003; Henderson, 2003).

Recently, studies tended to lay heavy emphasis on econometrically testing the impact of urbanization on economic development using more advanced mathematical techniques.

For instance, Moomaw and Shatter[1] (1993) related growth and different measures of urbanization using regression techniques and concluded that urban concentration might stimulate economic growth. In their subsequent study (Moomaw and Shatter 1996), they revealed that urbanization not only increases with per capita GDP but also with industry share of GDP. Similar empirical evidences can be found in Abdel-Rahman et al. (2006), which showed, in a cross sectional analysis, a statistically significant positive relationship between level of urbanity and standard of living, measured by real per capita GDP. Henderson (2003) contributed by specifying a non-monotonous effect of urban primacy on growth, indicating a spectrum of values of optimal primacy level, below which urban concentration promotes productivity. He further suggested that the optimal degree of urbanization concentration varies with the level of development and country size. In his cross-country productivity studies, he pointed out that urbanization *per se* does not drive the growth, rather it is the urban concentration (or the degree to which urban resources are concentrated in one or two large cities) that is more relevant.

Not many studies have put the problem in the context of time-series analysis. McCoskey and Kao (1998) was one of the few pioneering works. Using panel cointegration methods and accounting explicitly for developed and less-developed countries, they found that long-run effects of urbanization on output per worker cannot be rejected. Their study emphasized that even if urbanization is crucial to economic development, the impact of urbanization varies greatly across countries and time. Therefore, determining the long run effects based on simple cross section techniques may produce biased and inconsistent results. Studying the relationships in the framework of time series may greatly facilitate our understanding of the interrelation of urbanization and growth, truly capturing the dynamic and temporal nature of the question. The present study will follow this approach and put the problem in the context of temporal analysis.

The majority of the above literatures assume that urbanization and economic growth affect each other simultaneously over time, i.e. the former could be both the cause and consequence of the latter, without explicitly acknowledging the lead-lag relationship of the two processes. To the best of our knowledge, there have not yet been any in-depth empirical studies on the causal relationship between urbanization and economic development. In this paper an attempt is made to pin down the causal relationship between urbanization and economic development over time using Granger Causality Method (Engle and Granger 1987; Granger, 1969). Simply put, Granger causation is lagged correlation, so that if one time series precedes another, the first is inferred to cause the second.

This study aims to answer the following questions:
(1) Is there a long-run equilibrium relationship between urbanization level and economic development?

[1] Moomaw and shatter (1993) used population in "the largest city in the country", "percentage of urban population" and "metropolitan concentration" as proxies for urbanization level to test the hypothesis that urbanization levels influence economic growth. The results suggested that metropolitan concentration is positively related to growth while the population of the largest city has a negative impact.

(2) If there is a stable long-run relationship between urbanization and economic development, what is the direction of the causal relationship between them? In other words, is causality running in either direction or both directions?

As noted by Bertenelli and Strobl (2003), one criticism that could be cast against most of the econometric findings in the abovementioned studies is their failure to distinguish between developed and developing countries[2]. Since the two different groups of nations undergo different paths of economic development (see, for instance, Mankiw et al., 1992 and Quah, 1996), their socioeconomic characteristics are very much different. For this reason, this study tests the two broad economic groups separately. The countries that are included in our studies are listed as follows:

Table 1: Sample countries

Developed countries	Australia, Belgium, Canada, Denmark, France, Hollands, Italy, Japan, Norway, Portugal, South Korea[3], Sweden, UK, USA
Developing countries	Bangladesh, Brazil, Chile, China, Egypt, India, Indonesia, Iran, Mexico, Myanmar, Nigeria, Paraguay, South Africa, Thailand

The period of study selected is 1950-2000. Apart from data availability, the reason we focus on such a relative long-term relationship is that it will mainly reflect the structural differences, rather than simply temporary convergences and divergences of the two processes influenced by other exogenous factors.

Gross Domestic Products per capita is used as a proxy to measure the level of economic development of the nations. The annual data were obtained from Center for International Comparisons of Production, Income and Prices (CIC), University of Pennsylvania[4]. To make the data truly comparable, they are converted to real terms by deflating to the base year of 1950. Data of urbanization level are obtained from the Population Division of the United Nations, Department of Economics and Social Information and Policy Analysis (DESIPA) and other sources[5]. DESPIA shows that the definitions of urbanization vary across countries. Appendix A provides the meanings adopted by each sample country.

The paper finds some evidence that urbanization and economic development are co-integrated, which is inconsistent with some earlier studies: Bertenelli and Strobl (2003) using semi-parametric estimation techniques on a panel of 39 developing countries during the period 1960-1990, revealed no systematic relationships between urbanization and economic growth. It mainly showed the existence of a threshold value below which

[2] The present study used the definitions provided by the World Bank (1997) to determine whether a nation is developed: They are countries whose GNP per capita was $9,266 or above in 1999.
[3] South Korea was still a low-income country in 1950, with a GDP per capita figure of USD 265.2, which was roughly one-eighth of that of the USA. The country has been widely regarded as developed after 1990, after a period of substantial average growth in its GDP per capita of about 9% p.a. between 1950-1990.
[4] See **http://pwt.econ.upenn.edu/php_site/pwt61_form.php**
[5] We also used yearbooks of national statistics published by various government authorities of the sample countries.

marginal increases in urban concentration would deter and above which would promote growth; With complete data for the years 1985-2002, Abdel-Rahman et al. (2006) reported in his time series analyses that urbanization has no straightforward link to economic development. Out of the 35 sample countries they studied, only two exhibit statistically-significant positive relationships between urban population growth (independent variable) and economic growth (dependent variable), whilst four display statistically-significant negative relationships. The results further conclude that higher economic growth is associated with no change or a lower growth rate of urban population. Our Granger causality tests suggest that urbanization Granger-causes economic development for developing countries while the opposite holds for developed countries. It is therefore suggested that the causal relationship between the two variables is actually dependent upon the economic status of the nation. Some economic explanation is presented in the subsequent parts of our discussion to account for this phenomenon.

The remainder of the paper is organized as follows: The second section discusses the statistics applied in this paper and the empirical results. The third section presents some economic arguments and ideas to address the findings. The last section concludes.

2. Data and Statistics

The study is a contribution to the debate on the abovementioned urban economic questions. It attempts to verify whether there is a causal relationship between the urbanization process and economic development. Logarithmic transformations were first performed on the data in order to mitigate the problems of heteroskedasticity and skewed distributions. In our study, Ln(GDP) refers to logarithmic transformation of per capita of real Gross Domestic Product and Ln(Urb) means logarithmic transformation of urbanization level. We then proceeded with testing the order of integration (stationarity) of each variable by unit root tests. The term *integration* means that shocks happened in the past remaining undiluted influence the realization of the series concerned forever, and that a series has theoretically infinite variance and a time-dependent mean (Ender 1995). The least squares regression estimation techniques are appropriate only for stationary time-series, and ignoring such requirement will produce unreliable statistics. The co-integration test is then applied if the series are non-stationary and Granger-causality test is applied if the series are stationary.

