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Urbanization and Poverty Reduction Outcomes

Panupong Panudulkitti

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The author of this dissertation is:

Panupong Panudulkitti
1712 Brookhaven Circle, NE
Atlanta, GA 30319

The director of this dissertation is:

Jorge L. Martinez-Vazquez
Department of Economics
Andrew Young School of Policy Studies
Georgia State University

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URBANIZATION AND POVERTY REDUCTION OUTCOMES

BY

PANUPONG PANUDULKITTI

A Dissertation Submitted in Partial Fulfillment
of the Requirements for the Degree
of
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ACCEPTANCE

This dissertation was prepared under the direction of the candidate's Dissertation Committee. It has been approved and accepted by all members of that committee, and it has been accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Economics in the Andrew Young School of Policy Studies of Georgia State University.

Dissertation Chair: Jorge L. Martinez-Vazquez

Committee: Mary Beth Walker
Felix K. Rioja
Charles R. Hankla

Electronic Version Approved:
James R. Alm, Dean
Andrew Young School of Policy Studies
Georgia State University
December 2007

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ABSTRACT

URBANIZATION AND POVERTY REDUCTION OUTCOMES

By

PANUPONG PANUDULKITTI

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Committee Chair: Dr. Jorge L. Martinez-Vazquez

Major Department: Economics

This dissertation attempts to examine the effect of urbanization on poverty reduction outcomes by considering various dimensions of poverty and channels of reducing poverty. First, we develop a theoretical model in order to infer a relationship between urbanization and poverty reduction outcomes. Specifically, it shows an optimal level of urbanization to properly allocate basic public infrastructure and promote pro-poor growth.

Second, we conduct empirical analysis on international data to examine the testable hypotheses that are derived from the theoretical model. Further, we explore the "channeled effects" of urbanization on basic education and health by the IV estimation and on productivity by the dynamic panel GMM estimation. As the theoretical model suggests, our results exhibit the statistically significant relationship in a non-linear form between urbanization and poverty.

In addition, we explore the impact of urbanization on poverty reduction outcomes in different regions in order to see the various magnitudes of urbanization effects among regions.

CHAPTER I

INTRODUCTION

Urbanization is a transitory pattern of economic development that transforms and shifts economic and other activities from rural to urban sectors. Poverty is a level of economic development, which barely meets the minimum standards of human well-being. This dissertation examines a relationship between urbanization and poverty reduction outcomes. We construct a theoretical model that explicitly links urbanization and poverty to the basis of rural and urban infrastructures for basic needs and incomes for the poor. We extend a model by Devaranjan, Swaroop, and Zou (1996) in combination with pro-poor growth developed by Kakwani and Pernia (2000), Ravallion and Chen (2003), and Kraay (2006). Our model unambiguously yields the effect of urbanization on poverty reduction outcomes, which depends upon the degree of urbanization via infrastructure channels and income.

Economic theory states that agglomeration effects in production and consumption are central forces in shaping any economy. Poverty reduction outcomes can generally be considered as the by-product of urbanization. However, there is considerable controversy among academic research concerning this issue. Some researchers have argued that urbanization has no impact on economic growth, which helps to reduce poverty. In contrast, other researchers show that urbanization stimulates economic growth and is a more efficient delivery of basic public services. The model in this dissertation will show that urbanization plays a critical role in determining the actual effect of urbanization on poverty reduction outcomes. If urbanization is below a particular level, an increase in urban population will largely promote overall human development.

On the other hand, if urbanization is over a determined level, then the impact of urbanization will lead to a lower standard of living for both rural and urban areas. Therefore, in order to understand the potential of urbanization for poverty reduction outcomes, our findings are important for social planners, especially in those developing countries with a rapidly growing rate of urbanization.

In this dissertation, we also empirically estimate the effect of urbanization on poverty reduction outcomes. By using international panel data, we apply the instrumental variable (IV) estimation in the context of the generalized method of moments (GMM) framework to investigate the relationship between urbanization and poverty reduction outcomes. Also, we employ the dynamic panel GMM estimation in our empirical model to explore the effect of urbanization on pro-poor growth. The robustness of poverty reduction outcomes through channels of urbanization are shown via poverty indicators (through both monetary and non-monetary dimensions). Our findings show that urbanization plays a pattern of positive roles via non-linear form on poverty reduction.

Motivation

One of the crucial characteristics of developing countries is poverty. The concept of poverty includes the 'state of being' without many or most of the necessities needed for daily living. Using the World Bank's poverty criteria,[1] it shows that people living in poverty amounted to 1.5 billion (40% of the world population) in 1981, 1.227 billion (30%) in 1987, 1.314 billion (29%) in 1993, and 1.1 billion (21%).

[1] People have consumption levels below $1 (1993 Purchasing Power Parity: PPP$) a day per person. The percentage numbers shown are calculated from the 2006 World Development indicators CD Rom.

Along with international concerns, at the heart of economic development is the improvement of poverty reduction. As mentioned in the Poverty Reduction Strategy Papers (PRSP) sourcebook,[2] poverty can be evaluated by the monetary dimension, such as income or the level of consumption, and non-monetary dimensions, such as health care, education, and basic public services.

These two dimensions define human well-being through the standard of living, which can be interpreted and connected to economic development objectives. As countries have developed, the modern pattern of economic development, which can be observed around the world, can be seen as a process of transition from agriculture-dominated economy to industry-dominated economy through the so-called "urbanization process," which is caused by the concentration of populations in urban areas.

Thus, the urbanization process[3] is closely linked to economic development. There are two keys issues involved in this process. The first is urbanization itself (hereafter, urbanization) and the second is urban concentration by which a degree of urban resources is concentrated in one or two large metropolitans rather than spreading over many cities. The first footstep of the urbanization process starts with urbanization whereby it leads to urban concentration. In addition to the existence of cities, the agglomeration of production and consumption in urban areas caused by the urbanization process has several effects on economic, social, and environmental issues.

Currently, the status of total urban population accounts for about 50% of the world population. In fact, on average, the more urbanized countries (developed countries) will have 75% of their total population living in urban areas whereas the less

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[2] See the PRSP sourcebook by the World Bank
[3] Details on this are overviewed in the literature review chapter.

urbanized countries (developing countries) account for only 30% of the total population residing in urban areas.[4] Therefore, the condition of better human well-being seems to be associated with higher urbanized areas.

There are two groups of economists concerned with the urbanization process: Traditionalists and Modernizers. Traditionalists are concerned the consequences of urbanization policies, which produce an over- urbanization process that negate economic development, while Modernizers claim that urbanization processes involve creating economies of scale that enhance productivity levels and provide better and cheaper goods and services. The conflicting viewpoints among economists remain, and deserve increasing attention.

Both theoretical and empirical questions have inquired as to whether urbanization would assist poor people. Over the decades, the World Bank and its members have been asked as to find the optimal level of urbanization in which to promote poverty reduction. The literature on urbanization processes has examined and been concerned with the effect of urban concentration on poverty. Only a scant number of researchers have paid attention to how urbanization alleviates poverty from the economic development point of view. In other words, there has been little research on the economic relationship between urbanization and poverty in both theoretical and empirical analyses. Therefore, some of the missing links between urbanization and poverty can be expanded and explored in this dissertation so that it will assist policy makers in producing proper policies of urbanization for poverty reduction and in understanding the phenomena of economic development to poverty outcomes.

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[4] Calculations from the World Urbanization Prospects: The 2005 Revision by the United Nations (http://esa.un.org/unup: accessed March 2006).

The Need for Theoretical Analysis

A variety of theoretical frameworks on poverty reduction have been indirectly explored in various fields of economics such as economic growth, wage differentials, and demographical transitions. For economic growth, Becker et al. (1992) provide the so-called BWM Model. The BMW model is a dynamic computable general equilibrium model that blends a branch of economic fields such as public finance and trade into general equilibrium for the Indian economy. Theoretical works by Henderson (1988), Faria et al. (1996), and Bertinelli and Black (2004) show the dynamic path of economic growth involved by urbanization.

The seminal work of Tadaro (1969) and Harris and Tadaro (1970) examined an incentive to migrate based on wage differentials between urban and rural earnings that cause urbanization. This model later became known as the H-T Model. Several recent works extend the H-T model to commodities such as land (Brueckner and Zenou 1999) or infrastructure (Issah et al. 2005). Similarly, the impact of population change through migration on economic growth has been explored by Zhang (2002). Although the literature has examined the effect of urbanization, the majority of studies are based on migration. Therefore, these works do not examine the impact of urbanization on human development and well-being for the poor. Also, they do not explore the role of institutions such as governments in pushing urban and rural populations for a higher standard of living.

In Chapter III, we depict two theoretical models. The first model extends the Devaranjan et al. model by introducing a new parameter representing urbanization. In this respect, the role of government budget constraints has been involved in enhancing basic public infrastructure to meet basic living requirements. The second model builds upon the first model in this chapter by introducing urbanization into poverty in order to examine the effect of urbanization on the sources of pro-poor growth that help the poor escape from poverty. Both models share the outcomes of poverty reduction based on the potential mechanism of urbanization.

