

AUTHOR ACCEPTED MANUSCRIPT

PRELIMINARY INFORMATION

Urbanization and Economic Growth in Indonesia : Good
News, Bad News, and (Possible) Local Government Mitigation

Accepted for publication in

Regional Studies

To be published by Taylor and Francis

**THE FINAL PUBLISHED VERSION OF THIS ARTICLE
WILL BE AVAILABLE ON THE PUBLISHER'S PLATFORM**

This Author Accepted Manuscript is copyrighted by the World Bank and published by Taylor and Francis. It is posted here by agreement between them. Changes resulting from the publishing process—such as editing, corrections, structural formatting, and other quality control mechanisms—may not be reflected in this version of the text.

This Author Accepted Manuscript is under embargo for external use and is made available for internal World Bank use only. It is not for distribution outside the World Bank.

Urbanization and Economic Growth in Indonesia:
Good News, Bad News, and (Possible) Local Government Mitigation

Blane D. Lewis
Senior Economist
World Bank, Jakarta

Address: Jakarta Stock Exchange Building, Jl. Jenderal Sudirman, Kav. 52-53,
Jakarta, Indonesia, 12190
Phone: +622152993362; +62218179996887
Email: blewis@worldbank.org; blane.lewis@indo.net.id

(Received November 2011; in final form October 2012)

Time series analysis for Indonesia over the period 1960-2009 suggests that the level of urbanization is positively associated with economic growth but that the rate of change of urbanization is negatively correlated with growth of economic output. A sub-national dynamic panel investigation provides additional evidence of the positive and negative level and rate effects, respectively. The panel analysis also implies that the harmful impact of urban population growth is linked to insufficient local public infrastructure spending. Local governments that invest more heavily in infrastructure are better able to cope with the apparent detrimental effects of rapid urbanization on economic growth.

Key words: urbanization, economic growth, local government, vector error correction (VEC) models, generalized method of moments (GMM) estimation, Indonesia

JEL Classification Codes: R11, R50, O10, O53

INTRODUCTION

A vast and growing academic literature exists on examining the relationship between urbanization and economic development (Wang, He, Liu, Zhuang, and Hong, 2012). The empirical association between the percentage of the population that resides in urban areas and the level and growth of economic output is, of course, well-established (Ciccone and Hall, 1996; Glaeser, 1994 and 1998; Henderson, 1988, 2003, and 2010; and Rauch, 1993). But while there is a strong positive relationship between urbanization and economic development, the former does not actually cause the latter (Fujita and Thisse, 2003; Henderson, 2002a, 2003, and 2010; and Polèse, 2005). The case for causality is, however, stronger for agglomeration economies, which typically develop in urban areas of sufficient size (Quigley, 1998 and 2008). In any case, while urbanization per se may not cause economic development, the relative or absolute size of the urban population often serves as a convenient proxy for agglomeration economies, which themselves can help to stimulate growth and development (Brülhart and Sbergami, 2009).

Rosenthal and Strange (2004) identify four main types of agglomeration economies. The first relates to economies that result from the sharing of inputs by industries that exhibit internal increasing returns to scale. The second concerns economies attendant to labor market pooling, which allows for a better match between business demand for and worker supply of

particular skills. The third is associated with productivity gains that derive from knowledge spillovers. Finally, agglomeration serves to concentrate demand as well, which leads to consumption economies and the “bright city lights” phenomenon of urban attraction. An often used taxonomy categorizes agglomeration economies as either localization or urbanization economies, depending on whether they are internal or external to single industries located in urban areas. The former are most often identified with Marshall (1920) and the latter with Jacobs (1969 and 1984), although as Rosenthal and Swan note, Marshall was clearly aware of cross-industry economies too.

Diseconomies of agglomeration have also been recognized as an important feature of urbanization, as well, of course. Among these, congestion costs have been singled out as particularly problematic. Although congestion is normally associated with insufficient road capacity, it can be a problem for many types of infrastructure, including water, electricity, ports, railroads, and air transport, among others. In any case, these diseconomies serve to constrain effective service delivery and economic growth. The form and effects of agglomeration diseconomies have been investigated in some depth by a number of authors (see, for example, Tolley et. al, 1979; Linn, 1982; and Richardson, 1987). Such diseconomies are thought to be especially constraining for the largest metropolitan areas within countries. Moreover, Henderson (2002b) shows that large city diseconomies may have negative consequences for cities throughout the urban hierarchy, as limited resources are concentrated in the largest places in an effort to reduce diseconomies, leaving medium and small sized cities unattended.

Much of the recent empirical work on the link between urbanization and economic growth has employed large cross-country panel data sets, where panels include both developing and modern economies. These studies take the level of urbanization and/or the extent of urban concentration as proxies for agglomeration economies or diseconomies. Such

empirical investigations then attempt to discern the extent to which forces of agglomeration determine the level and/or growth of economic output. Brülhart and Sbergami (2009) provide a recent contribution along these lines. The authors find that agglomeration supports economic growth up to a certain level of development after which diseconomies prevail, in accordance with the well-known Williamson hypothesis (Williamson, 1965). Bloom, Canning, and Fink (2008), on the other hand, provide evidence to the contrary. Using a similar data set they find no evidence to support the assertion that the level of urbanization influences economic growth in any manner.

Single country studies that empirically examine the relationship between urbanization and economic development are comparatively rare, especially for the major developing countries of the world. Cali (2008) examines urbanization in India and finds only a weak positive relationship between the proportion of the population living in urban areas and economic growth. On the other hand, Mitra and Mehta (2011) find that urbanization levels, economic growth, and poverty reduction among Indian states are all strongly and positively associated with one another. Chang and Brada (2006) review the literature on urbanization in China and offer empirical evidence to suggest that the country's recent "under-urbanization" constrains economic growth. Finally, da Mata et al. (2007) examine the influence of economic development on urbanization in Brazil (but not the reverse). They find that a variety of economic phenomena, including income earning opportunities, market potential, and the quality of labor have an impact on city growth.

This paper investigates urbanization and economic growth in a single developing country—Indonesia. Indonesia is the fourth largest country in the world and a nation of growing economic and political significance in Asia specifically, and the developing world more generally. Indonesia's urban population now makes up more than 50 percent of the total. The growth rate of its urban population is one of the highest in Asia, exceeded only by

that of much smaller and still largely rural countries of Bhutan, Nepal, and Lao. The paper analyzes the potential impact of both the level and the rate of change of urbanization on national and sub-national economic growth in Indonesia. In addition, it considers the interaction between urban population growth and local government infrastructure investment, focusing on the possible effects on local economic growth. The study takes two different approaches in the empirical investigation. The first is based on cointegration time series techniques and the second employs dynamic panel data analysis.

The paper makes three contributions to the academic literature. First, it uses cointegration time series methods to empirically examine the relationship between urbanization and economic growth; this appears not to have been done before. Second, it explicitly focuses on the rate of change of urbanization as a potential determinant of economic growth, an issue that has so far been largely neglected in the empirical academic literature. Third, it innovatively examines the relationship between public infrastructure spending, urbanization, and economic growth in a sub-national dynamic setting.

Briefly, the time series analysis suggests that the level of urbanization is positively associated with economic growth, as is commonly found, but that the rate of change of urbanization is negatively correlated with output growth; the dynamic panel data investigation confirms the positive and negative level and rate effects, respectively. And the latter examination also implies that the harmful impact of urbanization growth on economic development is linked to insufficient infrastructure spending by local governments.

The rest of the paper proceeds as follows. First, some background information on urbanization, economic growth, and infrastructure spending in Indonesia is presented. Second, the data and empirical methods are described. Third, the time series investigation is carried out and the empirical results are discussed. Fourth, the dynamic panel data analysis is

undertaken and the derived output is reviewed. A final section of the paper draws conclusions and discusses policy implications.

BACKGROUND

Indonesian GDP per capita grew from just over Rp 1.6 million to Rp 9.5 million between 1960 and 2009 (in constant 2000 terms).¹ This represents a rather modest annual rate of growth of around 3.6 percent. Economic growth would have been significantly stronger over that time frame, however, if not for economic stagnation related to political conflict and civil strife in 1965-67 and the Asian Financial Crisis (AFC) of 1997-1998.²

The total population in Indonesia is currently about 230 million. Population grew at a rate of just under 1.9 percent per year between 1960 and 2009. By contrast, the urban population grew at a rate of 4.6 percent per annum over the period. The portion of the population that is urban increased from 17.1 percent in 1960 to 52.6 percent in 2009. Indonesia has gone from a largely rural country to a mostly urban one in less than two generations. Figure 1 shows the time path of per capita GDP and urbanization over the period.