2.1 The Order of Integration

We first carry out the unit root test to check whether a series is stationary or not. Since a wrong choice of transformation of the data produces biased results and has consequences for wrong interpretation, it is therefore crucial to check for the stationarity of time series data to set up an appropriate methodology in the formation of econometric models (Engle and Granger, 1987). We tested each series for unit roots by performing the Augmented Dickey-Fuller (ADF) tests (Dickey and Fuller, 1979), done on level series and first-order differenced series successively. A variable is said to be integrated of order I(1) if it must be differenced once to become stationary. Following Gujarati (1995), to test for integration, each series is tested based on the following auxiliary equation:

$$\Delta' y^t = \alpha + \delta y^{t-1} + \phi t + \sum \lambda^t \Delta y^{t-1} + \varepsilon_t \quad \textbf{(1)}$$

where Δ is the first-difference operator, α is the constant term, y^t is the relevant time-series variable, t is a linear deterministic trend, and ε_t is an error term with a mean of zero and a constant variance. The null hypothesis that unit root (non-stationarity) exists in y is rejected, when δ being the parameter of interest, is non-zero. Ordinary least squares are used in the estimation of the equations.

The ADF test is a one-sided test of the significance of the estimate δ, and Fuller (1976, table 8.5.2) provides its critical values. To ensure the residuals are white noise, lagged terms in $\Delta' y^t$ are added. In case we do not reject the null hypothesis, i.e. the series is nonstationary in levels, we should continue to apply the same procedure on the first-order differenced series of y^t, second-order differenced series, and so on until a stationary differenced series with no unit roots is found. If the null hypothesis of a unit root is rejected at first differences, then the series is said to be integrated of order 1 or I(1).

The results of the test are shown in Table B of Appendix B. Determined by these critical values, the ADF test suggests that the majority of the series we examined are non-stationary at levels, while stationary at first differences for the entire sample period. For some series ($Ln(GDP)_{Canada}$, $Ln(GDP)_{Norway}$, $Ln(GDP)_{Mexico}$, $Ln(GDP)_{Myanmar}$, $Ln(Urb)_{Myanmar}$, $Ln(Urb)_{Nigeria}$ and $Ln(Urb)_{Paraguay}$), the ADF tests indicates they are stationary in both at their levels and first differences. In the following sections, we treat them as I (1).

2.2 Cointegration

Cointegration(CI) between two variables means a long-run equilibrium relationship, deviations from which must be stationary. Methodology developed by Johansen (1988, 1991, 1995) and Johansen and Juselius (1990, 1992) is adopted for the co-integration tests in this study. In practice, there are at least three other CI tests widely used by researchers: the Engle and Granger (1987) two-stage approach, the Wickens and Breusch (1988) one-stage approach, and the Peasaran and Shin (1995) autoregressive distributed lag model approach. All of these methods have their own virtues and drawbacks[6]. There has not yet been any consensus on which method is superior to the others.

[6] For instance, Engle-Granger procedure has very low power in rejecting the "no cointegration hypothesis" even when we observe a long run equilibrium relationship (Cheung and Lai, 1993). In addition, it does not take the possibility of multiple co-integration into account. On the other hand, as noted by Phillips (1991), maximum likelihood coefficient estimator seems to be more consistent, symmetrically distributed and asymptotically median unbiased.

For brevity, if there exists a β such that $y_t - \beta x_t$ is an I (0) process, then y and x are said to be co-integrated. Based on the results of the above unit root tests, there seems to be an indication that urbanization and economic development have a stable long term equilibrium relationship across the countries we examined. In the interest of parsimony and readability, the technical specifications of Johansen Cointegration test are intentionally left out. Those for are econometrically inclined can refer to Engel and Granger (1987), Johnansen and Juselius (1990) and Johansen (1991) for the details.

The Johansen procedure examines two statistics to estimate the CI vectors: a trace test and a maximum Eigen-value test. They both possess an asymptotic distribution and their critical values are shown in Johnansen and Juselius (1990). Since the sample size in this study is relatively small, we borrowed the view of Cheung and Lai (1993) and took only the trace test into consideration. This test shows more robustness to both the skewness and excess kurtosis in the residuals than the maximal Eigen-value test. To capture the short-run dynamics, a number of lags for each variable are included. We employ the Akaike criteria (AIC; 1969, 1994) and the Schwartz (1978) Bayesian Criteria to determine the order of the vector autoregressive.

The results of Johansen Cointegration test are presented in Table C of Appendix B. The first row in each sub-table tests the hypothesis of no integrations, whereas the second row tests the hypothesis of one cointegration, all against the alternative hypothesis of full rank, i.e. all series in the vector autoregression are stationary. (Johnansen and Juselius, 1990)

Table 2 below summarizes the results and lists the countries that possess cointegration relationships between Ln(GDP) and Ln(Urb). Except for Norway, Portugal and Chile, the tests show the presence of cointegrating equation(s) at 5 per cent significance level for all other countries.

Table 2: Results of Cointegration Tests: Countries that exhibit cointegration relationship between Ln(GDP) and Ln(Urb)

Developed Countries
Australia, Belgium, Canada, Denmark, France, Holland, Italy, Japan, Portugal, South Korea, Sweden, the UK
Developing Countries
Bangladesh, Brazil, Chile, China, Egypt, India, Indonesia, Mexico, Myanmar, Nigeria, Paraguay, South Africa, Thailand

2.3 Granger Causality

Cointegration is a necessary but not sufficient condition for causality. In this study, we applied Granger's causality test (1969, 1988) to examine the causal linkage between the two series. Theoretically, a time series x_t Granger-causes another time series y_t if the addition of past values of x_t contribute significantly to the explanation of variations in y_t, other things being constant (Pindyck and Rubinfeld, 1998). In our study, if ln(GDP) and ln(Urb) are cointegrated, vector autoregression (VAR) model can be constructed in terms of the levels of the data involving the estimations of the following two equations:

$$Ln(GDP)_t = \alpha_0 + \sum_{j=1}^{k} \gamma_j Ln(GDP)_{t-j} + \sum_{j=1}^{k} \beta_j Ln(Urb)_{t-j} + \mu_{1t} \qquad (2)$$

$$Ln(Urb)_t = \alpha_1 + \sum_{j=1}^{k} \gamma_j Ln(Urb)_{t-j} + \sum_{j=1}^{k} \beta_j Ln(GDP)_{t-j} + \mu_{2t} \qquad (3)$$

Where k is a suitably chosen positive integer; γ_j and β_j, j=0, 1, …k are parameters and α 's are constants; and μ 's are disturbance terms with zero means and finite variances. Both equations are tested by a standard F test. For equation (2), the null hypothesis that Ln(Urb) does not Granger-cause Ln(GDP) is rejected if the β_j , j>0 are jointly significantly different from zero. Similarly, Ln(GDP) Granger-causes Ln(Urb) if the β_j, j>0 in (3) are jointly different from zero.