The Need for Empirical Analysis

From our theoretical models, we draw a relationship between urbanization and poverty by introducing the variable of urbanization, which has an effect on the poor's income and basic infrastructure. The empirical work examines the underlying poverty reduction outcomes from urbanization. Previous empirical works in the literature examine the effect of the concentration of population on a variety of poverty dimensions.[5] In this dissertation, we penetrate those poverty measurements into a commonly used indicator for poverty. The Human Development Index (HDI)[6] is used in this study because it is one of the most insightful indicators in revealing the development of human well-being dimensions (i.e., reduction in poverty).

In this dissertation, we do not only examine the direct relationship between urbanization and poverty for non-monetary poverty dimensions (the HDI), but also depict the urbanization effect on pro-poor growth for monetary poverty dimensions. Our empirical analysis also involves incorporating important roles such as institutions, international trade, and demography, which are related to urbanization, into poverty reduction outcomes analysis. In addition, we also investigate the effects of urbanization

[5] See Chapter II for the review of literature.
[6] See Chapter II for details.

through the potential transmission channels on poverty reduction outcomes such as basic education, health care, and a decent standard of living, which is realized through productivity. Built on our framework analyses, the specifications of these empirical models will be shown in the following chapters and will enable us to reveal a missing connection in the existing literature while also allowing us to deal with empirical econometric issues.

Overview of the Dissertation

The remainder of this dissertation is organized as follows: Chapter II presents an overview of definitions, poverty dimensions used in previous studies, and pro-poor growth sources as well as a brief on the urbanization process in economic development. This will be followed by the literature review. Chapter III will develop the theoretical model and then be followed by the methodology for empirical estimations and data in Chapter IV. The presentation and discussion of the estimation results will be revealed in Chapter V followed by the conclusion in Chapter VI.

CHAPTER II

LITERATURE REVIEW

The structural changes of economic development, like urbanization, create a connection with ways in which to conquer poverty and further increase the standard of living. This chapter presents a conceptual framework and a survey of theoretical and empirical literature that provides a background in order for us to connect previous findings with this study's goals. A review of the literature reveals some meaningful findings that are crucial to the following discussions, and we are further able to comprehend the economic impacts of urbanization on poverty in several aspects.

The outline of this chapter is as follows: The first subsection reviews the conceptual frameworks of poverty as well as some key factors that cause poverty. In addition, the definitions and measures of poverty normally used in academics are also included. The second subsection presents definitions and characteristics of growth helping the poor or "Pro-poor Growth." In the third subsection, we briefly review the process of urbanization and its advantages and disadvantages are discussed and broadened into its effects. Finally, in the last subsection, we survey the previous literature, which is based on monetary and non-monetary dimensions of the urbanization effect into different dimensions of poverty. These studies combine various results in order to diversify the past and compare it to present phenomena and future events. The reviewed studies in this subsection are useful for a base in developing our model, and these are then extended to the frontier of the dissertation, theoretically and empirically.

Concepts of Poverty

The Conceptual Framework

Poverty encompasses broad definitions that link to a situation of being poor in a variety of dimensions. Its multi-dimensions can be parsimoniously defined and measured in many ways. First, poverty may be analyzed through objective and subjective approaches. The objective approach involves normative judgments as to what constitutes poverty and further, what required assistance may involve when moving people out of impoverished states. We may also consider this perspective as the welfare approach. The subjective approach attempts to place a premium on people's preferences by how much they value goods and services, i.e., we can consider this perspective as the individual utility approach. Conventionally, poverty measurements gain more weight within the objective approach. Only in recent years has there been some interest paid to measurements concerning the subjective approach.

Second, poverty measures can be captured by physiological and sociological deprivations. The former is based on a person's lack of income and basic needs such as food, clothing, or shelter. The latter is based on underlying structural inabilities and inherent disadvantages. This means that there are external impediments such as being individual handicaps (having bad health or poor education) and not having enough infrastructure or land. In other words, this categorized concept can be considered as causes of poverty

Finally, we review a poverty dimension as absolute and relative poverty. Broadened meanings have gradually expanded from a minimum subsistence level to a relative deprivation level. In this respect, poverty can be evaluated from an absolute level to a relative level. The former level shows how a person makes at least a living for human life, while the latter level expresses how a person maintains as good as a standard of living for daily life. Absolute poverty refers to lower level requirements in terms of subsistence, necessarily established based on nutrition, socially acceptable living conditions, and other indispensable goods. Absolute poverty can not be only given in terms of food, drinking water, shelters, and health/education facilities, but also provided in forms of having risk, vulnerability, powerless, or lacking of voice/freedom.

Relative poverty is a comparison between the lowest segment of the population and the upper segments of the population on which it is usually measured by either income quintiles or deciles. For instance, a person is absolutely poor if his/her income is less than the defined income poverty line, while that person is relatively poor if he/she belongs to the lowest income strata, for example, the poorest 10 percent of the population.

Although absolute and relative poverty can be positively correlated with each other, they may also move in opposite directions. For instance, when absolute poverty increases, relative poverty may decline. Because the gap between the upper and lower strata of population is smaller by a decline in well-being of relative poverty, at the same time, additional households may fall beneath the absolute poverty line. Note that the poverty line has been constructed by the World Bank in order to define a state of poverty, which is based upon consumption ability.[7] The value of the poverty line varies in different regions, for example, Africa, which is usually set at U.S. 1$ (1993 PPP$) a day per person or Latin America, which is set at U.S. 2$ (1993 PPP$) a day per person.

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[7] See the 1990 Poverty World Development Report (WDR).

It is important to note that Sen (1993) points out that absolute poverty can be employed in the capability space, which usually shows the relative character of poverty. For example, a household, which is incapable of obtaining sufficient commodities, can be considered as absolutely poor. However, relative factors such as households across different groups and regions may be taken into account to establish absolute poverty.

In addition to expanding poverty concepts, other concepts can be linked with poverty such as inequity, vulnerability, exclusion, and underdevelopment. Inequity indicators characterize different situations of poverty. The identification of inequity has been developed in different ways: the disaggregation between groups of population such as gender, race, and so on; the association with distributional measures, for example, the Lorenz curve and the income distribution; and the use of mathematical approaches such as the Atkinson index (Atkinson 1970). Vulnerability reveals the inabilities of the poor to cope with external risk, shock, and internal defenselessness. Exclusion emphasizes how social deprivation hampers people from fully participating in social activities. Underdevelopment also shows how much people lack progress to alleviate deprivation and lack of human development.

Measuring Poverty

Poverty reflects the state of being poor, and it can not only be identified by the monetary dimension, but also by the non-monetary dimensions.[8] The monetary dimension is considered as “money” income, and it is quantitative information, while the non-monetary dimensions are generally regarded as qualitative information. In the following paragraph, we expand on these two concepts.

[8] See the 2000 Attacking Poverty World Development Report (WDR).

(1) Monetary Dimension

This approach of poverty measurement considers circumstances in which both individuals and households are impoverished; that is when their consumption or income falls below a certain threshold level, which are usually defined as a minimum, social acceptable level of well-being by a group or population. Since consumption and income provide different information on poverty, there is controversy whether consumption or income is a better measure of poverty. From existing empirical evidence, if the survey had done enough on households' consumption data, consumption would tend to provide a more accurate condition of poverty (Kakwani et al. 2004; Kraay 2006). Income measurements have several distinct disadvantages such as: acquisitions, which pertain to price and commodity differentials, will tend to overstate or understate the true value of the income measure; the problem of the exclusion of certain goods will not be directly reflected on the income indicator; and the omission of other factors such as time required to access a good will reduce an individual's ability to meet current needs. However, income measurement also has its advantages, in particular, that it is easier to measure and calculate than consumption. Nevertheless, when both income and consumption are available, the analyst should compare both measurements side by side.

To quantify the monetary dimension, the commonly used measures for poverty are the followings:

- Headcount Index (HI)

The HI is simply the proportion of population that is poor as the percentage of the population living below the certain threshold, i.e., people with their income or consumption below the poverty line or, in short, the incidence of poverty. The poverty line is established by costing a minimum basket of essential goods for basic human well-being. The disadvantages of this index are that the index is not able to display the severity degrees of poverty and the distribution among the poor themselves. The formula of HI is as follows:

$H = \frac{q}{n}$ where q is the number of poor and n is the total population.

- Poverty Gap (PG)

The PG is proposed as an alternative index, which is further developed to answer a missing part in the HI. The PG index measures the degree of how the mean aggregate income or consumption of the poor differs from the established poverty line, i.e., the depth of poverty. The PG formula is as follows:

$PG = \frac{1}{n}\sum_{i=1}^{q}\frac{z-\mu_i}{z}$ for $\mu_i < z$; where μ_i is the income of the i^{th} poor person and z is poverty line.

And PG can also be expressed in terms of the headcount index as:

$PG = H$ where $I = \frac{Z-\mu^*}{z}$ is the income gap of the poor in which μ^* is the mean income among the poor.

- The FGT index of poverty

Foster, Greer and Thorbecke (1984), hereafter FGT, propose another alternative index that combines the properties of the two previous indices by adding in a new consideration: the severity of poverty, into the FGT index. The formula of FGT is as follows:

$$P_\alpha = \frac{1}{n}\sum_{i=1}^{q}\left[\frac{z-y_i}{z}\right]^\alpha$$

where y_i is the income of the i individual ranked in increasing value of income; q is the number of poor; n is the total population; and α is the aversion coefficient for poverty.