Figure 1 here

Table 1 provides some comparative information on the level and growth of GDP per capita and various dimensions of population for Indonesia and a number of other key countries in Asia, on which data are readily available. The table illustrates four important points. First, the table shows that the growth of Indonesia's GDP per capita has been rather modest in comparison with other countries. Indonesia's GDP growth trails by a significant margin GDP growth rates in China, Vietnam, and Thailand and is about the same as that of India; it exceeds only that of Philippines. Second, Indonesian population growth is also in the middle range of those of countries shown in the table. Population growth in Indonesia is

lower than in Philippines and India and about the same as in Vietnam and Thailand and significantly higher than in China.

Table 1 here

Third, urban population growth in Indonesia is substantially higher than it is in other countries in the region. Urban growth in the Philippines is a rather distant second and all other countries have urban population growth rates much lower than that of Indonesia. Finally, as the table shows, the growth rate of the urbanization ratio (i.e. the percentage of the total population that resides in urban areas) in Indonesia is also significantly higher than it is in other countries. Growth of the urbanization ratio represents the growth in urban population net of total population growth and indicates the pace at which urbanization is proceeding. The growth rate of urbanization in Indonesia is very high indeed.

Public infrastructure expenditure has not kept pace with rapidly rising urbanization, however. Consolidated government infrastructure spending in Indonesia declined precipitously after the AFC and has since stagnated. Recent estimates suggest that government-wide infrastructure expenditure makes up about only around three to four percent of GDP, down from around eight percent during the period 1994-1997 (World Bank, 2012). Indonesian infrastructure spending now trails by a significant extent that of fast growing economies in Asia such as China, Thailand, and Vietnam, all of which spend about eight to ten percent of GDP on infrastructure (Asian Development Bank, 2010; World Bank, 2011).

Sub-national governments in Indonesia make up about half of consolidated public infrastructure spending, a seemingly meaningful amount. Lewis and Oosterman (2010) provide evidence to suggest, however, that Indonesian sub-national spending on infrastructure, which is financed entirely out of gross operating budgets, is barely sufficient to keep up with the depreciation of local public assets. In any case, it is reasonably clear that

both central and sub-national governments will have to increase infrastructure spending in order to meet rising demand, especially in urban areas, and stimulate regional and national economic growth.

DATA AND METHODS

This study makes use of two separate data sources, one for the time series examination and one for the dynamic panel data analysis. The variables used in the time series analysis include per capita GDP, the urbanization ratio, and gross capital formation, also measured in per capita terms. Data on these variables for Indonesia over the time frame 1960-2009 have been accessed from the World Bank's World Development Indicators (2010). World Bank series on GDP, urbanization, and gross capital formation are complete for the period in question. Descriptive statistics on the three series can be found in Table A1 in the appendix to this paper.

Variables used in the panel analysis comprise a variety of socio-economic and fiscal indicators, all of which are measured at the sub-national district level, over the period 2003-2007. Data are available on up to 366 district (or local) governments. The selected five-year time frame is purely a function of the accessibility of data on decentralized units of government. The availability of local economic and fiscal data is especially problematic and long lags between the end of a year and the availability of data for that year are the norm.

Socio-economic variables employed in the investigation include those on gross regional domestic product (GRDP), total population and urban population, and the average number years of schooling of adults. Data are from the Indonesian Central Bureau of Statistics (BPS). The sole fiscal variable used in the study is local government capital spending on infrastructure, data on which have been amassed by the Ministry of Finance (MoF), which collects them in the first instance directly from local governments. Descriptive statistics on the variables used in panel examination can be found Table A2 in the appendix.

This paper makes use of two distinct empirical methods: vector-error correction (VEC) cointegration time series models and dynamic panel data (DPD) analysis, where the latter uses systems generalized method of the moments (GMM) estimation techniques.

A VEC is a restricted form of the standard vector autoregression (VAR) model. VARs and VECs can be useful tools to explore the long-term dynamic relationships among non-stationary variables. Importantly, the methods can be used to treat all variables as endogenous in the dynamic system and also provide a test for the assumed endogeneity. Furthermore, VECs provide a means for deriving well-defined long-term associations among variables—the cointegrating relations. Short-run dynamics can also be explored as deviations—error corrections—from long-run equilibrium. Cointegrating relations and error corrections are particular to VECs. The basic VEC model, i.e. in which variables are assumed to be integrated of order one, can be represented by the following system of equations.

$$\Delta x_t = \sum_{p=1}^{p-1} \Gamma_p \Delta x_{t-p+1} + \delta \beta' x_{t-1} + \varepsilon_t \quad (1)$$

In the formulation above, Δ refers to the first difference of a variable, x_t is an n by one vector of time series variables at time t ; Γ are the n by n coefficient matrices to be estimated; $\beta' x_{t-1}$ are the r stationary linear combinations (i.e. the equilibrium or cointegrating relations), where the β are to be estimated; δ are the short-term (speed of adjustment parameters) to be estimated; and ε_t represents white noise disturbances (which may be correlated across equations). Furthermore, p is the number of lags included in the dynamic system and r (the number of cointegrating relations) is called the cointegrating rank. Note that if the cointegrating rank is zero, then the system in equation (1) reduces to a standard VAR.

Although not explicitly shown in equation (1), it is common to include various deterministic variables in the specification as well. Such variables are of two main types. First, time trends may be integrated into the model, either as linear trends in the variables or

as linear trends in both the variables and the cointegrating relations. Second, a variety of dummy variables may be included; these may be either incorporated directly into the system of difference equations in the usual way and/or they can enter the cointegrating space.

The former type of dummy variable may be used to model exogenous shocks to system, where the shocks can be either transitory or permanent, and the latter may be employed to model structural breaks in the level or trend of the cointegrating relations. Note that when structural break dummies are included in the cointegrating space it is typical to also include dummies in the difference equations, as well; the former integrate the breaks into the equilibrium relations while the latter serve as (exogenous) shocks to the dependent variables in equation (1). These methods are based on the work of Johansen (1995, 1996, and 1997). Juselius (2006) provides an excellent rigorous introduction and extended examples of the relevant techniques. The basic methods are outlined in an applied fashion in Greene (2011).³

Systems GMM is an instrumental variables approach for estimating DPD models, especially those with many panels and few periods. The methods are particularly useful where simultaneity is a potential problem, as it is in the current case. The basic model used in the analysis can be represented in the following equation.

$$y_{it} = \sum_{j=1}^p \alpha_j y_{i,t-j} + x_{it} \beta_1 + w_{it} \beta_2 + v_i + \varepsilon_{it} \quad (2)$$

In the above framework i and t are local government and time subscripts, respectively; x is a vector of strictly exogenous explanatory variables; w is vector of predetermined and endogenous variables⁴; α_j , β_1 , and β_2 are the parameters to be estimated; v are the panel level effects, and ε is the usual error term, independently distributed for each i over all t .

In equation (2) the lagged dependent variables are correlated with panel-level effects, rendering the usual estimators inconsistent. Estimation of equation (2) via systems GMM proceeds by first differencing the equation to remove the panel level effects and using instruments to form moment conditions. Possible instruments of the differenced equation

include lagged levels of the endogenous and predetermined variables (second lags and onward) and differences of the exogenous variables. Instruments for the level equation can also be employed and these comprise lagged differences of endogenous and predetermined variables, as well as all exogenous variables.

Employment of the systems GMM methodology portends a number of advantages in model estimation beyond providing a solution for simultaneity. It obviates the need for making particular assumptions about the precise distributional form of the error term in the estimating equation; helps to overcome omitted variable bias, and is relatively robust in the presence of measurement error. The panel data methods described briefly above and used in the present investigation are based primarily on the work of Arellano and Bond (1991), Arellano and Bover (1995), and Blundell and Bond (1998). Again, Greene (2011) provides an up-to-date and thorough description of the techniques.⁵

URBANIZATION AND ECONOMIC GROWTH IN INDONESIA, 1960-2009

The objective of this section of the paper is to empirically examine the relationship between (the level and growth of) urbanization and economic growth in Indonesia, at the national level, over time. To do so, an economic growth equation is estimated; estimation is based on VEC procedures described above. The main relationship of interest is that between per capita economic output and the urbanization ratio. Given the obvious importance of investment to the level and growth of economic output a variable representing per capita gross fixed capital formation is also included in the analysis. All variables are measured in log terms. Variable names are LGDP, LURB, and LIVT, where the meanings are obvious.