Table 3 below reports the test results for Granger causality. From the test results, we observe that Ln(GDP) Granger-causes Ln(Urb) for most of the developed countries (9 out of 14), whereas for the majority of the sample developing countries (11 out of 14), Ln(Urb) Granger-causes Ln(GDP). Another noteworthy finding is that a bi-directional causal relationship exists for South Korea and Mexico. Based on Table 3, Table 4 summarizes the findings. In the next section, we will provide some economic explanation to account for the findings.

Table 3: Statistic results of Granger Causality Tests

Country	Null Hypothesis	F-Statistic	Probability
Australia	Ln(GDP) does not Granger cause Ln(Urb)	**12.0249***	**0.02034***
	Ln(Urb) does not Granger cause Ln(GDP)	6.46778	0.05579
Belgium	Ln(GDP) does not Granger cause Ln(Urb)	0.67464	0.55915
	Ln(Urb) does not Granger cause Ln(GDP)	2.93748	0.16408
Canada	Ln(GDP) does not Granger cause Ln(Urb)	3.05655	0.15644
	Ln(Urb) does not Granger cause Ln(GDP)	6.47497	0.05569
Denmark	Ln(GDP) does not Granger cause Ln(Urb)	**14.2109****	**0.00699****
	Ln(Urb) does not Granger cause Ln(GDP)	3.53185	0.10227
France	Ln(GDP) does not Granger cause Ln(Urb)	**23.5749****	**0.00184****
	Ln(Urb) does not Granger cause Ln(GDP)	1.11419	0.32624
Hollands	Ln(GDP) does not Granger cause Ln(Urb)	0.93115	0.36671
	Ln(Urb) does not Granger cause Ln(GDP)	0.03547	0.85597
Italy	Ln(GDP) does not Granger cause Ln(Urb)	**7.13031***	**0.03199***
	Ln(Urb) does not Granger cause Ln(GDP)	6.49655	0.05541
Japan	Ln(GDP) does not Granger cause Ln(Urb)	**8.63228***	**0.02177***
	Ln(Urb) does not Granger cause Ln(GDP)	2.87862	0.13358

*(**) denotes rejection of the hypothesis at 5% (1%) significance level.

(Con't) Table 3: Statistic results of Granger Causality Tests

Norway	**Ln(GDP) does not Granger cause Ln(Urb)**	2.93748	0.16408
	Ln(Urb) does not Granger cause Ln(GDP)	0.67464	0.55915
Portugal	**Ln(GDP) does not Granger cause Ln(Urb)**	0.46896	0.51549
	Ln(Urb) does not Granger cause Ln(GDP)	0.22137	0.65230
S. Korea	**Ln(GDP) does not Granger cause Ln(Urb)**	**35.3359****	**0.00057****
	Ln(Urb) does not Granger cause Ln(GDP)	**30.0335****	**0.00093****
Sweden	**Ln(GDP) does not Granger cause Ln(Urb)**	**8.05192***	**0.03959***
	Ln(Urb) does not Granger cause Ln(GDP)	0.44346	0.66996
UK	**Ln(GDP) does not Granger cause Ln(Urb)**	**9.25792***	**0.03156***
	Ln(Urb) does not Granger cause Ln(GDP)	3.68424	0.12380
USA	**Ln(GDP) does not Granger cause Ln(Urb)**	3.37788	0.10868
	Ln(Urb) does not Granger cause Ln(GDP)	2.90197	0.13225
Bangladesh	**Ln(GDP) does not Granger cause Ln(Urb)**	4.80066	0.06458
	Ln(Urb) does not Granger cause Ln(GDP)	**6.70156***	**0.03601***
Brazil	**Ln(GDP) does not Granger cause Ln(Urb)**	1.63198	0.30323
	Ln(Urb) does not Granger cause Ln(GDP)	**53.3121****	**0.00131****
Chile	**Ln(GDP) does not Granger cause Ln(Urb)**	0.49902	0.50276
	Ln(Urb) does not Granger cause Ln(GDP)	0.69927	0.43065
China	**Ln(GDP) does not Granger cause Ln(Urb)**	0.32516	0.58635
	Ln(Urb) does not Granger cause Ln(GDP)	**10.8350***	**0.01327***
Egypt	**Ln(GDP) does not Granger cause Ln(Urb)**	1.23551	0.38210
	Ln(Urb) does not Granger cause Ln(GDP)	1.23551	0.38210
India	**Ln(GDP) does not Granger cause Ln(Urb)**	0.53943	0.48654
	Ln(Urb) does not Granger cause Ln(GDP)	**19.9225****	**0.00292****
Indonesia	**Ln(GDP) does not Granger cause Ln(Urb)**	2.76474	0.14031
	Ln(Urb) does not Granger cause Ln(GDP)	**6.78884***	**0.03514***
Iran	**Ln(GDP) does not Granger cause Ln(Urb)**	3.91029	0.11451
	Ln(Urb) does not Granger cause Ln(GDP)	**9.66135***	**0.02941***
Mexico	**Ln(GDP) does not Granger cause Ln(Urb)**	**13.1141****	**0.00850****
	Ln(Urb) does not Granger cause Ln(GDP)	**23.2088****	**0.00629****
Myanmar	**Ln(GDP) does not Granger cause Ln(Urb)**	0.27454	0.61648
	Ln(Urb) does not Granger cause Ln(GDP)	**6.34435***	**0.03988***
Nigeria	**Ln(GDP) does not Granger cause Ln(Urb)**	0.38714	0.55352
	Ln(Urb) does not Granger cause Ln(GDP)	1.09956	0.32921
Paraguay	**Ln(GDP) does not Granger cause Ln(Urb)**	3.69905	0.12316
	Ln(Urb) does not Granger cause Ln(GDP)	**7.09853***	**0.04832***
S. Africa	**Ln(GDP) does not Granger cause Ln(Urb)**	0.80741	0.39874
	Ln(Urb) does not Granger cause Ln(GDP)	**7.47910***	**0.04452***
Thailand	**Ln(GDP) does not Granger cause Ln(Urb)**	0.15306	0.70727
	Ln(Urb) does not Granger cause Ln(GDP)	**9.70336***	**0.01696***

*(**) denotes rejection of the hypothesis at 5% (1%) significance level.