An increase of α means that more weight is given to the poorest, i.e., those are further away from the poverty line. Note that when $\alpha = 0$, P_α is the headcount index (HI); when $\alpha = 1$, P_α is the poverty gap (PG); and when $\alpha = 2$, P_α is the square poverty gap (SPG). The SPG index means that the distributional measure captures differences in income levels among the poor, i.e., the severity of poverty is to reflect inequality among the poor.

- Sen's poverty index

Sen (1976) argues that neither HI nor the income gap measures reflects the intensity of poverty. The accurate poverty index should reflect a transfer of income among the poor that should be taken account into the aggregate poverty index. For example, income transfer among the poor can move a transferred person above or below the poverty line; this distribution then should reflect the relative position of that person in the reference group of the poor. To satisfy this requirement,[9] Sen proposes a measure of poverty that includes the distributionally sensitive aspect by holding these two axioms: (i) Monotonicity: given other things equal, a reduction in income of an individual below the poverty line must increase the poverty measure. (ii) Transfer: other things being equal, a pure transfer from a person below the poverty line to anyone who is richer must increase the poverty measure.

[9] See Sen (1976) for details.

The expression of Sen's poverty index is given as follows:

$P = H\left[I + (1-I)G^{*}\right]$ where H is the headcount index; I is a per-person percentage gap (income-gap ratio); and G^{*} is the Gini coefficient of the income distribution of the poor.

However, note that there are several disadvantages to Sen's poverty index. First, Sen's poverty index concerns only a large group of the population. When there is a merge of two or more identical groups of population, the value of the index will not represent replication invariant. The second is that this index is not a continuous individual income function. Based on a discrete individual income, if the income of a person increases above the poverty line, the value of this index will reveal a lack of continuity.

- Watts' poverty index

Watts (1968) reasons that the welfare of households should be normally divided into two attributes: that of human and non-human wealth. Human wealth refers to intangible abilities and social status, while non-human wealth refers to common income sources. The formula of Watt's poverty index is given as follows:

$W = \frac{1}{N}\sum_i \log\left(\frac{z}{y_i}\right)$ where z is the poverty line and y_i is a composite of human and non-human wealth.

Note that Watt's poverty index has recently become less popular mainly due to the difficulties involved in its calculations. For example, attributes, especially human wealth, must be positive and non-zero values only in order to compute the index.

Further, as seen in previous works, such as the Normalized Deficit index (Watts 1968) and Clark et al. (Clark, Hemming, and Ulph 1981), the measure of calculations and explanations are not as simple as the above indices reveal, thus, alternative approaches have not been treated well within the literature.

(2) Non-monetary Dimensions

Although money or income is an excellent quantitative indicator, non-monetary indicators are still crucial to assess poverty in terms of the level of human well-being. This dimension of measuring poverty is based on outcomes with respect to education, health, nutrition, sanitation, vulnerability, and other social indictors of human well-being. In some cases, we can feasibly employ the non-monetary dimensions to link with the monetary dimension. For example, a given individual has a lower level of basic needs than a threshold line, i.e., the poverty line, and then we can conclude that he/she is poor. From various non-monetary indicators, we briefly recognize three important poverty aspects:[10] (i) Health and nutrition poverty is concerned with the health status of an individual in a household, such as life expectancy or incidences of diseases. (ii) Education poverty is concerned with the basic provisions needed for education levels such as the number of schooling years or literacy levels. (iii) Composite indices of wealth recognize poverty indicators other than the above two, such as civil rights or other vulnerabilities.

The most commonly used measures of non-monetary indicators[11] are the Human Development Index (HDI), the Human Poverty Index (HPI), the Gender-related Development Index (GDI), and the Gender Empowerment Measure (GEM).

[10] See the PRSP sourcebook for details.
[11] See the 2000 Human Development Report (HDR) for details.

- The Human Development Index (HDI)

The HDI, which was developed in 1990 by the United Nations Development Programme (UNDP), is a comparative measure of average achievements of human development for a country. The index relatively rates on a scale of zero to one and is based on equal weighting (one- third weight) of the following basic elements: (i) A long and healthy life measured by life expectancy at birth. (ii) Knowledge calculated by the combination of the adult literacy rate and the combined primary, secondary, and tertiary gross enrollment ratio. (iii) A decent standard of living assessed by the Gross Domestic Product (GDP) per capita at Purchasing Power Parity (PPP) in U.S. Dollars.

It is important to note that, in some cases, the HDI cannot accurately reflect human development due to its normalization assumption. For example, China, during the 1990s had very high GDP per capita, but the adult literacy rate was lower than the rate of GDP per capita. This implies that GDP per capita could be overwhelmingly weighting education aspects.

- The Human Poverty Index (HPI)

The HPI assesses deprivation of human well-being in segments of the population. This index emphasizes only health and education aspects. Typically, the HPI recognizes two different types: the HPI-1 and the HPI-2.

The HPI-1 is used for developing countries. The index is normalized in terms of percentages between 0 and 100 and equal weights based on three basic aspects: (i) A long and healthy life – vulnerability to death at a relatively early age as measured by the probability at birth of not surviving to age 40. (ii) Knowledge – exclusion from the world of reading and communications as measured by the adult illiteracy rate. (iii) A decent standard of living – lack of access to overall economic provisioning as measured by the unweighted average of two indicators (the percentage of the population without sustainable access to an improved water source and the percentage of children under weight for their age).

The HPI-2 is used for selected OECD countries. The index uses the same components as the HPI-1, and it also includes social exclusion. The index value also rates on a scale between 0 and 100. The four basic aspects are equally weighted: (i) A long and healthy life – vulnerability to death at a relatively early age as measured by the probability at birth of not surviving to age 60. (ii) Knowledge – exclusion from the world of reading and communications as measured by the percentage of adults (aged 16–65) lacking functional literacy skills. (iii) A decent standard of living measured by the percentage of people living below the income poverty line (50% of the median adjusted household disposable income). (iv) Social exclusion measured by the rate of long-term unemployment (12 months or more).

- The Gender-related Development Index (GDI)

To differentiate the index by gender, the GDI adjusts the average achievement to reflect inequalities between men and women. The index value rates on a level from zero to one, and it is calculated by equally weighing the following components: (i) A long and healthy life measured by life expectancy at birth. (ii) Knowledge measured by the adult literacy rate and the combined primary, secondary and tertiary gross enrollment ratio. (iii) A decent standard of living measured by estimated earned income (PPP$).

- The Gender Employment Measure (GEM)

This index concentrates on female opportunities rather than capabilities. The value of index rates on a scale of zero to one, and it is calculated from equally weighting gender inequality in three key aspects: (i) Political participation and decision-making power measured by women's and men's percentage shares of parliamentary seats. (ii) Economic participation and decision-making power measured by two indicators (women's and men's percentage shares of positions as legislators, senior officials, and managers, and women's and men's percentage shares of professional and technical positions). (iii) Power over economic resources measured by women's and men's estimated earned income (PPP$).

Pro-poor Growth

Since the claim that economic growth can reduce poverty has been argued among economists (Ahluwalia, Carter, and Chenery 1979; Kakwani 1993; Kakwani and Pernia 2000; Dollar and Kraay 2002; Ravallion 2004; Lopez and Serven 2006), pro-poor growth has recently been merged into discussions of economic development policies. Pro-poor policies reflect the concept of pro-poor growth in such a way that the poor are given attention in policies and programs, which seek to alleviate inequalities and to facilitate income and employment generation. Recent research from Kakwani and Pernia (2000), Ravallion and Chen (2003), Ravallion (2004), and Son and Kakwani (2006) have discussed definitions of pro-poor growth to identify the links and benefits from growth to effective growth for the poor. Even the characteristic of pro-poor growth are very broad; briefly speaking, growth is pro-poor only if the poor are promoted in order to have a higher growth rate of incomes than those of the non-poor.

Naturally, market mechanisms will let the rich proportionally exploit their economic advantages better than the poor such as human or capital investment. If it proceeds without government interventions, the gap between the rich and the poor in a market economy becomes persistent and larger over time. Therefore, a strategy used to reduce this gap is based upon favoring the poor. As pro-poor growth starts accelerating, the poor will proportionally benefit more than the non-poor. Pro-poor growth does not only reduce the incidence of poverty, but also enables the bottom group of income distribution to consume more and to access to the basic services that meet the minimum standard of living such as health and education facilities. Tanzi (1974) and Corbacho and Schwartz (2002) point out that the fiscal budget plays an important role in helping the poorest people at the bottom of income distribution. Government expenditures must be spent on basic services such as education and social welfare to directly reach the poor.

It is important to note that the source of pro-poor growth is a common feature of pro-poor studies. Economic growth synchronously reflects on poverty within two facets. Economic growth stimulates greater poverty reduction while also increasing the gap of inequality. Kakwani (1993) and Kakwani and Pernia (2000) point out that sources of pro-poor growth materialize when income for the poor increase into average incomes. Kakwani et al. (2004) have conceptualized pro-poor growth by introducing the Poverty Equivalent Growth Rate (PEGR). The PEGR will result in the same level of economic growth, but not accompany changes of inequality. This pro-poor growth measure similarly follows the analytical analysis in Kakwani and Pernia (2000).

Kraay (2006) analogously represents the sources of pro-poor growth and how to measure pro-poor growth, i.e., what kind of growth can reach and help the poor. There are two sources of pro-poor growth: the first is direct economic growth that increases incomes of the poorest group in the income distribution, and the second source is poverty sensitivity to growth, for example, if incomes of the poorest grow faster (i.e., more sensitive) than average incomes, then poverty will decrease at a faster rate.