The standard VEC model assumes that all variables are non-stationary in their levels and that the variables become stationary (i.e. unit roots are eliminated) after taking first differences. Otherwise put, the basic model presumes that variables are integrated of order one— $I(1)$. A variety of univariate tests are available to test the stationary properties of

variables. The two most frequently used tests are the Augmented Dickey-Fuller (ADF) Kwiatkowski-Phillips-Schmidt-Shin (KPSS). Greene (2011) discusses the two tests and provides some examples.

Table 1 provides the results of applying these two unit root tests to the three variables integral to the present analysis. Each of the two procedures is implemented separately to test equations that include an intercept, on the one hand, and an intercept with trend, on the other. Execution of the tests results in somewhat ambiguous outcomes regarding the order of integration of the variables. Three of the four tests suggest that LGDP is $I(1)$ but one of the tests implies that LGDP is (trend) stationary. All tests indicate that LIVT is $I(1)$. Finally, one of the tests implies that LURB is $I(1)$ while the other three procedures suggest that the variable may be integrated of order two— $I(2)$.

Table 2 here

So, the order of integration of LGDP and LURB, at least, would seem to be somewhat in doubt. As Juselius (2006) notes, however, a final stance on the issue can only be taken after the stationary properties of the variables in question are investigated in a multivariate framework (i.e. in the context of the estimated VEC model). The question of the stationary properties of the variables will be taken up again below. In the meantime estimation proceeds under the assumptions that all variables are $I(1)$ and that the model outlined in equation (1) is appropriate.

Model specification is as follows. First, linear trends in the variables are assumed (but not in the cointegrating relations). Second, both the rapid increase in GDP in 1968 that occurred after Sukarno was overthrown and Suharto was installed as president and the sharp decrease in economic output that transpired in 1997 (and continued through 1998) during the AFC are modeled as structural breaks in the level of the cointegrating relations. Finally, the

model is estimated with variables lagged three times, as an application of the standard lag length tests indicated should be the case.⁶

Before proceeding with estimation, it is typical to formally investigate the residuals of unrestricted model with a view to determining the extent to which the underlying model is well-behaved. The unrestricted model is that from equation (1) before any rank conditions or identifying restrictions are imposed. Table 3 provides the basic multivariate residual diagnostics of the unrestricted model. Specifically, the table provides the multivariate Lagrange multiplier tests for autocorrelation and heteroskedasticity (ARCH) and the Doornik-Hansen (1994) multivariate test for normality.

Table 3 here

The output suggests that the system appears to be generally well-specified. Note, however, first degree autocorrelation appears to be somewhat problematic for residuals in the unrestricted model. On the other hand, the multivariate ARCH and normality tests do not suggest any specification problems with regard to heteroskedasticity or non-normality among variable residuals in the system. The issue of model specification will be taken up again below. In the meantime, it is assumed that the model is sufficiently well behaved to proceed with estimation.

The analysis continues by testing for the existence and number of cointegrating relations among the three endogenous variables. Rank testing procedures developed by Johansen (1996) are used in the examination. Table 4 provides the results of Johansen's rank test. The table shows the trace test statistic, the critical values, and the relevant p-values by rank. The test suggests the existence of one cointegrating relation among LGDP, LIVT, and LURB, at the five percent level of significance.

Table 4 here

The single cointegrating relation is now estimated using the procedures developed by Johansen (1995, 1997). The long-run equilibrium relation is specified so as to form an economic output equation, i.e. estimation is conditioned on LGDP.⁷ LGDP, LIVT, and LURB are all treated as endogenous. As noted above, variables enter the model with linear trends and structural breaks are assumed for 1968 and 1997.

Table 5 provides the essential estimation output. The top panel of the table shows the estimated coefficients in the long-run equilibrium relation (i.e. the β' in equation (1), as well as assumed structural breaks), along with those for short-run error correction parameters for the endogenous variables (i.e. the δ). The bottom panel provides the estimated short-run coefficients for first lagged differences of the endogenous variables, the constant, and the shift-dummies that serve to initiate the structural breaks. T-statistics are shown in parentheses below estimated coefficients.

Table 5 here

The estimated long-run parameters are all statistically significant and all have the anticipated signs. They show that per capita output, per capita investment, and the level of urbanization are all positively associated with one another in the posited long-run equilibrium relation.⁸ In addition, the output provides support for the assumption of structural breaks in the cointegrating relations in 1968 and 1997.

The estimated error correction parameters are statistically significant for all three variables, as well and they have the expected signs. The absolute value of the magnitude of the coefficients indicates the speed with which the variables adjust to deviations from long-run equilibrium. The results imply that investment adjusts most rapidly to such deviations, followed by economic output. Urbanization adjusts comparatively slowly to deviations from long-run equilibrium, as might be expected.

Finally, the table shows that coefficients for first lag of differenced LURB, the constant, and the shift-dummies are all statistically significant in the DLGDP equation. The statistical significance of short-term parameters in other equations is indicated in the table but not discussed here.

The main interest in this section of the paper is to use the output from Table 5 to estimate an economic growth equation. Applying the information in the table to the LGDP equation from the system of equations in (1) yields the following, where only the statistically significant relations of main interest are shown.

$$\Delta LGDP_t = 4.431 - 0.511 LGDP_{t-1} + 0.112 LIVT_{t-1} + 0.599 LURB_{t-1} - 5.623 \Delta LURB_{t-1} + 0.074 DC(68) - 0.205 DC(97) \quad (3)$$

Since per capita GDP is represented in log form, the left-hand side of equation (3) signifies annual growth of per capita economic output. The estimated equation shows that economic growth in one period is negatively related to the level of economic output in the previous period, positively correlated with the level of investment in the previous period, and positively associated with the level of urbanization in the prior period. In addition, the relation suggests that growth of per capita output is negatively related to the rate of change of the urbanization in the prior period. This is a key point in the analysis and will be taken up further below. Finally, the shift dummies are both statistically significant and have the expected signs. All together the independent variables explain 77 percent of the variation in the growth of per capita GDP.

It is perhaps useful to note that, negative effects of urbanization growth notwithstanding, the results above imply that urbanization is generally supportive of economic growth. Substituting actual values for urbanization and growth of urbanization variables into the estimated equation above shows that net impact on growth is positive across the entire range of the sample. So, the combined effects of the level and growth of urbanization positively influence growth of economic output. All things considered,

therefore, the analysis suggests that agglomeration economies remained positive over the 50 year time frame of the study.

In addition, an examination of the residuals of the estimated (restricted) system implies that autocorrelation is no longer problematic (as it seemed to be in the unrestricted model); also residuals remain homoskedastic and normally distributed. Finally, post-estimation diagnostics suggest that each of the variables is non-stationary in the estimated multivariate framework.⁹ This helps to alleviate possible concerns about the potential stationarity of LGDP as suggested by one of the univariate unit root tests previously carried out. However, while the post-diagnostics also suggest that LURB is non-stationary, the order of integration of the variable is still in doubt. That is, LURB might still be either $I(1)$ or $I(2)$.

Unfortunately, a formal test of the existence and number cointegrating relations of system in equation (1) under the assumption that some variables are $I(2)$ provides ambiguous results as regards the order of integration of LURB. In any case, perhaps the easiest and most straightforward way of dealing with LURB under the assumption that it is $I(2)$ is to begin by differencing the variable. The resultant variable, $\Delta LURB$, can then be presumed to be $I(1)$ and $\Delta LURB$ can, in turn, be used to estimate the system provided by equation (1).

This approach is used to re-estimate the model in equation (1), following the same steps as outlined above. Residual diagnostics suggest no problem with the new unrestricted system; residuals show no sign of autocorrelation or heteroskedasticity and they appear to be normally distributed. The rank order test implies the existence of one cointegrating relation among the three variables: LDGP, LIVT, and $\Delta LURB$.¹⁰ The amended cointegration output is provided in Table 6. The table provides the same information and is organized in the same manner as before.