Table 4: Summary of the Results of Granger Causality Tests

Ln(GDP) Granger-causes Ln(Urb)
Australia, Belgium, Denmark, France, Italy, Japan, South Korea, Sweden, UK, Mexico
Ln(Urb) Granger-causes Ln(GDP)
Bangladesh, Brazil, China, India, Indonesia, Iran, Mexico, Myanmar, Paraguay, South Africa, South Korea, Thailand,

3. Discussion of the Results

For most of the developing countries we examined, our empirical results suggest that urbanization and economic development are moving in tandem throughout time, and the Granger causal link runs from the former to the latter. We conjecture that the direction of the causal link is largely dependent on the economic driving forces of the countries. For poor countries to industrialize, more production resources have to be diverted to the manufacturing industries and tertiary industries. In view of the relative scarcities of productive factors in most developing countries, more expensive machineries and other capitals for productions tend to be substituted by the more plentiful and hence cheaper labor from agricultural sector. As noted by many researchers (for instance Hu, 2000 and Todaro, 1995), a number of developing nations have seen a large and continuous migration of rural peasants into large cities. Such migration could happen without affecting the overall agricultural outputs because rural labor was very excessive relative to capital and other natural resources. If marginal product is zero in agricultural sector and positive in some other activity in cities, there is efficiency to be gained in transferring resources away from the former sector to the latter. (Lewis, 1954) A rural peasant, who received average product based on sharing rules in a family-run farm business, can have his stand of living improved if he migrates, as long as the marginal product in working as a farmer is lower than the going wage in the cities. Disguised unemployment [7]can be solved by means of such labor resources reallocation from countryside to cities, and this process is an important source for the subsequent manufacturing agglomeration occurred in the cities (Fujita and Hu, 2001; Rosenthal and Strange, 2001). This helps explain why the causal link shows urbanization precedes development for developing countries.

One might think that the virtually unlimited supply of rural workers can ensure a long-lasting growth of urban economy for developing country, but in reality it is often the opposite that is observed. Urbanization may not induce economic growth as smoothly and quickly as one expects. It may take years or decades before prosperity comes and this is how the time lag of the causation between the two variables appears. Very often, over-urbanization occurs because substitution between labor and other at the preliminary stage of national development may not be always easy, if not absolutely impossible. Some industries are more capital intensive or mechanized, they can in no way absorb the rural workers at the same rate as the migration. Examples are some engineering industries, information technology and banking. Other sectors such as legal and accounting services demand highly-educated labors. Therefore, it is not uncommon to find in many today-developing countries that masses of poor peasant flee the rural areas and move to urban

[7] Disguised employment may be measured roughly by the difference between the existing labor input in the agricultural sector and the labour input that sets marginal product equal to the wage in city. (Ray, 1998)

metropolises, entering informal labor markets and engaging in jobs like hawking small trinkets, taking photographs for tourists, prostitutions and other very marginal occupations. Thus, over-urbanization may explain why urbanization comes before economic growth since growth can only be actualized until the labor market in the cities can absorb the labor force of the migrants, turning it into economically productive units.

Scale economies also play an important role in determining the pace of growth of a nation's economy but it may take a lengthy time to optimize the efficiency gains. At firm level, entrepreneurs have to consume considerable time in search of the most efficient ways to produce. For instance, time for matching the right persons with the right jobs is essential for the firms; time is also required during the course of "doing by learning" for the workers. For localization economies at industry level, competition among firms spatially adjacent to each other can stimulate productivity through the process of innovation. Such process is, again, time-dependent. Furthermore, knowledge spillovers among firms might take years. At a national level, it might be a prolonged process of "trial and error" for the policy-makers to figure out the "best" urban structure, for both "software" and "hardware" of the cities. For instance, laws may have to be amended repeatedly before they are truly effective and enforceable; training an individual to be a professional and economically productive unit through school education may require a lengthy time.

Physical infrastructure is another oft-cited determinant of economic growth. (Malpezzi et al., 2004) Infrastructure reduces costs in manufacturing sector characterized by both firm-level returns to scale and industry-level external returns to variety. Researchers have estimated returns to infrastructure far in excess of those for other investments such as private capital[8]. Construction works may draw a large number of rural workers to the cities, and processes may require a considerable amount of time. This accounts partly for the aforementioned time lags. Another reason for the time delay is that urban planners usually take into account of the potential increase in future demand for infrastructure by the society at large and therefore allow extra usage capacity during the construction phrases, for example, building wider roads and larger drainage pipes. These economic inputs will only be fully economized until the size of urban population reaches certain level. This time delay illustrates why many of the above cross-section analysis fail to reflect the positive impact of urbanization on growth.

Our Granger causality test results also show a switch of the casual sign as the nation grows into a developed nation. For most of the developed nations we investigated, the economic growth Granger-causes urbanization. This, to a large extent, is attributed to the gradual change in factors of production. For a country to promote further economic growth, it has to move into sectors that have high value-added per worker, that is, sectors like high tech industries (DeVol et al., 1999), biotechnology (Pollack, 2002) and financial services (Levine, 1997). As share of agricultural sector to overall GDP is diminishing, rural-urban migration ceases to be the major driving force for the economic growth. This justifies why developed economies could grow without any urbanization immediately

[8] See Gerhard (1994) and Ayogu (2007) for a comprehensive study on the roles of physical infrastructure in the development process.

ahead. The economy is less and less dependent on labor-intensive industries, rather it is more inclined to innovations, technology and other professional industries.

Then why is there urbanization after economic growth in our causal test on developed countries? We conceptualize this observation by borrowing the idea of suburbanization. Suburbanization is in fact a worldwide phenomenon of many large modern metropolises such as London and Paris (Anas et al., 1998). One factor for the occurrence of decentralization of population is rising income. It goes without saying that demand for housing increases with income[9], and since property prices are lower in suburban regions, income growth therefore makes suburban locations more attractive. Technological innovations in transportation, on the other hand, lower the opportunity costs of living outside the urban cores, further fostering decentralization. Moreover, deterioration of central city housing, urban crime, congestions and other urban problems further speed up the process of suburbanization. The original urban areas gradually annex the surrounding villages and towns, eventually forming a larger urban agglomeration. Urban economists often term it as "megacity". Examples of megacities include Tokaido Corridor in Japan, Seoul-Incheon in South Korea, BosWash and Southern California in the US and the Greater London in the UK.

For two particular countries in our analysis, South Korea and Mexico, we observe a bi-directional causal links between urbanization and economic development. We infer that it is because the two countries have transformed from a developing country to a developed (or nearly developed) country within the 50-year under investigation. Statistics show that the GDP per capita (in real term) of South Korea and Mexico at year 2000 were USE 14936.69 and USD 9710.99 respectively, whereas another high-income country, Greece, has a per capita GDP of USD 15557.83 at 2000. It seemingly suggests that the two countries have made a progressive step towards modernization.

4. Concluding Remarks

This paper seeks to empirically test the causal direction of urbanization and economic development. By examining 28 countries data over the period of 1950-2000, the results indicate that the two processes have a long-run equilibrium relationship. Furthermore, using Granger causality techniques, we find some evidence that the direction of causal link runs from urbanization to economic growth for developing countries, while the opposite holds for developed countries. It is therefore suggested that the causal relationship between the two variables is actually dependent upon the economic status of the nation. We then provide some explanation to account for the observations. The consistency and strength of the findings are of some surprise. However, as suggested by previous literature (Bertenelli and Strobl, 2003; Henderson, 2003; Duranton and Puga, 2004), increasing returns due to externalities may largely a matter of how the population across cities is distributed. Therefore, future research focus could be on measures of urban concentration rather than urbanization *per se*.