The implications of pro-poor growth are obviously linked to poverty reduction policies that attempt to enhance the state of human well-being and to increase the consumption power of the poor. A basket of pro-poor growth policies carry institutional and political implications: from a macro perspective, government spending and budget allocations for infrastructure on urban areas are proportionally comparable in rural areas whereas from a micro perspective, issues arise such as the removal of a monopoly from power, the fairness of market competition, or subsidies for the poor in public health services.

The Process of Urbanization

As mentioned earlier, the urbanization process is comprised of urbanization and urban concentration. Urbanization can be seen as the first step prior to urban concentration, and it needs to be emphasized for this research. However, there is also a necessity to overview the complete urbanization process such that we are able to present a clearer view of urbanization itself. The urbanization process presents both costs and benefits concerning economic and financial issues. A movement toward increasing productivity and economic efficiency may reflect beneficial results for the urbanization process. Another necessary and crucial component of economic development is the costs of urban growth because there are fiscal burdens that a government faces when it invests in infrastructure to meet rapidly changing basic needs, such as sanitation and electricity

(Linn 1982; Richardson 1987). These investments will be costly from an overall macroeconomic perspective because they are also associated with opportunity costs, which may retard economic growth elsewhere in an economy. For efficiency purposes, urbanization process costs can be considered as economic externalities such as those associated with pollution and congestion.

The gradual pace of the urbanization process may allow time for political and economic institutions and market instruments to develop because these mechanisms are essential to efficient urbanization processes in order to promote proper economic development. But, along with the rapid urbanization process, undesirable effects can be found in the form of both social and economic problems. In particular, the urbanization process can not only lead to an uneven income distribution among urban population or between rural and urban populations, but may also produce an uneven city-size distribution among cities or between rural and urban areas. In a city, the incidence of urbanization on poverty and unemployment can represent significant problems, as reflected in Ravallion (2001).

Although costs of urban living are expensive, urban wages are usually higher than rural wages. The motivation of migrants from rural to urban areas results in a net benefit gain because of higher salaries, and then a massive number of excessive low-skilled and unproductive workers who migrate will be seeking job opportunities in urban areas. Formal job sectors (such as firms or industries) can absorb this type of labor at a certain level, while an unabsorbed number of low-skilled and unproductive laborers will turn to informal job sectors such as minimum-paid jobs or low-paid daily work. With minimum payment and without skill improvement, these people will become the majority share of urban poverty. In fact, the urban share of the poor will lead to a decreased quality of daily living and larger inequity among urban populations. Meanwhile, it will tend to retard economic development in terms of higher public spending burdens and lower fiscal revenues such as those associate with higher tax administration cost.

Internationally, the rapid urbanization process has been more likely to create a few gigantic cities as opposed to a network of cities, which is likely to be evenly distributed. In developing countries, spatial concentration is mainly dominated by population and capital in the capital city or main port cities. In Williamson's Hypothesis,[12] the degree of urban concentration will slowly associate with economic development at the initial stage, and then the rate of degree of urban concentration will increase in the middle stage. At the last stage, the rate of degree of urban concentration will decline again. This relationship looks like a "S" shape. The concentration of urban-bias population and capital will continue for a long period in the second stage. Various studies (Ades and Glaeser 1995; Gallup et al. 1999; Henderson 2003) find that urban concentration associates positively with economic growth.

A primate city (the largest city's urban population in the national population, such as the capital city), with marginal costs over marginal benefits may keep growing without suburbanizing and diversifying to the contiguous areas or other cities. As a result, rural areas will be paid less attention and is thought to subsidize urbanization costs as economic development proceeds. Under these circumstances, uneven income and city-size distribution between rural and urban areas generally create a larger gap with very slow convergence between the two areas.

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[12] See Williamson (1965).

However, the urbanization process may also be beneficial in that it not only contributes to economic development by increasing efficiency and outputs (economic growth), but also has the potential to sustain an indispensable interaction between rural and urban areas (large, medium, and small cities). There are benefits in the short and long-term. In the short term, efficiency is embraced through shifting unproductive rural labor to a city, firm, or cluster, thus producing the first benefit of economies of urbanization called “the localized external economies of scale.” This location advantage generates consumption and production needs, and leads to higher productivity that will allow higher wages to be paid to the new urban labor force. As income rises, savings tend to increase, while capital accumulation accelerates. Furthermore, the agglomeration of clusters in a single urbanized area will diversify many specializations and productivities from different clusters. Labor pooling and intermediate goods and services are produced to serve economic development: this is called the second benefit of economies of urbanization or “the urbanized external economies of scale.” A government will seek to meet the requirements to properly suit the movement of the economy and the link between rural and urban areas. The localized and urbanized economies of scales will lead to higher income and better health care, education, and public services at least in urban areas, while the side effect of urban economies of scale will more or less expand into rural areas, such as a higher demand for non-urban products (agricultural products) or an improvement of public services.

In the long term, through rural-urban migration, the population is attracted to job opportunities in the urbanized areas. Population density may continue to rise, and the price of land and the cost of living in urban areas will increase. The marginal benefit of economies of scale diminishes as population grows. Firms and manufacturers in large cities will see their profits and the demand of goods offset by a higher cost of production from transportation and infrastructure congestions. They will try to lower those costs by moving their production lines to medium or small cities instead. In medium and small cities, standardized goods will be produced and distributed to the large cities, while the large cities will be left with the services and innovative firms that are important to economy such as financial institutions. The urbanization process will shift to the satellite cities and disperse the size distribution among urban areas as well as between rural and urban areas.

Since agricultural sectors are located in rural areas, the effect of the urbanization process spills over to the suburb or rural areas. Low-skilled rural laborers do not only receive more education from public spending to serve urban growth, but also are forced to learn and practice skilled jobs in order to benefit from the change in technology and rural commodity productions so that the spillover effects may raise their incomes. As the use of labor is reduced by technology replacement, rural commodity productivity tends to be higher. Rural areas will reap the benefits from the urbanization process through higher income share and better education as well as basic provisions.

In addition, we realize that the urbanization process is a pattern of economic development, which comes with the transition from rural agricultural to urban industrial and economic activities and labor. Specifically, urbanization may be considered as the interdependent economic process via industrialization that has the characteristic of absorbing the excessive release of unproductive labor forces from rural areas. Thus, urbanization and industrialization are twin mechanisms that shape economic growth.

However, the causality of this relationship remains open for extensive discussion. For example, on the one hand, Kim (2005) finds that the adoption of the steam engine, which was the force of industrialization, among U.S. cities from 1850 to 1880, did not substantially contribute to urbanization. On the other hand, Rosenberg and Trajtenberg (2004), conclude based on the similar data set that the steam engine was always a catalyst for urban population growth.

To reduce the ambiguity of urbanization and industrialization, we concede that people were originally dispersed in these areas and that there is no significant concentration, such as in the rural areas. Urbanization will form a concentration as in urban areas in order to exploit agglomerative economies of scale. For economists, the goods produced in both areas will be categorized themselves by the nature of goods such as land uses or factors of production. On the one hand, urban areas are not suitable for agricultural products, which are usually produced in rural areas, because these products are more dependent on the environment such as rainfall, soil, and so on. On the other hand, rural areas are not suitable for producing non-agricultural products, which are major goods leading to industrialization and are less dependent on labor-intensive production.

Such transitory transformation shifts not only economic activities from the rural-agricultural base to the urban-manufacturing base, but also population from a rural environment to an urban environment is directed by government policies and market institutions. For the urbanization process, many studies have focused on the issue of urban concentration, rather than urbanization. Note that the degree of urbanization is represented by the percentage of urban population relative to the national population (i.e., the urban percentage), and the degree of urban concentration is commonly measured by the percentage of largest city's urban population in the national population or so called "urban primacy."[13]

In this dissertation, we place an emphasis on urbanization in that it is a crucial part of the urbanization process. Urbanization reflects a level of economic development, which is directly related to the ultimate objective concerning human well-being and development.

The Existing Literature on Urbanization and Poverty

In this subsection, we start reviewing the causes of urbanization and place it within the previous theoretical literature in order to understand how urbanization affects poverty. The seminal and extended literature is presented both from monetary and non-monetary dimensions. Next, we review evidence from the existing empirical literature and draw a relationship between urbanization and poverty using both international data and country case study data. Finally, we briefly summarize what we have learned from the literature.

Theoretical Literature

The early studies on urbanization focused on rural-urban migration that initiated the urbanization process. The conceptual framework is based on the wage differentials between different geographical areas. Later, several economists spotlighted the migration

[13] There are two other alternatives to measure urban concentration: the Hirschman-Herfindahl concentration index that is the sum of squared shares of every city in a country in a national urban population, and Zipf's Law by Gabaix (1999), that a country is ranked by cities from largest (rank 1) to the smallest, and then this ranking, which is multiplied by population size, will approximately provide the same constant for all cities.

concept concerning the environment, amenities, and additional factors were incorporated into economic models, as discussed in the non-monetary dimensions.

Basically, the literature identifies three main causes of urbanization: a natural increase in urban population; the reclassification from rural to urban areas due to a natural increase of population; and rural-urban migration. A natural increase of population and the reclassification from rural to urban areas have few significant impacts on the economy. The key factor is rural-urban migration that can be observed in developing countries. The seminal work on rural-urban migration can be dated back to Tadaro (1969) and Harris and Tadaro (1970).