Table 6 here

The results in Table 6 are not discussed in detail but are instead used to directly estimate the economic growth equation, as was done earlier. The new economic growth equation can be written as follows, where, as before, only the variables with statistically significant coefficients on variables of interest are included. Equation (4) differs from equation (3) in that LURB does not appear as an explanatory variable in the equation since $\Delta LURB$ is used in its stead in the cointegrating relations.

$$\Delta LGDP_t = 4.383 - 0.316LGDP_{t-1} + 0.012LIVT_{t-1} - 3.779\Delta LURB_{t-1} + 0.047DC(68) - 0.219DC(97) \quad (4)$$

Several points are worth highlighting. First, the estimated coefficients of lagged LGDP and lagged LIVT have the same signs and reasonably similar magnitudes across equations, although both are lower in estimated equation (4). Second, and most importantly for the purposes here, the coefficient of lagged $\Delta LURB$ appears negative in both equations and the magnitudes of the coefficients are quite comparable across the two equations, although again smaller (in absolute value) in equation (4). Finally, the overall fit of alternative specification is about the same, but slightly better, than the previous one; the R^2 of estimated equation (4) is 82 percent.

In the current context, therefore, the most important results of the estimation output shown in Tables 5 and 6 above relate to the relationship between economic growth and urbanization. Most significantly, the estimation results suggest that economic growth is positively related to the level of urbanization, as has often found to be the case, but negatively related to the rate of change of urbanization. This implies that the pace of urbanization may be proceeding too quickly from an economic growth point of view. The obvious question is: how might the pace of urbanization negatively influence economic growth?

The hypothesis offered here relates to the relationship between urbanization growth and public infrastructure investment. The argument comprises two parts: (1) the rapid pace of urbanization creates severe strain on the available infrastructure, all other things remaining

equal, and (2) current levels of public infrastructure spending are insufficient to address the infrastructure bottlenecks. As such, the argument is that it is not the pace of urbanization per se that negatively affects growth but rather government's inability to invest sufficiently in infrastructure to overcome the increasing congestion created by rapid in-migration.

It is no secret that public infrastructure is in a state of disrepair in Indonesia. The country ranks poorly among nations in Asia in terms of the quality of its public assets, both in general and across a wide range of specific types: water, electricity, roads, ports, railroads, and air transport. Symptoms of low quality infrastructure include poor and decreasing access to potable water and sanitation systems; a large and rising number of electricity blackouts; significant and worsening road congestion, especially in urban areas; and high and rising inter-island cargo transport costs; among others. Poor quality infrastructure is consistently identified by businesses as a severe constraint on operations in Indonesia (World Bank, 2011).

SUBNATIONAL URBAN POPULATION, PUBLIC INFRASTRUCTURE INVESTMENT, AND ECONOMIC GROWTH

Following from the above examination, the analysis below has two main objectives. First, it provides a check on the result derived above that urban population size and growth positively and negatively affect economic growth, respectively.¹¹ Second, it investigates the hypothesis that the harmful impact of urban population growth is at least partly linked to insufficient local public infrastructure spending. The investigation is carried out at the level of local government jurisdictions over the five year period 2003-2007 using a DPD model and GMM estimation techniques, as previously described.

The average urban population size among the 366 jurisdictions in the sample was about 230,000 during the period and ranged from zero to just over three million. Urban population growth was approximately four percent per year across local jurisdictions on

average and varied from around negative ten percent to just over 11 percent per annum. The share of local government infrastructure investment in total expenditure budgets averaged about 14 percent among districts in the sample over the five year period. The average masks significant variation, of course; infrastructure shares of total expenditure ranged from near zero to just less than 40 percent among all local governments. (See Appendix Table A2 for summary statistics of variables used in this part of the analysis.)

The model specified and estimated below draws on three distinct but related academic literatures: growth theory, new economic geography, and urban economics. Straub (2008) has recently comprehensively reviewed these three literatures in the context of examining the impact of infrastructure on economic growth. The following paragraphs draw heavily on that review.

Modern growth theory emphasizes the role of public capital in stimulating economic growth, among others. In this context, both direct and indirect effects may be important. Increases in the stock of public capital (or, alternatively, increases in the flow of public capital services—i.e. intermediate inputs) can directly raise the productivity of other factors (given complementarity among factors) and thereby stimulate increases in economic output. These direct productivity-enhancing effects may even result in higher steady state growth, depending on aggregate returns to scale, among other things (Barro, 1990). Indirect effects relate to the possible efficiency-enhancing externalities of public capital (i.e. infrastructure). More and better quality infrastructure may reduce private capital adjustment costs, for example, by facilitating investment logistics or by decreasing the need for own-provision of certain inputs such as roads, water, or electricity (Agenor and Moreno-Dodson, 2006); alternatively such costs may be reduced by the increases in human capital and labor productivity that may obtain as a result of public investment (Galiani et al., 2005). Of course

the importance of human capital in and of itself to economic growth has been much stressed in the endogenous growth theory literature, starting with Romer (1986) and Lucas (1988).

Recent growth theory and empirics also argues that public capital at both central and subnational levels may serve to encourage growth in the above manners. The empirical analysis below assesses the significance of local government capital spending as a determinant of district economic growth in Indonesia. As Straub (2008) notes, a particular problem with previous empirical applications of this type is that public capital was most often treated exogenously, with the probable consequence that unrealistically large effects of infrastructure on growth were found. As such, the empirical model used here specifies local public capital spending to be endogenously determined.

New economic geography attempts to explain how agglomeration arises in the first instance (Fujita, Krugman, and Venables, 1999) and also the means by which infrastructure affects the extent and pattern of agglomeration (Baldwin et al., 2003). Agglomeration may arise as a function of so-called first and second nature factors. The former relate to the natural geographic attributes such as proximity to major waterways, soil and sub-soil characteristics, and weather conditions, etc. that influence firm location. The latter mainly concern increasing returns in production, which may be either internal or external to (industrial sector) firms. Internal increasing returns may be a function of backward demand linkages, which encourage firms to locate in areas with large “home markets”, or forward supply linkages, which put downward pressure on some input prices, thereby enhancing the economic attractiveness of an area. External increasing returns comprise the usual labor market externalities or knowledge spillovers, for example, as first emphasized by Marshall (1920) and Jacobs (1969). These agglomeration tendencies are usually thought to be tempered by dispersion forces. The latter are a consequence of rising costs of partially immobile factors or increasing congestion, among possible others. Access to and costs of transportation infrastructure

largely determine the net effects of agglomeration and dispersion in the economic geography framework (Baldwin et al., 2003; Deichmann et al., 2005).

In addition, and more recently, the economic geography literature has stressed the self-reinforcing nature of agglomeration and (endogenous) economic growth, a mutually beneficial relationship that may derive from either technological spillovers (Martin and Ottaviano, 1999; Baldwin, 1999; Baldwin and Forslid, 2003) or purely from market (trade) interactions (Martin and Ottaviano, 2001). Given the above, the empirical model specified below posits that agglomeration, as proxied by urban population size, positively affects economic growth (at least beyond some threshold population size) and that agglomeration and economic growth are simultaneously determined.

Urban economics literature focuses on the significance of urbanization for economic growth, *inter alia* (Henderson, 2002a and 2003). As mentioned at the outset of the paper, the literature argues that urbanization is not by itself a cause of economic growth but rather that it proceeds in parallel with growth. The received wisdom is instead that agglomeration economies that exist in urban places drive growth to higher levels. In this regard, both localization and urbanization economies may be important, as previously noted. Henderson (2010) argues that industries subject to localization economies tend to locate in small to medium sized urban places while industries bound by urbanization economies are more likely to locate in larger urban centers. There is no firm consensus in the literature as to the relative significance of localization and urbanization economics; this depends in large measure on specific country or regional circumstances and, in practice, on analytical approach used in addressing the question as well. Generally, but not always, both are found to be at least somewhat important (Lall, Shalizi, and Deichmann, 2004). Due to lack of data for the district-level panel set-up used here, this study is not able to distinguish between localization

and urbanization economies; instead it focuses on the general impact on growth of agglomeration economies, broadly construed, again, as proxied by urban population size.

Another long-standing concern in the urban economics literature is the relationship between urbanization and infrastructure. Clearly, urbanization leads to significant infrastructure needs (Henderson, 2002a and 2010). Moreover, if the pace of urbanization outstrips infrastructure investment the resultant congestion can limit growth. Alternatively, sufficient spending on public capital may help overcome constraints imposed by rapid urban population growth. In the model employed here therefore, in addition to the relationships specified in the previous paragraphs, it is posited that urban population growth and the interaction between urban population growth and infrastructure spending, both of which are endogenously determined, help explain economic growth.