[9] Anas et al., (1998) provides more empirical evidence showing income growth encourages suburbanization.

Appendix A

Table A: Definitions of *urbanization* [10]used by each sample country:

Country	Definitions of Urbanizations
Australia	Definition: All urban centres with 1,000 inhabitants or more. Starting in 1991, the definition of "urban" has changed in the census counts.
Belgium	Cities, urban agglomerations and urban communes following the 1977 administrative reclassification (2000 and 2006 UN estimates are based on communes with 5,000 inhabitants or more).
Canada	Areas with at least 1,000 inhabitants and a population density of at least 400 persons per square kilometre (as of 1981; the definition of "urban" has changed slightly between 1951 and 1981).
Denmark	Localities with 200 inhabitants or more.
France	Communes with 2,000 inhabitants or more living in houses separated by at most 200 meters; or communes in which the majority of the population is part of a multi-communal agglomeration as defined above.
Holland	Due to several historical changes in definition of urban areas, urban is defined in this publication as municipalities with 20,000 inhabitants or more.
Italy	Communes with 10,000 inhabitants or more.
Japan	Densely inhabited districts (DID), defined as groups of contiguous basic unit blocks each of which has a population density of 4,000 inhabitants or more per square kilometre, or which has public, industrial, educational and recreational facilities, and whose total population is 5,000 persons or more within a *shi, ku, machi or mura*.
Norway	Localities with 2000 inhabitants or more.
Portugal	Agglomerations of 2,000 inhabitants or more.
South Korea	Places with 50,000 or more inhabitants are usually considered urban. However, the reported proportion urban from the census actually refers to the total population of *dong*, the administrative division for urban areas, rather than places.

[10] Source: Population Division of the United Nations, Department of Economics and Social Information and Policy Analysis, United Nations.

(Con't) Table A: Definitions of *urbanization* used by each sample country:

Sweden	Built-up areas with at least 200 inhabitants and where houses are at most 200 meters separated from each other (according to the administrative divisions of 2003).
The UK	England and Wales: urban areas formed of continuously built-up urban land, the largest urban areas forming agglomerations in which urban subdivisions are recognised. Scotland: urban localities, similar in concept to urban areas in England and Wales, except that the urban localities as defined do not extend across local government district boundaries. Northern Ireland: urban area formed of continuously built up land, forming an agglomeration in which urban subdivisions are recognised. Prior to 1974 (England and Wales) and 1975 (Scotland) the definition of urban and rural was based on administrative boundaries. The census figures refer to the population present. In order to achieve consistency in the definition of an urban area it was assumed for the 2001 census that an urban area in England and Wales had a population of at least 1,500 people; in Northern Ireland it was 1,000 people or more; while in Scotland is was assumed that all settlements and localities were assumed to be urban.
USA	Urban areas, defined as densely settled territory that meets minimum population density requirements and encompasses a population of at least 2,500 inhabitants. A change in the definition for the 2000 census from place-based to density-based has a small effect on the comparability of estimates before and after this date.
Bangladesh	Places having a municipality (*pourashava*), a town (*shahar*) committee or a cantonment board. In general, urban areas are a concentration of at least 5,000 persons in a continuous collection of houses where the community sense is well developed and the community maintains public utilities, such as roads, street lighting, water supply, sanitary arrangements, etc. These places are generally centres of trade and commerce where the labour force is mostly non-agricultural and literacy levels are high. An area that has urban characteristics but has fewer than 5,000 inhabitants may, in special cases, be considered urban.
Brazil	Urban and suburban zones of administrative centres of *municipios* and districts.
Chile	Populated centres with definite urban characteristics, such as certain public and municipal

(Con't) Table A: Definitions of *urbanization* used by each sample country:

China	Up to 1982: total population of cities and towns. Cities had to have a population of at least 100,000 or command special administrative, strategic, or economic importance to qualify as cities. Towns were either settlements with more than 3,000 inhabitants of whom more than 70 per cent were registered as non-agricultural or settlements with a population ranging from 2,500 to 3,000 inhabitants of whom more than 85 per cent were registered as non-agricultural. For the 1990 census: (1) all residents of urban districts in provincial and prefectural-level cities; (2) resident population of "streets" (*jiedao*) in county-level cities; (3) population of all residents' committees in towns. For 2000: The urban population of mainland China is composed of population in City Districts with an average population density of at least 1,500 persons per square kilometre, other population in sub-district units and township-level units meeting criteria such as "contiguous built-up area", being the location of the local government, or being a Street or having a Resident Committee.
Egypt	Governorates of Al-Qahirah (Cairo), Al-Iskandariyah (Alexandria), Bur Sa'id (Port Said), Al-Isma'iliyah (Ismailia) and As-Suways (Suez); frontier governorates; and capitals of other governorates as well as district capitals (markaz).
India	Towns (places with municipal corporation, municipal area committee, town committee, notified area committee or cantonment board) and all places having 5,000 inhabitants or more, a density of less than 1,000 persons per square mile or 390 per square kilometre, pronounced urban characteristics and at least three-fourths of the adult male population employed in areas other than agriculture.
Indonesia	Municipalities (*kotamadya*), regency capitals (*kabupaten*) and other places with urban characteristics.
Iran	Every district with a municipality. In censuses before 1986, all county centres (*shahrestan*) regardless of size and places with a population of 5,000 persons and more.
Mexico	Localities with 2,500 inhabitants or more.
Myanmar	Not available.
Nigeria	Towns with 20,000 inhabitants or more whose occupations are not mainly agrarian.
Paraguay	Administrative centres of the official districts of the Republic.
South Africa	A classification based on dominant settlement type and land use. Cities, towns, townships, suburbs, etc., are typical urban settlements. Enumeration areas comprising informal settlements, hostels, institutions, industrial and recreational areas, and smallholdings within or adjacent to any formal urban settlement are classified as urban. The 1996 estimate was adjusted to comply with the 2001 census definition. Estimates from 1980, 1985 and 1991 were adjusted to take into account the populations of Transkei, Bophuthatswana, Venda and Ciskei.
Thailand	Municipalities. In 1999, 981 sanitary districts were reclassified as *Tambon* municipalities and data for proportion urban were adjusted retrospectively.