The Harris-Tadaro (H-T) model divides an economy into rural and urban economies and attempts to explain an incentive to migrate by using expected income wages in urban areas compared to agricultural wages in rural areas. If urban wages are higher than agricultural wages, migration will move into urban areas, i.e., the transition from agricultural sectors to industrial sectors following the process of economic development. Relative wages are initially caused from the difference in the price of goods between rural and urban products. The literature reveals that rural-urban migration is promoted by government policies and depicts the existence of high rates of unemployment in urban areas. However, the H-T model theoretically implies that a migration equilibrium condition will equate both wages.

The basic H-T model is further extended in order to investigate the dynamics of urban wages and migration by Krichel and Levine (1999). The role of land capital is also incorporated into the extended H-T model in order to examine the equilibrium of urban areas that will affect efficiency wages (Corden and Findlay 1975; Brueckner and Zenou 1999; Brueckner and Kim 2001).

Furthermore, Ravallion (2001) constructs a theoretical representation of the urbanization of poverty on which the incidence of poverty is linked to the urbanization level. The model applied to developing countries reflects an increasing convex function of the share of the poor who live in urban areas. He concludes that under certain circumstances, a higher level of urbanization does affect the increase of the urban share of poverty. Although, urbanization may soothe national poverty conditions in both urban and rural areas, poverty becomes more urbanized in urban areas with a given increment of the urban population as well as those reflected in Ravallion et al. (2007).

In light of non-monetary dimensions, Issah et al. (2005) also expands the H-T model with other exogenous variables. This work extends the H-T model into the effect of urban infrastructure and amenities for urban immigrants. The Issah et al. (2005) theoretical results show that an increase in urban infrastructure has a positive impact on manufacturing employment sectors of urban employment. The model also shows an ambiguous impact on employment in the informal sector of urban employment. For example, an increase of urban infrastructure has an ambiguous impact on rural employment such that the improvement of urban infrastructure might possibly bring immigrants from rural sectors, but there is no guarantee.

Synchronically emerging with migration concepts, considerable effort has gone into examining the effect of the urbanization process on dynamic economics processes and economic growth. Although in recent years there have been a large number of studies dealing with the relationship between economic development (Gross domestic

Products: GDP, Gross National Products: GNP, and economic growth) and urbanization, there is little direct exploration of the link between urbanization and poverty as follows:

Bertinelli and Black (2004) construct a model that focuses on urbanization with the simple dynamics of rural-urban migration with human capital investment in an economy with a single urban locale. The benefits of agglomeration of human capital in urban areas will generate the technological knowledge process that directly promotes economic growth. Furthermore, the impact of policies that attempt to retard urbanization will cease economic growth because these policies are designed by a short-sighted policy planner. Similar results are found in Faria and Mollick (1996).

Tolley and Thomas (1987) and Polèse (2005) demonstrate the positive impact of urbanization on economic growth and explain the equalization of real earnings between rural and urban areas. The improvement of labor skills and technology play a crucial role. As urbanization proceeds during development, the use of technology will improve skills for both low-skilled and skilled laborers. The rise in the wage rate will speed up so as to catch up with the upward shift in urban productivity. Hence, the upward shift of marginal urban productivity is a source of economic growth.

Empirical Literature

Moomaw and Shatter (1993) use international data between 1960 and 1985 to estimate the regression between the rate of economic growth and the urbanization process including urbanization itself, metropolitan concentrations, and urban primacy. Using Ordinary Least Square (OLS) and based on endogenous growth theory, their findings show that urbanization has no effect on economic growth. Metropolitan concentration substantially drives growth, while urban primacy is negatively associated with growth. They conclude that the pattern of urbanization processes contribute to economic development. Concentrations in larger cities provide the force with which to accelerate economic activity but reason that the primate city impedes growth.

In a similarly inspired study, Jones and Kone (1996) investigate two empirical evidentiary cases: the U.S. and 113 countries. Their results show the strong relationship between levels of per capita GDP and the percentage of population living in urban areas, thus finding a significant relationship.

More recently, Henderson (2003) examines the effect of the urbanization process on economic growth by using international panel data. Having applied the dynamic panel GMM technique, the empirical evidence shows that there is little support for the idea that urbanization drives growth. The results conclude that urbanization is just a “by-product” of industrialization by moving out of agricultural sectors and developing into manufacturing sectors. The impact of urbanization is positive, but weak on economic development. In contrast, urban concentration shows a strong association with economic growth. His study concludes that there is a best degree of urban concentration (measured by urban primacy) that will effectively promote the productivity growth rate. Apparently, Appleton et al. (2006) demonstrates the poverty situation (defined by the 1 PPP$ poverty line) from the 1988-2002 urban survey data in China. Because of increasing urban resident registrations, the study points out that income for the poor rose and absolute poverty in urban areas was driven out by economic growth. China’s economic growth has a significantly positive effect on its standard of living across the income strata.

Conversely, some economists econometrically delineate the effect of economic growth on urbanization. Wheaton and Shishido (1981) estimate the effect of the level of economic development on a measure of urban concentration in 38 developed and developing countries. The results demonstrate that urban concentration plays an important role for stimulating economic growth. There is an optimal degree of urban concentration found at a certain level of development. Moomaw and Shatter (1996) and Davis and Henderson (2003) find empirical evidence by utilizing cross-country panel data. They depict a strong and positive relationship between populations living in urban areas and economic growth (income per capita). The agricultural sector share on GDP has a negative coefficient, while the manufacturing sector share of GDP has a positive coefficient. Using dummy variables, the results show that different regions around the world will have different structural changes of urbanization.

Furthermore, Davis and Henderson (2003) also find that the logarithm form of national urban population is an increasing concave function of the logarithm form of income per capita. The functional relationship between national urban population and income per capita could be expressed by the concave function. Their findings also indicate that there is no “S-shape” relationship between income and urban concentration. However, unlike urban concentration, the percentage population living in urban areas is linked to the logarithm form of income per capita in a linear form.

Fay and Opal (2000) utilize an econometric model to examine the pace of urbanization in Africa. The trend of urban population has been increasing in the past few decades. Unlike other countries, urbanization in African countries has not been accompanied by economic growth. Their findings show that although urbanization has proceeded, economic growth remains negative. According to Easterly (1999), the absent links between urbanization and growth may be explained by a long and variable lag between growth and changes in the quality of life. The socio-economic progress factors in developing countries may also retard growth.

Although there are several works exploring urbanization effects on the monetary poverty dimension, the empirical works have only recently paid more attention to the non-monetary dimensions, such as basic needs and services. The main difficulty of these works have faced is that non-monetary dimensions are not only complex and multifaceted, but also more difficult to measure than the monetary dimension. However, there are several works that attempt to examine the potential linkage between urbanization and non-monetary poverty dimensions. Pham (2001) suggests that the cause of migration does not only depend upon only wage differentials but that basic needs and services are also involved in rural-urban migration decisions. Thus, the attractiveness of urban infrastructure should be taken into account in order to understand migration.

Issah et al. (2005) econometrically show that the provisions of infrastructure in Ghana, such as water and electricity, strongly promote the effect of rural-urban migration. Hence, there is a necessity for government parts to distribute sufficient infrastructure in urban and rural areas to control the level of urbanization. Jayasuriya and Wodon (2002) examine country efficiency in health and education indicators. They used international panel data together with a stochastic production frontier estimation method to compare the impact of the level of public spending on education and health outcomes as well as the efficiency in public spending. They find that urbanization and the quality of the bureaucracy are strong determinants of the efficiency of countries in enhancing education and health outcomes, while the impact of corruption is not statistically significant. However, these three variables only explain half the variation in efficiency measures between countries.

Similar results are found by Liu et al. (2003) and Dreze and Murthi (2001). The former concludes that urbanization is positively associated with substantial changes in rural health and insurance status in China. The latter finds that for India, urbanization can improve the literacy rate, but has no significant effect on fertility.

Ramadas et al. (2002) study the SimSIP (Simulations for Social Indicators and Poverty) that is a set of user-friendly Excel-based simulators that facilitate the analysis of issues related to social indicators and poverty. Their results are likely to run in tandem with Wodon and Ryan (2002). Such urbanization is an important determinant of non-monetary indicators of well-being at the national level, including education (literacy and school enrollment), health (life expectancy and infant and child mortality), and access to basic infrastructure (water and sanitation). Urbanization can have a larger impact than economic growth on these social indicators.

Summary of the Relationship between Urbanization and Poverty

In brief, the theoretical literature finds that urbanization has a “direct effect” in raising incomes. A variety of urbanization channels to increase incomes are recognizable: the migration process to equilibrate wage differentials between rural and urban areas; an increase of technology and labor skills to enhance productivity; and the positive effects of urbanization on economic growth to increase per capita income. The above studies have reviewed the relationship between urbanization and monetary poverty dimensions, and empirically showed somewhat mixed results. However, the majority of the research confirms that there is more or less a positive effect of urbanization on economic growth. One possible explanation of the mixed results is that various empirical models and data (the cross-country and time periods) are used in these studies.

In accordance with the non-monetary poverty dimensions, such as the "channeled effect," some of the research explains theoretically how different available infrastructure and amenities between rural and urban areas for basic needs and services interact with urbanization. Empirical evidence shows the significance of urbanization effects and its positive association with the enhancement of basic needs and services as well as efficient infrastructure provisions.