The impact of urban population, urban population growth, and local government infrastructure investment on economic growth is investigated via the specification and estimation of a basic growth model. The general form of the equation can be written as follows.

$$gy_{it} = \alpha y_{it}^0 + \beta x_{it} + \varepsilon_{it} , \quad (5)$$

where the subscripts i and t refer to local government jurisdiction and year, respectively; gy is annual real growth of per capita output over the period; y^0 is the level of per capita output at the beginning of the period; \mathbf{x} is a matrix of other variables that may influence economic growth; α and β represent the coefficients to be estimated; and ε is the usual error term.

The level of output at the beginning of the period is included in the estimating equation as is typical in such analyses. It is anticipated the level of output in the previous period will negatively affect economic growth during the period, since it is relatively easier to grow fast from a low base.

Specific variables in \mathbf{x} include urban population size, urban population size squared, urban population growth, per capita local government infrastructure investment, urban population growth multiplied by local government per capita infrastructure spending, and the average years of education of adult residents of the district. In addition, dummy variables for year are also included in the regression. A number of other variables were tried in the analysis as well, such as the level and growth of the working age population and resident morbidity, but they were discarded due to lack of significant effects. Other variables, such as private investment spending, especially, or variables distinguishing between localization and urbanization economies would ideally be included in the examination but relevant data are not available. As noted, GMM estimation helps to mitigate biases associated with omission of relevant variables so perhaps this will not pose too great a challenge to derived output.

The rationale for including urban population, urban population growth, public capital investment, and the interaction between urban population growth and capital spending in the estimating equation has been discussed above. Urban population squared is also included in the regression, since previous research suggests that economic growth is relatively strong in mostly rural areas and larger urban centers but relatively weak in small urban places (World Bank, 2012) and because agglomeration economies (as proxied by urban size) may only obtain after some threshold is reached. If this is true then coefficients of urban population and its squared value should be negative and positive, respectively.

Based on the time series analysis, the influence of urban population growth on economic growth should be negative. Given received theory and empirical evidence from around the world, it is anticipated that the level of infrastructure investment will be positively related to economic growth. There are no a priori expectations regarding the impact of the interaction variable; interaction effects could be either positive or negative. Finally, as

suggested by the literature on endogenous growth it is anticipated that the years of education of adult residents should positively influence local economic growth.

Economic growth and urban population growth are measured contemporaneously in the model. Given the likely simultaneous relationship between the two variables, urban population is taken to be endogenous. All other variables (except the time dummies and the interaction term) are measured at the beginning of the period. As such, there can be no contemporaneous feedback from economic growth to those variables. However, it is possible that economic growth in one period may influence future values of any of the indicated variables. With this in mind, all other variables are specified as predetermined, except time dummies, of course, which are treated as exogenous. GMM estimation of the system as described here uses lagged levels of the both endogenous and predetermined variables (second lags and onwards) and differences of the exogenous variables as instruments of the differenced equation. Instruments for the level equation are not employed since their use creates problems with the validity of over-identifying restrictions.

Table 7 provides the regression results. Estimated coefficients and z statistics (based on robust standard errors) are presented and an indication of the statistical significance of the estimated coefficients is provided. Estimation results for the time dummies have been expunged for convenience. The number of observations, cross section units, and instruments are shown. Finally the table also supplies the usual summary statistics. They are all self-explanatory, perhaps with the exception of the Sargan statistic. The latter allows for a test of the null hypothesis that the over-identifying restrictions forced by the instrumental variables technique used in GMM estimation are valid.

The results are quite satisfactory given expectations and data limitations discussed just above. All variables are significant determinants of economic growth at acceptable statistical levels, except perhaps years of education. (The latter is statistically significant only

at the 15 percent level.) The Wald statistic is highly significant. And the Sargan statistic strongly supports the conclusion that the over identifying restrictions imposed by the instrumental variables technique are valid.

Table 7 here

Specifically, the level of economic output at the beginning of the period is negatively associated with economic growth during the period, as is often found in studies similar to this one. Urban population and its squared value are negatively and positively related to growth, respectively. The results indicate that the influence of the urban population on economic growth declines until population reaches some particular size, after which it rises again. A simple calculation reveals that the threshold urban population size in question is about 78,000, indicative of a medium sized city in Indonesia. (The median urban population among districts in Indonesia is approximately 95,000.)

These results suggest that agglomeration economies can be important in driving economic growth even in relatively small urban places and that such economies become more important as cities become larger. As previously noted, the data do not permit disentangling the specific effects of localization and urbanization economies in this context. There is only limited other research in Indonesia to draw upon in this regard as well. Henderson and Kuncoro (1996) found significant localization economies for apparel, nonmetallic minerals, and machinery and strong urbanization economies for wood, furniture, and publishing (Henderson and Kuncoro, 1996). Deichmann et al. (2005) discovered strong local and urbanization economies in the office supply and computing sectors and among business services and rubber and plastic industries, respectively. Both studies determined that localization economies were more pervasive than urbanization economies. Broadly speaking localization economies appear to be more important in small to medium sized places while

urbanization economies seem more significant in larger cities and metropolitan areas (Henderson, 2002).

The output also provides additional support for the finding that urban population growth negatively affects economic growth. The output suggests that a one percent increase in the growth of urban population results in an approximate one percent decline in the rate of economic growth (ignoring for a moment the interaction effects between urban population growth and infrastructure spending).

Finally, the results imply a positive effect for local government infrastructure spending on growth; interestingly, the interaction variable is also positively associated with economic growth. This suggests that the negative impact of an increase in urban population growth on economic growth is mitigated by local government investment in infrastructure. At some point, in fact, when the level of local public investment becomes high enough, the net effects of urban population growth become positive. A simple calculation based on the regression output shows that the level of per capita investment needed to force a positive net impact of urban population growth on economic is about Rp 205,000. This amount falls approximately in the 80th percentile of local public capital spending on infrastructure. Otherwise put, only about 20 percent of all districts in Indonesia invest in infrastructure in sufficient amounts to overcome the apparently detrimental effects of rapid urban population growth.

CONCLUSIONS AND POLICY IMPLICATIONS

Indonesia's urban population now comprises more than 50 percent of the total; the country is presently one of the more urbanized developing nations in Asia. Urban population growth has been very rapid indeed—about 4.5 percent annually since 1960, making it one of the most quickly urbanizing countries in the world. Indonesia has gone from a largely rural country to a mostly urban one in less than two generations.

Economic growth in Indonesia has been mostly mediocre since 1960, averaging just 3.6 percent per year. This growth rate puts Indonesia on par with India but significantly behind fast growing economies of China, Thailand, and Vietnam. Of course, economic growth would have been significantly stronger over the period if not for the economic stagnation in the mid-1960s and, especially, the Asian Financial Crisis of 1997-1998. On the other hand, the negative impacts of the crisis were felt even more strongly in other countries in the region, so this is not quite the defense that many Indonesian policymakers have made it out to be.

Time series analysis for Indonesia over the period 1960-2009 demonstrates that the level of urbanization is positively associated with economic growth, a common finding among both developing and modern countries alike. The analysis also shows that rate of change of urbanization is negatively correlated with the growth of economic output over the period considered. This is a key finding of the study. A plausible explanation for this result is that the rapid pace of urbanization in Indonesia has overwhelmed government's ability to meet attendant needs for infrastructure spending. Arguably therefore, it is not the pace of urbanization per se that negatively affects growth but rather government's inability to invest sufficiently in required infrastructure, a failure that has resulted in significant agglomeration diseconomies related to congestion, among possible others.

A dynamic panel data investigation, for the period 2003-2007, supplies additional evidence of the positive level and negative growth effects of Indonesia's urbanization on economic growth. The panel analysis also supports the hypothesis that the harmful impact of the rate of urban population growth on economic growth is at least partly linked to insufficient infrastructure investment, in this case by local governments. Local governments that invest more heavily in public infrastructure are better able to cope with the apparently detrimental effects of rapid urbanization on economic growth. In fact, at some level of

infrastructure investment the negative impact of urban population growth is overcome.

Unfortunately, the evidence suggests that only about twenty percent of local governments spend enough on infrastructure in this regard.

It should be a rather straightforward matter for central government to increase its own infrastructure spending, given sufficient access to finance and political will. But how might central government encourage more local spending on infrastructure? Central government does, in fact, have a few tools at its disposal to stimulate more local government infrastructure investment. Perhaps the most important such mechanism is the intergovernmental specific-purpose grant (DAK). The transfer is allocated to local governments with a view to stimulating capital spending across a variety of sectors, including infrastructure.