Appendix B
Table B: Unit Root Tests on Ln (Urb) and Ln (GDP)

Developed Countries			**Developing Countries**		
Variables	**ADF Levels**	**ADF First Differences**	**Variables**	**ADF Levels**	**ADF First Differences**
Australia			**Bangadash**		
Ln (GDP)	-2.697359	**-12.62662***	Ln (GDP)	-2.284303	**-7.778680***
Ln (Urb)	-3.397313	**-6.242258***	Ln (Urb)	-2.008818	**-5.379719***
Belgium			**Brazil**		
Ln (GDP)	-1.932188	**-6.887120***	Ln (GDP)	-2.332038	**-8.241414***
Ln (Urb)	-0.834892	**-7.498039***	Ln (Urb)	-0.895680	**-5.382677***
Canada			**Chile**		
Ln (GDP)	**-5.919846***	**-6.591774***	Ln (GDP)	-1.218543	**-6.017902***
Ln (Urb)	-2.022832	**-6.441770***	Ln (Urb)	-1.961284	**-8.080786***
Denmark			**China**		
Ln (GDP)	-0.651826	**-8.748994***	Ln (GDP)	-2.160163	**-9.594697***
Ln (Urb)	-3.762642	**-5.462468***	Ln (Urb)	-1.972896	**-11.891701***
France			**Egypt**		
Ln (GDP)	-1.214435	**-8.354892***	Ln (GDP)	-2.019413	**-11.673943***
Ln (Urb)	-3.782054	**-9.226982***	Ln (Urb)	-3.747997	**-8.166130***
Hollands			**India**		
Ln (GDP)	-2.741975	**-6.863723***	Ln (GDP)	-2.693131	**-6.188246***
Ln (Urb)	-0.095146	**-11.095669***	Ln (Urb)	-3.633194	**-5.574411***
Italy			**Indonesia**		
Ln (GDP)	-0.411421	**-6.250457***	Ln (GDP)	-3.888499	**-12.353039***
Ln (Urb)	-1.118345	**-10.293664***	Ln (Urb)	-1.630297	**-8.962122***
Japan			Iran		
Ln (GDP)	1.107145	**-7.948681***	Ln (GDP)	-1.321569	**-4.483029***
Ln (Urb)	-0.724214	**-4.983848***	Ln (Urb)	-0.801877	-**5.401838***

(Con't) Table B: Unit Root Tests on Ln (Urb) and Ln (GDP)

Norway			**Mexico**		
Ln (GDP)	**-6.081695***	**-9.330958***	Ln (GDP)	**-5.880938***	**-7.336938***
Ln (Urb)	-2.109032	**-6.608960***	Ln (Urb)	0.338263	**-12.403201***
Portugal			**Myanmar**		
Ln (GDP)	-1.205370	**-15.770209***	Ln (GDP)	**-4.344684***	**-6.961176***
Ln (Urb)	-1.347313	**-12.980992***	Ln (Urb)	**-4.454759***	**-9.090522***
South Korea			**Nigeria**		
Ln (GDP)	-2.075405	**-10.186891***	Ln (GDP)	-1.673048	**-6.547401***
Ln (Urb)	-0.166184	**-17.894352***	Ln (Urb)	**-8.753230***	**-11.356240***
Sweden			**Paraguay**		
Ln (GDP)	-1.619367	**-8.667387***	Ln (GDP)	-1.645122	**-5.328594***
Ln (Urb)	-2.071442	**-13.152392***	Ln (Urb)	**-4.577868***	**-13.447973***
UK			**South Africa**		
Ln (GDP)	-3.920840	**-5.537811***	Ln (GDP)	-3.291286	**-8.387641***
Ln (Urb)	-2.995821	**-4.975888***	Ln (Urb)	-2.460553	**-16.765102***
USA			**Thailand**		
Ln (GDP)	-2.341986	**-6.122606***	Ln (GDP)	-1.751658	**-7.471642***
Ln (Urb)	-2.890154	**-4.649516***	Ln (Urb)	-2.519397	**-13.681261***

Note: Estimates are obtained from EViews 3.0. The ADF test should be compared to the critical values of -4.0815 at the 5% levels of significance, which is denoted by *.

Table C: Results of Co-integration Test

Australia					
Ln (GDP) & Ln (Urb)		Likelihood	5 Percent	1 Percent	Hypothesized
	Eigenvalue	Ratio	Critical Value	Critical Value	No. of CE(s)
	0.849778	17.12797	15.41	20.04	None *
	0.007437	0.067180	3.76	6.65	At most 1
Belgium					
Ln (GDP) & Ln (Urb)		Likelihood	5 Percent	1 Percent	Hypothesized
	Eigenvalue	Ratio	Critical Value	Critical Value	No. of CE(s)
	0.842314	21.53966	15.41	20.04	None **
	0.420823	4.915331	3.76	6.65	At most 1 *
Canada					
Ln (GDP) & Ln (Urb)		Likelihood	5 Percent	1 Percent	Hypothesized
	Eigenvalue	Ratio	Critical Value	Critical Value	No. of CE(s)
	0.780522	20.41165	15.41	20.04	None **
	0.528321	6.763101	3.76	6.65	At most 1 **
Denmark					
Ln (GDP) & Ln (Urb)		Likelihood	5 Percent	1 Percent	Hypothesized
	Eigenvalue	Ratio	Critical Value	Critical Value	No. of CE(s)
	0.979187	45.19000	15.41	20.04	None **
	0.683020	10.34024	3.76	6.65	At most 1 **
France					
Ln (GDP) & Ln (Urb)		Likelihood	5 Percent	1 Percent	Hypothesized
	Eigenvalue	Ratio	Critical Value	Critical Value	No. of CE(s)
	0.914986	35.50526	15.41	20.04	None **
	0.772382	13.32076	3.76	6.65	At most 1 **
Hollands					
Ln (GDP) & Ln (Urb)		Likelihood	5 Percent	1 Percent	Hypothesized
	Eigenvalue	Ratio	Critical Value	Critical Value	No. of CE(s)
	0.827542	18.97596	15.41	20.04	None *
	0.295902	3.157534	3.76	6.65	At most 1
Italy					
Ln (GDP) & Ln (Urb)		Likelihood	5 Percent	1 Percent	Hypothesized
	Eigenvalue	Ratio	Critical Value	Critical Value	No. of CE(s)
	0.832591	24.75245	15.41	20.04	None **
	0.618237	8.666598	3.76	6.65	At most 1 **

*(**) denotes rejection of the hypothesis at 5% (1%) significance level.