CHAPTER III

THE THEORETICAL MODEL

In this chapter, we attempt to develop a theoretical model that explores the relationship between urbanization and poverty outcome conditions. Poverty is modeled in the context of overall social welfare, which in turn is identified by the growth rate of consumption and the standard of living provided by availability of basic infrastructure. The growth rate of consumption implies the growth rate of income so as to achieve all basic needs, while the provisions of basic infrastructure from government public investments are comprised of the universal stock of sanitization, electricity, transportation, and health and education facilities so equally accessible that every individual, especially the poor, are able to receive a minimum requirement for basic human well-being needs, as reflected in Iimi (2005).

As discussed in the previous chapter, both urbanization and industrialization reflect the move of labor and economic activities from rural to urban areas. In this chapter, while we enable to incorporate unproductive labor absorption into urbanization because this labor can be presumably seen as external agglomerative economies for urban areas, we are also underlying the fact that there is a positive correlation between urbanization and total outputs such that we try to filter out and control industrialization for our own interest between urbanization and the growth rate, as also reflected in the subsection of the process of urbanization. Therefore, we will only focus on the effect of urbanization itself, which is based on economy-based transitions, and the consumption growth rate that trickles down to poverty reduction outcomes.

The first subsection of this chapter is based on Devaranjan et al. (1996), and we modify it to analyze the effect of urbanization on the economic growth rate and infrastructure. In the second subsection, we link the first subsection analysis to another analytical framework, which is based on the traditional compositions of pro-poor growth sources developed by Kakwani and Pernia (2000), Ravallion and Chen (2003), and Kraay (2006).

Devaranjan et al. model assumes a representative agent choosing to maximize consumption. Their model is intended to explain the relationship between the growth rate of the economy and the composition of government spending. In their model, total spending is defined as having “productive” and “unproductive” components, and these components are linked to examine their effect on the economic growth rate. Their results show the important impact of shifts in the proportion between two types of expenditures on the economic growth rate.

In this chapter, we modify the Devaranjan et al. model in three fundamental ways. First, we introduce an urbanization variable (defined by the urban percentage or the ratio of urban population to national population). This variable represents the urbanization process in the production function. As in Faria and Mollick (1996), we assume that the level of urbanization has a positive effect on total outputs such that per capita GDP moves in the same direction as industrial and service sectors, which only occur in urban areas. Second, to capture the long-run growth rate, we also introduce a composite of efficiency-enhancing term as the product of technological levels from urbanization to a production function (as in Henderson 1988).

Third, we introduce rural and urban infrastructure variables into the production function and modify the budget constraint for the government role by substituting infrastructure expenditures in urban and rural areas, whereas Devaranjan et al. use the productive and unproductive sectors. We also assume that the government is the only provider for basic infrastructure (as in Issah et al. 2005). Government infrastructure in rural and urban areas are defined as public education and health systems, sanitation, electricity, and other basic facilities, which are provided for daily living.

Based on this analytical framework, we further focus on the effect of urbanization that passes through the economic growth rate on poverty reduction outcomes. We introduce an urbanization variable into the fraction of the population below the poverty line. From an urbanite's point of view, Ravallion (2001) states that "migration proceeds from rural to urban areas. The out-migrants may or may not be poorer than those left behind, but it is assumed that the migration process comes with a lower incidence of poverty in the aggregate. This may be a direct effect of the incomes gains to the migrants, or indirect effect via their remittances to rural areas, or a consequent tightening of the rural labor market." We follow the basic assumption that the incidence of poverty decreases as urbanization increases. Thus, we will employ the newest urbanization variable as well as the analysis from the first subsection into the compositions of pro-poor growth sources to examine the effect of urbanization on incomes of the poor.

Economic development and poverty reduction go hand-in-hand to achieve the goal of pursuing both individual and social welfare. Our analysis takes into consideration that the growth rate used to maximize the poor's utility is not only important for per capita income and commodities, but also essential for the provisions needed in order to meet a standard of living for the poor, which includes intangible welfare such as more parks or recreation centers, and tangible welfare such as better health services or schools. These issues are important in order to disentangle the effect of urbanization. Therefore, our theoretical analysis will focus on poverty reduction outcomes through urbanization for the poor.

The Production Function Unit

We assume that the per capita production function (y) is in the form of a Cobb Douglas production function. This includes: private capital stock (k), urbanization (N), two types of government infrastructure (*Urban:* G_u and *Rural:* G_r). We also include the product of technological level (A) with the shift factor ($g(N)$). The specification of N is presumed as external agglomerative economies, and the shift factor is subjected to the degree of scale economies as a concave function of urbanization. We hypothesize that there is a positive effect on outputs from a larger magnitude of N , G_u and G_r . The idea is to reflect the fact that economic mechanisms that increase outputs per capita coincide with non-agriculture activities and improved infrastructure as well as long-run technological productivity. According to the basic model, we also assume that the specification of function is a constant elasticity of substitution (CES). Thus, the functional form is expressed below:

$$y = Ag(N)f(k, N, G_u, G_r) = Ag(N)(k^{\alpha} N^{\gamma} G_u^{\beta} G_r^{\theta}) \qquad (3.1)$$

where $\alpha \geq 0, \gamma \geq 0, \beta \geq 0, \theta \geq 0$; $\alpha + \gamma + \beta + \theta = 1$; $0 \leq N \leq 1$; A is positive and

constant; and $f_k > 0$; $f_N > 0$; $f_{G_u} > 0$; $f_{G_r} > 0$; $g_N > 0$; $g_{NN} < 0$

The parameters α, γ, β, and θ represent elasticities of outputs with respect to k, N, G_u, and G_r, respectively. Note that Devaranjan et al. (1996) define private capital stock, k, as the capital factors for physical capital as well as human capital.

Following Devaranjan et al. (1996), the budget constraint for the government is balanced and also finances the infrastructure expenditures through a flat rate tax. The budget constraint is:

$$\tau * y = G_u + G_r = G \tag{3.2}$$

where G is the total government infrastructure expenditures and τ is the flat tax rate.

Let us now assume that the share (λ) of total government infrastructure expenditures to shift government spending into urban areas is a linear function of urbanization (N). Thus, the new budget constraint is given below:

$$\tau * y = G_u + G_r = (\lambda(N))G + (1 - \lambda(N))G = G \tag{3.3}$$

where $0 \le \lambda(N) \le 1$; $\lambda_N > 0$.

The magnitudes of N will not only balance the budget allocation in rural and urban areas, but also shift the optimal amount of spending in both areas. Overall efficient public spending will be enhanced through the direct promotion of economic growth and is sufficiently supported with basic services and provisions. Furthermore, the model assumes that the flat tax rate (τ) and the share of total government infrastructure expenditures (λ) are chosen from a specific government agent perspective.

Consumption Behavior

We assume that preferences of the representative individual represent overall social preferences. Therefore, a Central Planner is valuable in order to maximize the individual's welfare. The Planner will determine at each unit of time how much an agent should have consumed, as well as how much the planner should provide for the stock of capital in order to serve specific life-time preferences in the future. The preference utility of an agent for consumption, $u(c)$, over time is given by

$$U = \int_0^\infty u(c)e^{-\rho t}dt \qquad \text{where } u_c > 0,\ u_{cc} < 0 \qquad (3.4)$$

Subject to the growth rate of private capital stock with respect to time $(\dot{k})$:

$$\dot{k} = (1-\tau)y - c \qquad (3.5)$$

where c is consumption and ρ is the rate of time preference; both are strictly positive.

A higher rate of time preference means that an agent increases the weight given to consumption into the current utility rather than the future utility.[14] From Equation (3.4), the condition of first and second derivatives of utility shows that the utility function of consumption is a concave curve, i.e., at a higher consumption, the marginal utility of consumption is increasing at a decreasing rate.

From Equation (3.5), the growth rate of private capital stock with respect to time implies that the constraint depend upon, on the right-hand-side (RHS), the difference between disposable income and consumption at any given point of time. Specifically, the saving rate is equal to the private capital stock rate on which an agent will allocate an agent's spending to consumption and saving.

We substitute Equations (3.1) and (3.3) into Equation (3.5) to obtain the new budget constraint:

[14] See Blanchard and Fischer (1989).

$$\dot{k} = (1-\tau)Ag(N)k^{\alpha}N^{\gamma}(\lambda G)^{\beta}((1-\lambda)G)^{\theta} - c \qquad (3.6)$$

To analyze the system, we specify the common utility function as the isoelastic (Constant Relative Risk Aversion: CRRA) utility function. The function is the constant elasticity of marginal utility expressed in the following form:

$$u(c) = \frac{c^{1-\sigma}}{1-\sigma} \qquad \text{where } 0 < \sigma < 1 \qquad (3.7)$$

where σ is the constant elasticity of substitution between consumption at any two points of time.

We set up and solve the Hamiltonian system by using the utility function (3.7), and then maximize the preference utility function (3.4) subject to the new budget constraint (3.7). The final result yields the following:[15]

$$\mu = \frac{\dot{c}}{c} = \frac{\alpha(1-\tau)Ag(N)k^{\alpha-1}N^{\gamma}(\lambda G)^{\beta}((1-\lambda)G)^{\theta}}{\sigma} \qquad (3.8)$$

where μ is the marginal value as of time zero of an additional unit of consumption.