Two main problems related to the DAK severely constrain its effectiveness in motivating increases in local government infrastructure investment at present. First, funding for the intergovernmental capital grant has stagnated at relatively low levels. While DAK funding rose significantly between 2003 and 2007, it has not increased in real terms during the last five years, despite an official policy agenda to the contrary. Second, the portion of the grant devoted to infrastructure has declined considerably over the years. In 2003, DAK distributions for infrastructure comprised over 50 percent of the total; by 2012 less than 25 percent of total DAK was allocated to traditional infrastructure sub-sectors.

In theory, there are reasonably straightforward ways around these two problems. First, substantial increases in the DAK could be paid for by rechanneling funds currently used for central government investment in local infrastructure into the DAK. Such investment is illegal under current decentralization legislation; more importantly perhaps recent research has shown that the spending crowds out local government capital spending (Lewis, 2012). At the limit, the DAK could be doubled in size by diverting all central capital spending on local

infrastructure to the DAK in the desired manner. Second, a rise in the proportion of capital grant funding allocated to infrastructure could be accounted for by reducing grant fragmentation. Currently, the DAK covers 22 sub-sectors, most of which are arguably of questionable importance in the context of rapid urbanization and the promotion of economic growth; many of these sub-sectors could simply be eliminated from DAK coverage, without any undue effects, and associated funds could be reallocated to infrastructure.

Of course, these things are more easily said than done. Central government line agencies will continue to strongly resist having their budgets cut in order to increase DAK funding. Even though it has been official policy since 2004 to re-channel illegal central spending on local infrastructure into the DAK the Ministry of Finance has failed to make any headway in relevant budget negotiations, despite being nominally in charge of the process. Many local governments also appear to favor the status quo, preferring to let central government build infrastructure in their jurisdictions rather than doing it themselves. In addition, the National Development Planning Agency (Bappenas), which to a large extent controls sectoral coverage of the DAK, may not be particularly amenable to reducing grant fragmentation, since many officials appear to believe that such reforms would dilute their influence. In this regard, it is perhaps useful to note that Bappenas is currently considering adding up to five more sectors to the DAK for 2013. Finally, National Parliament provides little support for reform of the DAK, in general. It tends to use its authority over grant allocations to respond to local lobbying and politicking rather than to promote any substantive development agenda.

In sum, a number of important factors constrain the Indonesian government from increasing local infrastructure investment to desirable levels. This does not mean that the objective is unachievable of course just that it won't be a simple matter. If government does fail to make the necessary reforms, however, it is likely that Indonesian economic growth will

remain significantly constrained by continued rapid urbanization. And citizen welfare will persist in falling ever further behind that of quickly growing countries in the region and elsewhere.

ACKNOWLEDGEMENTS

The research reported on in this paper was carried out in part when the author was an Associate Professor of Public Finance at Lee Kuan Yew School of Public Policy (LKYSPP), National University of Singapore (NUS) and was funded by a grant from NUS (R-603-000-028-133). The author thanks staff at World Bank in Jakarta for assistance with the data, Naomi Jacob of LKYSPP for expert research assistance, and three referees for useful comments.

APPENDIX

Table A1 provides summary statistics for the variables used in the time series analysis. GDP is per capita gross domestic product in and IVT is per capita gross capital formation; both variables are measured in real rupiah with 2000 as the base year. URB is the portion of the population that resides in urban areas. All data are from the World Bank's World Development Indicators, 2010.

Table A1 here

Table A2 provides summary statistics for all variables used in the panel data analysis. Variables are defined at the bottom of the table. All data were accessed from World Bank, Jakarta. See the text for a fuller description of the sources.

Table A2 here

REFERENCES

- Agenor, P. R. & Moreno-Dodson, B. 2006. Public infrastructure and growth: New channels and implications. World Bank Policy Research Working Paper 4064.
- Arellano, M., & Bond, S. 1991. Some tests of specification for panel data: Monte carlo evidence and an application to employment equations. *Review of Economic Studies*, 58 (2), 277-297.
- Arellano, M., & Bover, O. 1995. Another look at the instrumental variable estimation of error-components models. *Journal of Econometrics*, 68 (1), 29-51.
- Asian Development Bank. SDBS-Asian Development Bank. July 30, 2010.
<https://sdfs.adb.org/sdfs/index.jsp> (accessed 4 August, 2011).
- Baldwin, R. E. 1999. Agglomeration and endogenous capital. *European Economic Review*, 43, 253-280.
- Baldwin, R. E. & Forslid, R. 2003. The core-periphery model and endogenous growth: Stabilizing and destabilizing integration. *Economica*, 67, 307-324.
- Baldwin, R. E., Forslid, R., Martin, P., Ottaviano, G. & Robert-Nicoud, F. 2003. *Economic Geography and Public Policy*. Princeton, NJ: Princeton University Press.
- Barro, R. J. 1990. Government spending in a simple model of endogenous growth. *Journal of Political Economy*, 98 (5), s103-s125.
- Bloom, D. E., Canning, D., & Fink, G. 2008. Urbanization and the wealth of nations. *Science*, 319 (5864), 772-775.

- Blundell, R., & Bond, S. 1998. Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics*, 87 (1), 115-143.
- Brühlhart, M., & Sbergami, F. 2009. Agglomeration and growth: Cross-country evidence. *Journal of Urban Economics*, 65, 48–63.
- Calì, M. 2008. Urbanisation, inequality and economic growth: Evidence from Indian states and towns. Overseas Development Institute.
- Chang, G. H. & Brada, J. C. 2006. The paradox of China's growing under-urbanization. *Economic Systems*, 30 (1), 24-40.
- Ciccone, A., & Hall, R. 1996. Productivity and the density of economic activity. *American Economic Review*, 86 (1), 54-70.
- Deichmann, U., Kaiser, K., Lall, S., & Shalizi, Z. 2005. Agglomeration, transport, and regional development in Indonesia. World Bank Policy Research Working Paper 3477.
- Dennis, J. G. 2006. *CATS in RATS Cointegration Analysis of Time Series*. Illinois: Estima.
- Doornik, J., & Hansen, H. 1994. An omnibus test for univariate and multivariate normality. Working Paper.
- Fujita, M., Krugman, P., & Venables, A. J. 1999. *The Spatial Economy: Cities, Regions, and International Trade*. Cambridge, MA: MIT Press.
- Fujita, M. & Thisse, J. F. 2003. Does geographical agglomeration foster economic growth? And who gains and loses from it? *The Japanese Economic Review*, 54 (1), 121-145.
- Galiani, S., Gertler, P., & Schargrodsy, E. 2005. Water for life: The impact of privatization of water services on child mortality. *Journal of Political Economy*, 113, 83-120.

- Glaeser, E. 1994. Cities, information and economic growth. *Cityscape*, 1 (1), 9-77.
- Glaeser, E. 1998. Are cities dying? *Journal of Economic Perspectives*, 12 (2), 139-160.
- Greene, W. H. 2011. *Econometric Analysis, 7th Edition*. Upper Saddle River, New Jersey: Prentice-Hall Inc.
- Henderson, V. 1988. *Urban Development: Theory Fact and Illusion*. New York: Oxford University Press.
- Henderson, V. 2002a. Urbanization in developing countries. *The World Bank Research Observer*, 17 (1), 89-112.
- Henderson, V. 2002b. Urban primacy, external costs, and quality of life. *Resource and Energy Economics*, 24, 95-106.
- Henderson, V. 2003. The urbanization process and economic growth: The so-what question. *Journal of Economic Growth*, 8, 47-71.
- Henderson, V. 2010. Cities and development. *Journal of Regional Science*, 50 (1), 515-540.
- Henderson, V. & Kuncoro, A. 1996. Industrial centralization in Indonesia. *World Bank Economic Review*. 10, 513-540
- Henderson, V., Shalizi, Z., & Venables, A. 2001. Geography and development. *Journal of Economic Geography*, 1, 81-105.

Hill, H. 1994. The economy, in Hill H (ed) *Indonesia's New Order: The Dynamics of Socio-Economic Transformation*. Allen and Unwin, St Leonards, NSW, Australia

Jacobs, J. 1969. *The Economy of Cities*. New York: Random House.

Jacobs, J. 1984. *Cities and the Wealth of Nations: Principles of Economic Life*. New York: Random House.

Johansen, S. 1995. *Likelihood Based Inference in Cointegrated Vector Autoregressive Models*. Oxford University Press, Oxford.