(Con't) Table C: Results of Co-integration Test

Japan					
Ln (GDP) & Ln (Urb)		Likelihood	5 Percent	1 Percent	Hypothesized
	Eigenvalue	Ratio	Critical Value	Critical Value	No. of CE(s)
	0.889706	25.56251	15.41	20.04	None **
	0.470419	5.721024	3.76	6.65	At most 1 *
Norway					
Ln (GDP) & Ln (Urb)		Likelihood	5 Percent	1 Percent	Hypothesized
	Eigenvalue	Ratio	Critical Value	Critical Value	No. of CE(s)
	0.668453	10.97846	15.41	20.04	None
	0.109385	1.042591	3.76	6.65	At most 1
Portugal					
Ln (GDP) & Ln (Urb)		Likelihood	5 Percent	1 Percent	Hypothesized
	Eigenvalue	Ratio	Critical Value	Critical Value	No. of CE(s)
	0.489523	8.628600	15.41	20.04	None
	0.248981	2.576920	3.76	6.65	At most 1
South Korea					
Ln (GDP) & Ln (Urb)		Likelihood	5 Percent	1 Percent	Hypothesized
	Eigenvalue	Ratio	Critical Value	Critical Value	No. of CE(s)
	0.825812	19.13869	15.41	20.04	None *
	0.315385	3.410091	3.76	6.65	At most 1
Sweden					
Ln (GDP) & Ln (Urb)		Likelihood	5 Percent	1 Percent	Hypothesized
	Eigenvalue	Ratio	Critical Value	Critical Value	No. of CE(s)
	0.749384	16.92581	15.41	20.04	None *
	0.391532	4.471301	3.76	6.65	At most 1 *
UK					
Ln (GDP) & Ln (Urb)		Likelihood	5 Percent	1 Percent	Hypothesized
	Eigenvalue	Ratio	Critical Value	Critical Value	No. of CE(s)
	0.854292	17.90824	15.41	20.04	None *
	0.061672	0.572901	3.76	6.65	At most 1
USA					
Ln (GDP) & Ln (Urb)		Likelihood	5 Percent	1 Percent	Hypothesized
	Eigenvalue	Ratio	Critical Value	Critical Value	No. of CE(s)
	0.863767	21.06360	15.41	20.04	None **
	0.293203	3.123105	3.76	6.65	At most 1

*(**) denotes rejection of the hypothesis at 5% (1%) significance level.

(Con't) Table C: Results of Co-integration Test

Bangladesh					
Ln (GDP) & Ln (Urb)		Likelihood	5 Percent	1 Percent	Hypothesized
	Eigenvalue	Ratio	Critical Value	Critical Value	No. of CE(s)
	0.954659	31.09277	15.41	20.04	None **
	0.303164	3.250843	3.76	6.65	At most 1
Brazil					
Ln (GDP) & Ln (Urb)		Likelihood	5 Percent	1 Percent	Hypothesized
	Eigenvalue	Ratio	Critical Value	Critical Value	No. of CE(s)
	0.954659	31.09277	15.41	20.04	None **
	0.303164	3.250843	3.76	6.65	At most 1
Chile					
Ln (GDP) & Ln (Urb)		Likelihood	5 Percent	1 Percent	Hypothesized
	Eigenvalue	Ratio	Critical Value	Critical Value	No. of CE(s)
	0.461593	6.140534	15.41	20.04	None
	0.061188	0.568265	3.76	6.65	At most 1
China					
Ln (GDP) & Ln (Urb)		Likelihood	5 Percent	1 Percent	Hypothesized
	Eigenvalue	Ratio	Critical Value	Critical Value	No. of CE(s)
	0.897996	22.82316	15.41	20.04	None **
	0.223660	2.278481	3.76	6.65	At most 1
Egypt					
Ln (GDP) & Ln (Urb)		Likelihood	5 Percent	1 Percent	Hypothesized
	Eigenvalue	Ratio	Critical Value	Critical Value	No. of CE(s)
	0.809003	18.17415	15.41	20.04	None *
	0.305007	3.274683	3.76	6.65	At most 1
India					
Ln (GDP) & Ln (Urb)		Likelihood	5 Percent	1 Percent	Hypothesized
	Eigenvalue	Ratio	Critical Value	Critical Value	No. of CE(s)
	0.937181	25.89862	15.41	20.04	None **
	0.104283	0.991179	3.76	6.65	At most 1
Indonesia					
Ln (GDP) & Ln (Urb)		Likelihood	5 Percent	1 Percent	Hypothesized
	Eigenvalue	Ratio	Critical Value	Critical Value	No. of CE(s)
	0.868258	28.73033	15.41	20.04	None **
	0.688186	10.48815	3.76	6.65	At most 1 **

*(**) denotes rejection of the hypothesis at 5% (1%) significance level.

(Con't) Results of Co-integration Test

Iran					
Ln (GDP) & Ln (Urb)		Likelihood	5 Percent	1 Percent	Hypothesized
	Eigenvalue	Ratio	Critical Value	Critical Value	No. of CE(s)
	0.837007	28.16524	25.32	30.45	None *
	0.731640	11.83883	12.25	16.26	At most 1
Mexico					
Ln (GDP) & Ln (Urb)		Likelihood	5 Percent	1 Percent	Hypothesized
	Eigenvalue	Ratio	Critical Value	Critical Value	No. of CE(s)
	0.966906	32.65596	15.41	20.04	None **
	0.197505	1.980271	3.76	6.65	At most 1
Myanmar					
Ln (GDP) & Ln (Urb)		Likelihood	5 Percent	1 Percent	Hypothesized
	Eigenvalue	Ratio	Critical Value	Critical Value	No. of CE(s)
	0.930321	25.02795	15.41	20.04	None **
	0.110439	1.053245	3.76	6.65	At most 1
Nigeria					
Ln (GDP) & Ln (Urb)		Likelihood	5 Percent	1 Percent	Hypothesized
	Eigenvalue	Ratio	Critical Value	Critical Value	No. of CE(s)
	0.863683	28.58578	15.41	20.04	None **
	0.693772	10.65081	3.76	6.65	At most 1 **
Paragray					
Ln (GDP) & Ln (Urb)		Likelihood	5 Percent	1 Percent	Hypothesized
	Eigenvalue	Ratio	Critical Value	Critical Value	No. of CE(s)
	0.888468	23.28590	15.41	20.04	None **
	0.325565	3.544922	3.76	6.65	At most 1
South Africa					
Ln (GDP) & Ln (Urb)		Likelihood	5 Percent	1 Percent	Hypothesized
	Eigenvalue	Ratio	Critical Value	Critical Value	No. of CE(s)
	0.975461	34.32115	15.41	20.04	None **
	0.100545	0.953692	3.76	6.65	At most 1
Thailand					
Ln (GDP) & Ln (Urb)		Likelihood	5 Percent	1 Percent	Hypothesized
	Eigenvalue	Ratio	Critical Value	Critical Value	No. of CE(s)
	0.804568	15.45899	15.41	20.04	None *
	0.081599	0.766086	3.76	6.65	At most 1

*(**) denotes rejection of the hypothesis at 5% (1%) significance level.

References

Abdel-Rahman, A.N., Safarzadeh, M.R. and Bottomley, M.B. (2006). "Economic growth and urbanization: a cross-section and time-series analysis of thirty-five developing countries", International Review of Economics and Business, 53(3), 334-348.

Akaike, H. (1969). "Fitting autoregressive models for prediction", Annals of International Statistics and Mathematics, 21, 243-247.