Equation (3.8) is the long-term rate of growth in consumption or the long-term steady-state growth rate (hereafter, the growth rate). This implies the steady-state growth rate of per capita income because the representative utility function reflects the level of consumption assumed based on income.

The Effect of Urbanization (N) on the Growth Rate (μ)

In accordance with Equation (3.8), the growth rate is a function of urbanization (N), government infrastructure expenditures (G_u and G_r), and the shift factor ($g(N)$) .

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[15] See Appendix A.1 for details.

The total government infrastructure expenditures are also a function of urbanization. Therefore, we may obtain the functional form as follows:

$$\mu = h(N, G_u, G_r, g(N)) \tag{3.9}$$

From Equations (3.8) and (3.9), we are able to evaluate the impact of urbanization on the growth rate by derivative the growth rate respect to urbanization:

$$\frac{d\mu}{dN} = \frac{\alpha(1-\tau)Ak^{\alpha-1}G^{\beta+\theta}}{\sigma}\frac{d\left[g(N)N^{\gamma}(\lambda(N))^{\beta}(1-\lambda(N))^{\theta}\right]}{dN} \tag{3.10}$$

$$\frac{d\mu}{dN} = \frac{\alpha(1-\tau)Ak^{\alpha-1}G^{\beta+\theta}}{\sigma}\left[N^{\gamma}\lambda^{\beta}(1-\lambda)^{\theta}g_N + g\lambda^{\beta}(1-\lambda)^{\theta}\gamma N^{\gamma-1} + gN^{\gamma}(1-\lambda)^{\theta}\beta\lambda^{\beta-1}\lambda_N - gN^{\gamma}\lambda^{\beta}\theta(1-\lambda)^{\theta-1}\lambda_N\right] \tag{3.10*}$$

$$\frac{d\mu}{dN} = \frac{\alpha(1-\tau)Ak^{\alpha-1}G^{\beta+\theta}}{\sigma}\left[N^{\gamma}\lambda^{\beta}(1-\lambda)^{\theta}g_N + g\lambda^{\beta}(1-\lambda)^{\theta}\gamma N^{\gamma-1} + g\lambda^{\beta}\lambda_N N^{\gamma}(1-\lambda)^{\theta}\left\{\frac{\beta}{\lambda} - \frac{\theta}{1-\lambda}\right\}\right] \tag{3.10**}$$

$$\frac{d\mu}{dN} = \frac{\alpha(1-\tau)Ak^{\alpha-1}G^{\beta+\theta}\lambda^{\beta}(1-\lambda)^{\theta}}{\sigma}\left[N^{\gamma}g_N + g\gamma N^{\gamma-1} + g\lambda_N N^{\gamma}\left\{\frac{\beta}{\lambda} - \frac{\theta}{1-\lambda}\right\}\right] \tag{3.11}$$

What we are interested in is the sign of Equation (3.11). The common factor term is always positive, while the three terms in the RHS bracket affect the growth rate through urbanization. The first term shows the “channeled effect” of enhancing the level of technology through urbanization (external agglomerative economies) on the long-term growth rate. The second term represents the “direct effect” of urbanization on the growth rate. An increase of urban population will augment the agglomeration of production by itself and its elasticity of substitution at a diminishing rate. Note that the sign of the first and second terms are always positive. The third term reveals the indirect (or “channeled”) effect of urbanization on the growth rate through an “economic infrastructure effect.” This effect will be subject to economies of scale as well as depending on the level of efficiency that can deliver basic needs and services. Basically, if this effect is positive, a higher urbanization with better infrastructure will increase the growth rate. To understand this better, we rearrange Equation (3.11) to derive the following:

$$\frac{d\mu}{dN} = B\left[g_N + g\frac{\gamma}{N} + g\lambda_N \left\{ \frac{\beta}{\lambda} - \frac{\theta}{1-\lambda} \right\} \right] \tag{3.12}$$

where $B = \frac{\alpha(1-\tau)Ak^{\alpha-1}G^{\beta+\theta}\lambda^{\beta}(1-\lambda)^{\theta}N^{\gamma}}{\sigma} > 0$

Since the first two terms in the RHS bracket and the term λ_N are always positive, the sign of $\frac{d\mu}{dN}$ is determined by the term: $\left\{ \frac{\beta}{\lambda} - \frac{\theta}{1-\lambda} \right\}$.

Recall that $\frac{d\mu}{dN}$ is continuous and differentiable, we can find that at the optimal N, N^*, leading to at the point (N^*, G_u^*, G_r^*, g^*) will satisfy $\frac{d\mu}{dN} = 0$. Also, this satisfies that $\frac{\frac{d\mu}{dN}}{dG_u} \neq 0$, $\frac{\frac{d\mu}{dN}}{dG_r} \neq 0$, and $\frac{\frac{d\mu}{dN}}{dg} \neq 0$. And then G_u, G_r, and g can be expressed as a function of N. Thus, we can apply the implicit function theorem[16] to examine the interior conditions (or the effects) of urbanization on the growth rate and the effect of urbanization on urban and rural infrastructures.

[16] See Simon and Blume (1994).

In doing so, first, we equalize Equation (3.12) to zero, and then we can determine the sign of $\left\{\frac{\beta}{\lambda}-\frac{\theta}{1-\lambda}\right\}$ as follows: $g_N + g\frac{\gamma}{N} + g\lambda_N\left\{\frac{\beta}{\lambda}-\frac{\theta}{1-\lambda}\right\} = 0$, and then

$$N = N^* = -\frac{g\gamma}{g_N + g\lambda_N\left\{\frac{\beta}{\lambda}-\frac{\theta}{1-\lambda}\right\}} \qquad (3.13)$$

Equation (3.13) represents the optimal level of urbanization that leads to the maximum rate of growth (Mills and Becker 1986 and in the context of urban concentration by Williamson 1965 and Henderson 1988, 2003). We know that N, g, g_N, γ, and λ_N are always positive. We can obtain the condition:

$$\left|\frac{\gamma}{N}\right| < \left|\lambda_N\left(\frac{\beta}{\lambda}-\frac{\theta}{1-\lambda}\right)\right| \qquad (3.14)$$

When $\left\{\frac{\beta}{\lambda}-\frac{\theta}{1-\lambda}\right\} < 0$ (3.15)

We arrange Equation (3.15) and obtain the condition:

$$\frac{\beta}{\theta} < \frac{\lambda}{1-\lambda} \qquad (3.16)$$

With respect to condition (3.16), the relative proportion of infrastructure spending on urban areas to rural areas, $\frac{\lambda}{1-\lambda}$, is larger than the relative ratio of output elasticities, $\frac{\beta}{\theta}$. The share of infrastructure spending that is shifted from rural to urban areas is realized by a steady-state growth rate. On the other hand, the substitution of resources from rural to urban areas also increases urban populations. This dynamic pattern leads people to increase urbanization and in addition, involves the source of the growth rate. The urbanization process will take place as transitions of economic development evolve.

The initial share of infrastructure spending (λ) plays an essential role in stimulating the concentration of populations. Nonetheless, the initial share of infrastructure spending cannot by itself guarantee this process unless the components of rural and urban infrastructure are not complementary to the output production, i.e., the relative ratio of output elasticities is too large.

Suppose that the condition (3.16) holds, then we are able to investigate the interior conditions of urbanization on the growth rate. We attempt to place the two values of N in that the first N value is close to zero and the other N value is close to one, into Equation (3.10**):

$$\left.\frac{d\mu}{dN}\right|_{N\sim 0} = \frac{\alpha(1-\tau)Ak^{\alpha-1}G^{\beta+\theta}}{\sigma}\left[N^{\gamma}\lambda^{\beta}(1-\lambda)^{\theta}g_N + g\lambda^{\beta}(1-\lambda)^{\theta}\gamma N^{\gamma-1} + g\lambda^{\beta}\lambda_N N^{\gamma}(1-\lambda)^{\theta}\left\{\frac{\beta}{\lambda}-\frac{\theta}{1-\lambda}\right\}\right]$$

where $C = \dfrac{\alpha(1-\tau)Ak^{\alpha-1}G^{\beta+\theta}}{\sigma} > 0$

When we insert $N \sim 0$ into the equation, the first and second bracketed terms (positive value) are comparably larger than the third bracketed term (negative value). Thus, the interior conditions when $N \sim 0$ is $\left.\dfrac{d\mu}{dN}\right|_{N\sim 0} > 0$. This means that the effect of urbanization on the growth rate is positive for low levels of N. In other words, an increase of urbanization leads to an increase in the growth rate. Using the same comparison, when we place $N \sim 1$ into the same equation, the first and second bracketed terms (positive value) are comparably smaller than the third bracketed term (negative value). Thus, the interior conditions when $N \sim 1$ is $\left.\dfrac{d\mu}{dN}\right|_{N\sim 1} < 0$. This implies that a further increase in urbanization decreases the growth rate.

However, it is important to note that interior conditions depend upon the magnitude of N^*. For instance, if an economy is able to reach a higher value of N^*, possibly close to or equal to 1, the maximum rate of growth will accordingly act to the higher N^*.