Johansen, S. 1996. *Likelihood Based Inference in Cointegrated Vector Autoregressive Models, Second Edition*. Oxford University Press, Oxford.

Johansen, S. 1997. Likelihood analysis of the I(2) model. *Scandinavian Journal of Statistics* , 24 (4), 433-462.

Juselius, K. 2006. *The Cointegrated VAR Model: Methodology and Applications*. Oxford University Press.

Lall, S., Shalizi, Z., & Deichmann, U. 2004. Agglomeration economies and productivity in Indian industry. *Journal of Development Economics*, 73, 643-673.

Lewis, B. D. 2012. Local government capital spending in Indonesia: Impact of intergovernmental fiscal and in-kind transfers. Working Paper, World Bank, Jakarta.

Lewis, B. D., & Oosterman, A. 2010. Subnational government capital spending in Indonesia: Level, structure and financing. *Public Administration and Development*, 31 (3), 135-228.

Linn, J. F. 1982. The costs of urbanization in developing countries. *Economic Development and Cultural Change*, 30, 625-648.

Lucas, R. 1988. On the mechanics of economic development. *Journal of Monetary Economics*, 22, 3-42.

Marshall, A. 1920. *Principles of Economics*. Macmillan, London.

Martin, P. & Ottaviano, G. I. P. 2001. Growth and agglomeration. *International Economic Review*, 2 (4), 947-968.

Martin, P. & Ottaviano, G. I. P. 1999. Growing locations: Industry location in a model of endogenous growth. *European Economic Review*, 43, 281-302.

Mata, D. d., Deichmann, U., Henderson, J., Lall, S., & Wang, H. 2007. Determinants of city growth in Brazil. *Journal of Urban Economics*, 62 (2), 252-272.

Mitra, A. & Mehta, B. 2011. Cities as the engine of growth: evidence from India. *Journal of Urban Planning and Development*, June, 171-183.

Polèse, M. 2005. Cities and national economic growth: A reappraisal. *Urban Studies*, 42 (8), 1429-1451.

- Quigley, J. M. 1998. Urban diversity and economic growth. *Journal of Economic Perspectives*, 12 (2), 127-138.
- Quigley, J. M. 2008. *Urbanization, Agglomeration and Economic Development*. Commission on Growth and Development.
- Rauch, J. 1993. Productivity gains from geographic concentrations of human capital: Evidence from the cities. *Journal of Urban Economics*, 34 (3), 380-400.
- Richardson, H.W. 1987. The costs of urbanization: A four-country study. *Economic Development and Cultural Change*, 33, 561-580.
- Romer, P. 1986. Increasing returns and long-run growth. *Journal of Political Economy*, 94 (5), 1002-1037.
- Rosenthal, S. & Strange, W. 2004. Evidence on the nature and sources of agglomeration economies, in Henderson, J.V. and Thisse, J.F. (eds.) *Handbook of Regional and Urban Economics*, Volume 4, 2119-2171.
- Straub, S. 2008. *Infrastructure and growth in developing countries: Recent advances and research challenges*. Working Paper 54 , Development Research Department, Research Support Unit (DECRS), World Bank.
- Tolley, G., Gardner, J. & Graves, P. 1979. *Urban Growth Policy in a Market Economy*. Academic Press, New York.

Wang, H., He, Q., Liu, X., Zhuang, Y., & Hong, S. 2012. Global urbanization research from 1991 to 2009: A systematic research review. *Landscape and Urban Planning*, 104, 299-309.

Williamson, J. G. 1965. Regional inequality and the process of national development. *Economic Development and Cultural Change*, 13 (4), 3-45.

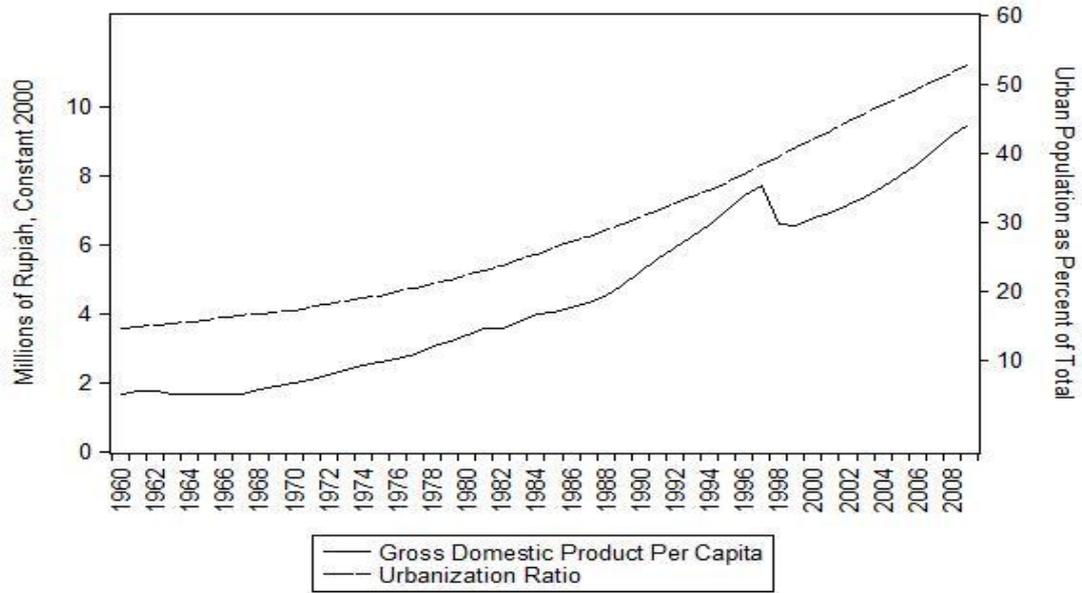
World Bank. 2010. *Indicators/ Data*. Retrieved August 12, 2011, from <http://data.worldbank.org/indicator>

World Bank. 2011. *Indonesia Economic Quarterly: Current challenges, future potential*. Jakarta: World Bank.

World Bank. 2012. *The Rise of Metropolitan Regions: Towards Inclusive and Sustainable Regional Development*. Jakarta: World Bank.

FIGURES AND TABLES

Figure 1: GDP and Urbanization in Indonesia, 1960-2009



	GDPPC (US\$)		Population		Urban Population		Urbanization Ratio	
	Level	Growth	Level	Growth	Level	Growth	Level	Growth
Country	2009	1960-2009*	2009	1960-2009	2009	1960-2009	2009	1960-2009
Indonesia	3,814	3.61	229,964	1.86	120,915	4.56	52.6	2.65
China	6,206	6.40	1,331,460	1.42	585,842	3.54	44.0	2.09
India	2,993	3.45	1,155,347	2.01	344,524	3.08	29.8	1.05
Philippines	3,354	1.38	91,983	2.53	60,396	4.16	65.7	1.59
Vietnam	2,682	5.01	87,279	1.90	24,717	3.27	28.3	1.35
Thailand	7,260	4.36	67,764	1.85	22,809	2.97	33.7	1.10

* Except Vietnam, growth rate for which is for the period 1984-2009, due to lack of data.

Source: World Development Indicators, 2010.

Table 2: Unit Root Tests

Variable	ADF-Intercept		ADF-Trend and Intercept		KPSS-Intercept		KPSS-Trend and Intercept	
	Test Stat	Conclusion	Test Stat	Conclusion	Test Stat	Conclusion	Test Stat	Conclusion
LGDP	-0.087	Unit Root	-1.767	Unit Root	0.924	Unit Root	0.121	No Unit Root
LIVT	-0.971	Unit Root	-0.862	Unit Root	0.832	Unit Root	0.203	Unit Root
LURB	-0.676	Unit Root	-2.827	Unit Root	0.935	Unit Root	0.197	Unit Root
DLGDP	-4.822	No Unit Root	-4.781	No Unit Root	0.111	No Unit Root	--	--
DLIVT	-5.505	No Unit Root	-5.469	No Unit Root	0.245	No Unit Root	0.099	No Unit Root
DLURB	-2.055	Unit Root	-0.601	Unit Root	0.463	No Unit Root	0.150	Unit Root
D2LURB	-7.468	No Unit Root	-7.795	No Unit Root	--	--	0.049	No Unit Root

Notes: D and D2 refer to the first and second difference of the variable in question. The null hypothesis for ADF is that the variable has a unit root; the null for KPSS is that the variable is stationary. Relevant lag lengths and bandwidths are automatically determined by the Modified Schwarz Criterion and Newey-West Bandwidth procedures for the ADF and KPSS tests, respectively. (These are not shown in the table.) The "Test Stat" is the adjusted t statistic. Null hypotheses are evaluated at the 0.05 level of significance.