Akaike, H. (1994). "A new look at the statistical model identification, automatic control", IEEE, 19(6), 716-723.

Alex A, Arnott R. and K.A. Small. (1998). "Urban spatial structure", Journal of Economic Literature, 34, 1426-1464.

Bertinelli, L. and Strobl E. (2003). "Urbanization, Urban Concentration and Economic Growth in Developing Countries", Credit Research Paper, Centre for Research in Economic Development and International Trade, University of Nottingham, 3(14).

Cheung, Y.W. and K. Lai. (1993). "Finite sample sizes of Johnsen's likelihood ration tests for cointegration", Oxford Bulletin of Economics and Statistics, 55(3), 313-328.

Davis, K. and H.H. Golden. (1954). "Urbanization and the development of pre-Industrial areas", Economic Development and Cultural Change, 3(1).

DeVol, R.C., P. Wong., J. Catapano and Robitshek, G. (1999). America's High-Tech Economy: Growth, Development and Risks for Metropolitan Areas, Milken Institute: Santa Monica, CA.

Dickey, D.A. and W.A. Fuller (1979). "Distribution of the estimators for autoregressive time series with a unit root", Journal of American Statistical Association, 74, 427-431.

Duranton, G. and D. Puga. (2001). Micro-foundations of urban agglomeration economies, in JF. Thisse and JV. Henderson, Handbook of Urban and Regional Economics, Volume 4.

Ellison, G. and E.L. Glaeser. (1997). "Geographic concentration in U.S. manufacturing industries: A Dartboard approach", Journal of Political Economy 105(5), 889-927.

Enders, W. (1995), Applied Econometric Time Series. New York: Wiely.

Engle, R. and Granger, C.W.J. (1987). "Co-integration and error correction: representation, estimation and testing", Econometrica, 55(2), 251-276.

Fujita, M. and Hu, D. (2001). "Regional disparity in China 1985- 1994: the effects of globalization and economic liberalization". Annals of Regional Science, 35, 3-37

Fuller, W.A. (1976). Introduction to Statistical Time Series. New York: Wiley.

Gerhard, G. (1994). “Public investment in infrastructure in a simple growth model”, Journal of Economic Dynamics and Control, 18, 1173-1187.

Granger, C.W.J. (1969). “Investigating causal relations by econometric models and cross spectral methods’, Econometrica, 37, 424-438.

Granger, C.W.J. (1988). “Some recent developments in a concept of causality”, Journal of Econometrics, 39, 199-211.

Gujarati, Damodar N. (1995). Basic Econometrics. New York: McGraw-Hill.

Henderson, J.V. (2002). “Urbanization in developing countries”, World Bank Research Observer, 17(1), 89-112.

Hochman, O. (1996). “More on scale economies and cities”, Journal of Regional Science and Urban Economics, 27:373, 387.

Hu, D. (2000). “Trade, rural-urban migration, and regional income disparity in developing countries: a spatial general equilibrium model inspired by the case of China”, Regional Science and Urban Economics, 32, 311-338.

Hughes, J. and Cain, L. P. (2003). American economic history (6th ed.). Boston: Addison Wesley.

Johansen, S. (1988). “Statistical analysis of cointegration Vectors”, Journal of Economic Dynamics and Control, 12, 231-254.

Johansen, S. (1991). “Estimation and hypothesis testing of cointegtation vectors in Guassian Vector Autoregressive Models”, Econometrica, 59, 1551-1580.

Johansen, S. (1995). Likelihood-based inference in Cointegrated Vector Autoregressive Models. New York: Oxford University Press.

Johansen, S., and K. Juselius (1990). “Maximum likelihood estimation and inference on cointegration: with the application to the demand of money”, Oxford Bulletin of Economics and Statistics, 52, 169-210.

Johansen, S. and K. Juselius. (1992). “Structural tests in a multivariate cointegration analysis of the PPP and the UIP for UK”, Journal of Econometrics, 53, 211-244.

Kamerschen, D.R. (1969). “Further analysis of overurbanization”, Economic Development and Cultural Change, 12(2), 235-253.

Levine, R. (1997). “Financial development and economic growth: views and agenda”, Journal of Economic Literature. 35, 688-726.

Lewis, W. A. (1954). "Economic development with ‚unlimited supplies of labor", the Manchester School of Economics and Social Studies, 22, 139-191.

Malpezzi, S., Seah, K-Y. and Shilling, J.D. (2004). "Is it what we do or how we do it? New evidence on agglomeration economies and metropolitan growth", Real Estate Economics, 32(2), 265-295.

Mankiw, G., D. Romer. and D. Weil (1992). "A contribution to the empirics of economic growth", Quarterly Journal of Economics, 107(2), 407-437.

McCoskey, S. and Ch. Kao (1998). A Panel Data Investigation of the Relationship between Urbanization and Growth, Mimeo: Syracuse University.

Mooaw, R. and Shatter, A. M. (1993). "Urbanization as a Factor in Economic Growth", The Journal of Economics, 19(2): 1-6.

Mooaw, R. and Shatter, A. M. (1996). "Urbanization and economic development: A bias toward larger cities?", Journal of Urban Economics, 40, 13-37.

Phillips, P.C.B. (1991). "Optimal inference in cointegrated systems", Econometrica, 59, 283-306.

Quah, D. (1993). "Galton's fallacy and tests of the convergence hypothesis", Scandinavian Journal of Economics 95, 427-447.

Pesaran, H. M. and Shin Y. (1995). "Autoregressive distributed lag modeling approach to cointegration analysis", DAE Working Paper Series no. 9514, Department of Applied Economics, Cambridge: University of Cambridge.

Pindyck, R. and D. Rubinfeld. (1998). Econometric Models and Economic Forecasts. Fourth Edition. New York: McGraw-Hill.

Pollack, A. (2002). Cities and States Clamor to be Bio Town. U.S.A: New York Times.

Ray, D. (1998). Development Economics. Princeton: Princeton University Press.

Rosenthal, S. and W. Strange (2004). Evidence on the nature and sources of agglomeration economies, in JF. Thisse and JV. Henderson, Handbook of Urban and Regional Economics, Volume 4.

Segal, D. (1976). "Are there returns to scale to city size?", Review of Economics and Statistics, 53, 339-350.

Schwartz, G. (1978). "Estimating the dimension of a model", Annals of Statistics, 6, 461-464.

Sovani, NV. (1964). "The analysis of over-urbanization", Economic Development and Cultural Change, 7(2), 113-122.

Todaro, M. P. (1995). A Model of Rural-Urban Migration, Leading Issues in Economic Development. New York: Oxford University Press.

Wheaton, W. C. and Shishido, H. (1982). "Urban concentration, agglomeration economies and the level of economic development", Economic Development and Cultural Change, 30, 17-30.

Wicken, M. R.. and T.S. Breusch (1988). "Dynamic specification, the long-run and the estimation of transformed regression model", Economic Journal, 98, 189-205.