Table 3: Residual Diagnostics for Unrestricted Model			
<i>Multivariate Test for Autocorrelation</i>			
	Dfree	Chi Sq	P-Value
LM(1)	9	23.398	0.005
LM(2)	9	11.396	0.250
LM(3)	9	4.014	0.910
LM(4)	9	7.780	0.556
<i>Multivariate Test for ARCH</i>			
	Dfree	Chi Sq	P-Value
LM(1)	36	26.824	0.866
LM(2)	72	78.834	0.272
LM(3)	108	106.435	0.525
LM(4)	144	149.091	0.369
<i>Multivariate Test for Normality</i>			
	Dfree	Chi Sq	P-Value
	6	5.900	0.435
<p>Multivariate tests for autocorrelation and heteroskedasticity (ARCH) are Lagrange multiplier tests. The multivariate normal test is based on Doornik-Hansen (1994) and is described in Dennis (2006).</p>			

Table 4: Rank Test				
Unit Roots	Rank	Trace	Crit Val	P-Value
3	0	67.318	33.773	0.000
2	1	16.975	18.112	0.088
1	2	3.885	5.804	0.142
<p>Trace is the test statistic developed by Johansen (1996) and has been adjusted for small sample size. Crit Val represents the critical values, which have been generated by simulation procedures in CATS; see Dennis (2006) for details. P-Values have also been adjusted, as per Doornik (1998).</p>				

Table 5: Vector Error Correction Estimation Results

<u>Long-Run Parameters (β)</u>								<u>Error Correction Parameters (δ)</u>						
LGDP	LIVT		LURB		C-1968		C-1997		DLGDP		DIVT		DLURB	
1.000	-0.220	*	-1.173	*	-0.200	*	0.256	*	-0.511	*	-1.363	*	-0.011	*
--	(-6.091)		(-13.317)		(-7.727)		(7.561)		(-10.785)		(-5.965)		(-1.964)	
	<u>Lagged Differences (Γ)</u>							<u>Constant and Shift Dummies</u>						
<u>Eq</u>	DLGDP{1}		DLIVT{1}		DLURB{1}				Constant		DC(1968)		DC(1997)	
DLGDP	-0.102		-0.048		-5.623	*			4.431	*	0.074	*	-0.205	*
	(-0.801)		(-1.296)		(-4.465)				(10.798)		(3.584)		(-13.497)	
DIVT	0.481		-0.177		-9.049				11.908	*	0.168		-0.563	*
	(0.780)		(-0.987)		(-1.490)				(6.019)		(1.680)		(-6.483)	
DLURB	-0.015		0.004		0.633				0.101	*	-0.001		0.000	
	(-0.939)		(0.822)		(4.075)	*			(2.005)		(-0.282)		(0.127)	

* indicates that the coefficient is statistically significant at the 0.05 level, using one sided t-test.

Table 6: Vector Error Correction Estimation Results, Alternative Model

<u>Long-Run Parameters (β)</u>								<u>Error Correction Parameters (δ)</u>						
LGDP	LIVT		DLURB		C-1968		C-1997		DLGDP		DIVT		D2LURB	
1.000	-0.037		11.960	*	-0.204	*	0.511	*	-0.511	*	-0.796	*	-0.003	
--	(-0.583)		(2.824)		(-4.422)		(8.696)		(-10.854)		(-5.150)		(-0.726)	
<u>Lagged Differences (Γ)</u>								<u>Constant and Shift Dummies</u>						
<u>Eq</u>	DLGDP{1}		DLIVT{1}		D2LURB{1}				Constant		DC(1968)		DC(1997)	
DLGDP	-0.169		-0.021		-0.393				4.383	*	0.047	*	-0.219	*
	(-1.405)		(-0.638)		(-0.358)				(10.920)		(2.484)		(-15.347)	
DIVT	-0.068		0.067		7.600				10.998	*	0.168		-0.61	*
	(-0.107)		(0.385)		(1.301)				(5.160)		(1.674)		(-6.800)	
D2LURB	-0.019		0.008	*	-0.247				0.040		0.000		0.000	
	(-1.129)		(1.811)		(-1.646)				(0.736)		(0.039)	*	(0.088)	

* indicates that the coefficient is statistically significant at the 0.05 level, using one sided t-test.

Table 7: GMM Regression Results ¹			
Independent Variables	Coef.	z Stat	
Log of per capita GRDP lagged	-1.041	-9.98	**
Log of urban population lagged	-2.234	-2.64	**
Log of urban population squared lagged	0.099	2.38	**
Growth of urban population	-0.942	-2.57	**
Log of per capita local infrastructure spending lagged	0.047	1.85	*
Growth of urban population times log of local infrastructure spending lagged	0.077	2.11	**
Log of average number of years of schooling lagged	1.563	1.43	
Constant	24.742	4.56	**
Number of observations	1,100		
Number of cross section units	366		
Number of instruments	31		
Wald Statistic	247.38		
Chi Sq Probability	0.000		
Sargan Statistic	14.07		
Chi Sq Probability	0.867		
¹ Dependent variable is real annual growth of per capita GRDP. All economic and fiscal variables are measured in real terms. The symbols ** and * indicate that the coefficient is statistically significant at the 0.05 and 0.10 percent levels, respectively.			

Table A1: Summary Statistics for Variables Used in Time Series Analysis			
	GDP	IVT	URB
Mean	4,532,915	1,156,623	28.7
Std Dev	2,448,535	816,765	11.9
Min	1,637,458	124,169	14.6
Max	9,466,563	2,854,613	52.6
Observations	50	50	50
<u>Variables</u>			
GDP	Per capita gross domestic product, constant 2000		
IVT	Per capita gross capital formation, constant 2000		
URB	Percentage of population living in urban areas		

Table A2: Summary Statistics for Variables Used in the DPD Analysis						
	g_y	GRDPPC	URBPOP	g_u	INFPC	SCH
Mean	0.032	5,755,150	231,823	0.041	183,882	7.4
Std Dev	0.304	6,635,536	387,892	0.349	453,514	1.1
Min	-0.129	319,739	0	-0.103	3	4.9
Max	0.131	18,345,961	3,108,407	0.115	6,627,114	11.8
Observations	1,205	1,689	1,689	1,158	1,586	1,689
<u>Variables</u>						
g_y	Annual growth of real gross regional domestic product, per capita					
GRDPPC	Real gross regional domestic product, per capita					
URBPOP	Urban population					
g_u	Annual growth of urban population					
INFPC	Real local capital spending on infrastructure, per capita					
SCH	Average number of years of education of adult residents					

NOTES

¹ The average exchange rate in 2000 was about Rp 8,400 to the dollar.

² See Hill (1994) for an investigation of Indonesia's economy over the period 1965-1991, including an analysis of the initial economic impact of Sukarno's political demise.

³ The VEC model is implemented in this paper using CATS in RATS version 2 (Dennis 2006).

⁴ For endogenous variables $E[w_{it}, \varepsilon_{is}] \neq 0$ for $s \leq t$ but $E[w_{it}, \varepsilon_{is}] = 0$ for $s > t$; and for predetermined variables $E[w_{it}, \varepsilon_{is}] \neq 0$ for $s < t$ but $E[w_{it}, \varepsilon_{is}] = 0$ for $s \geq t$.

⁵ GMM estimation was carried out in this paper using the `xtdpd` procedure in Stata 12.

⁶ Procedures employed include the modified likelihood ratio, final prediction error, Akaike information criterion, Schwarz information criterion, and the Hannan-Quinn information criterion tests. Application of the tests provides unambiguous support for a lag length of three.

⁷ Conditioning on one of the variables is required to assure model identification.

⁸ The positive relationship among variables in the cointegrating space can be more clearly seen by recognizing that in equilibrium the relation can be written as:

$$LGDP_{t-1} = 0.222LIVT_{t-1} + 1.173LURB_{t-1}.$$

⁹ Detailed post-estimation diagnostic output is available from the author upon request.

¹⁰ Results are available from the author upon request.

¹¹ Note that in the analysis that follows urban population size is used instead of percent of population that is urban as the proxy for agglomeration. Of two districts with the same percent of population residing in urban areas, the one with the larger urban population is likely to benefit more from agglomeration economies. To be consistent, growth of urban population is used instead of growth of the urbanization rate as the appropriate urban growth variable.