Second, it is important to note that this optimization provides a standard first order condition for an interior solution. To give concavity of the growth rate function, the second order condition must be negative to satisfy. Thus, according to Equation (3.10*), we can derive the second order derivative of the growth rate with respect to urbanization as follows:

$$\frac{d^2\mu}{dN^2}=\frac{\alpha(1-\tau)Ak^{\alpha-1}G^{\beta+\theta}}{\sigma}\frac{d}{dN}\left[N^{\gamma}\lambda^{\beta}(1-\lambda)^{\theta}g_N+g\lambda^{\beta}(1-\lambda)^{\theta}\gamma N^{\gamma-1}+gN^{\gamma}(1-\lambda)^{\theta}\beta\lambda^{\beta-1}\lambda_N-gN^{\gamma}\lambda^{\beta}\theta(1-\lambda)^{\theta-1}\lambda_N\right] \tag{3.17}$$

For simplicity, we transform the terms in the bracket as the following:

$$\frac{d^2\mu}{dN^2}=C\frac{d}{dN}\left[Q+R+S+T\right] \tag{3.18}$$

where $C=\frac{\alpha(1-\tau)Ak^{\alpha-1}G^{\beta+\theta}}{\sigma}>0$ and $Q=N^{\gamma}\lambda^{\beta}(1-\lambda)^{\theta}g_N$; $R=\lambda^{\beta}(1-\lambda)^{\theta}\gamma N^{\gamma-1}$;

$S=N^{\gamma}(1-\lambda)^{\theta}\beta\lambda^{\beta-1}\lambda_N$; $T=-N^{\gamma}\lambda^{\beta}\theta(1-\lambda)^{\theta-1}\lambda_N$

Note that $\lambda_{NN}=0$, then the derivatives of the terms in the bracket are

$$\frac{dQ}{dN}=\gamma N^{\gamma-1}\lambda^{\beta}(1-\lambda)^{\theta}g_N+N^{\gamma}\beta\lambda^{\beta-1}\lambda_N(1-\lambda)^{\theta}g_N-N^{\gamma}\lambda^{\beta}\theta(1-\lambda)^{\theta-1}\lambda_N g_N+N^{\gamma}\lambda^{\beta}(1-\lambda)^{\theta}g_{NN} \tag{3.19}$$

$$\frac{dR}{dN}=\gamma N^{\gamma-1}\lambda^{\beta}(1-\lambda)^{\theta}g_N+g\beta\lambda^{\beta-1}\lambda_N(1-\lambda)^{\theta}\gamma N^{\gamma-1}-g\lambda^{\beta}\theta(1-\lambda)^{\theta-1}\lambda_N\gamma N^{\gamma-1}+g\lambda^{\beta}(1-\lambda)^{\theta}\gamma(\gamma-1)N^{\gamma-2} \tag{3.20}$$

$$\frac{dS}{dN} = g_N N^{\gamma}(1-\lambda)^{\theta}\beta\lambda^{\beta-1}\lambda_N + g\gamma N^{\gamma-1}(1-\lambda)^{\theta}\beta\lambda^{\beta-1}\lambda_N - gN^{\gamma}\theta(1-\lambda)^{\theta-1}\beta\lambda^{\beta-1}\lambda_N^2 + gN^{\gamma}(1-\lambda)^{\theta}\beta(\beta-1)\lambda^{\beta-2}\lambda_N \tag{3.21}$$

$$\frac{dT}{dN} = -g_N N^{\gamma}\lambda^{\beta}\theta(1-\lambda)^{\theta-1}\lambda_N - g\gamma N^{\gamma-1}\lambda^{\beta}\theta(1-\lambda)^{\theta-1}\lambda_N - gN^{\gamma}\theta(1-\lambda)^{\theta-1}\beta\lambda^{\beta-1}\lambda_N^2 + gN^{\gamma}\lambda^{\beta}\theta(\theta-1)(1-\lambda)^{\theta-2}\lambda_N \tag{3.22}$$

The first term of Equations (3.19)—(3.21) and the second term of Equation (3.19) are positive whereas the rest of all terms in Equations (3.19)—(3.22) are negative. We can demonstrate that the summary of the first three terms of Equation (3.19), and the first term of Equations (3.20)—(3.22) is equivalent to $2g_N\lambda^{\beta}(1-\lambda)^{\theta}N^{\gamma}\left\{\frac{\gamma}{N}+\lambda_N\left(\frac{\beta}{\lambda}-\frac{\theta}{1-\lambda}\right)\right\}$.[17] From the condition (3.14) and (3.15), the sign of $\left(\frac{\beta}{\lambda}-\frac{\theta}{1-\lambda}\right)$ is positive, and the sign of $\left\{\frac{\gamma}{N}+\lambda_N\left(\frac{\beta}{\lambda}-\frac{\theta}{1-\lambda}\right)\right\}$ are negative, and then $2g_N\lambda^{\beta}(1-\lambda)^{\theta}N^{\gamma}\left\{\frac{\gamma}{N}+\lambda_N\left(\frac{\beta}{\lambda}-\frac{\theta}{1-\lambda}\right)\right\}$ will always be negative. Therefore, we can conclude that Equation (3.17) is negative.

In sum, the function of the rate of growth (μ) is represented as concavity with respect to urbanization; that satisfies: $\frac{d\mu}{dN}=\phi>0$ and $\frac{d^2\mu}{dN^2}=\frac{d\phi}{dN}<0$.

The Effect of Urbanization (N) on Infrastructure (G)

Through application of the implicit function theorem, the affect of urbanization on urban and rural infrastructures result in the following:

[17] See Appendix A.2 for details.

$$\frac{dG_u}{dN} = -\frac{\frac{d\phi}{dN}}{\frac{d\phi}{dG_u}} = -\frac{-}{?} \text{ and } \frac{dG_r}{dN} = -\frac{\frac{d\phi}{dN}}{\frac{d\phi}{dG_r}} = -\frac{-}{?} \qquad (3.23)$$

The signs of $\frac{dG_u}{dN}$ and $\frac{dG_r}{dN}$ are determined by the denominators $(\frac{d\phi}{dG_u})$ and $(\frac{d\phi}{dG_r})$, respectively. Recall Equation (3.11) and the budget constraint $G = G_u + G_r$, the equations of $\frac{d\phi}{dG_u}$ and $\frac{d\phi}{dG_r}$ are:

$$\frac{d\phi}{dG_u} = \frac{\beta G_u^{\beta-1}\alpha(1-\tau)Ak^{\alpha-1}G_r^{\theta}N^{\gamma}}{\sigma}\left\{g_N + g\frac{\gamma}{N} + g\lambda_N\left[\frac{\beta}{\lambda} - \frac{\theta}{1-\lambda}\right]\right\} \qquad (3.24)$$

$$\frac{d\phi}{dG_r} = \frac{\theta G_r^{\theta-1}\alpha(1-\tau)Ak^{\alpha-1}G_u^{\beta}N^{\gamma}}{\sigma}\left\{g_N + g\frac{\gamma}{N} + g\lambda_N\left[\frac{\beta}{\lambda} - \frac{\theta}{1-\lambda}\right]\right\} \qquad (3.25)$$

The signs of $\frac{d\phi}{dG_u}$ and $\frac{d\phi}{dG_r}$ depend on the term: $\left\{\frac{\beta}{\lambda} - \frac{\theta}{1-\lambda}\right\}$. Suppose that the condition (3.15) holds, we will get the value of N^* as Equation (3.13). Let consider 3 propositions:

Proposition 1*:* At the point when urban population is smaller than the optimal urban population $(N < N^*)$, Equations (3.24) and (3.25) is positive. This means that Equation (3.23) is: $\frac{dG_u}{dN} > 0$ and $\frac{dG_r}{dN} > 0$.

Proposition 2: At the point of optimal urbanization $(N = N^*)$, $\frac{d\phi}{dG_u} = 0$ and $\frac{d\phi}{dG_r} = 0$. The effect of urbanization on urban and rural infrastructure is equivalent to zero. This means that Equation (3.23) is: $\frac{dG_u}{dN} = 0$ and $\frac{dG_r}{dN} = 0$.

Proposition 3: At the point when urban population is greater than the optimal urban population $(N > N^*)$, Equations (3.24) and (3.25) is negative. This means that Equation (3.23) is: $\frac{dG_u}{dN} < 0$ and $\frac{dG_r}{dN} < 0$.

Each possible proposition presents different signs. Each of three propositions depicts that the magnitude of N produces the same sign of urbanization effects on infrastructure for both urban and rural areas such that results for infrastructure in rural areas yield the same results as those in urban areas.

Through analytical reasoning, it can be shown that, at the initial state of economic development, increasing urbanization will have a large effect. As urbanization increases, the provisions of infrastructure for both urban and rural areas increase according to Equations (3.24) and (3.25) when $N < N^*$. The explanation for this situation is that a government allocates more spending for investing in urban infrastructure. Urban areas are served through newly sufficient and efficient infrastructure when people become more urbanized. Meanwhile, rural areas receive increased services through existing rural infrastructure and through newly invested rural infrastructure when people get less tightening. This implies that the standard of living in such both areas as health and education will also increase, i.e., the allocation of infrastructure can increasingly provide for people in the cities and countryside. When an increase of urbanization approaches the optimal level, the provisions of infrastructure will increase at a decreasing rate.

Once urbanization has reached an optimal level, there should be no increase of infrastructure provisions. We should then assume that the level of infrastructure to serve people is going to transform from economies of scale to diseconomies of scale. In other words, basic needs and services can be subjected to congestion and if beyond the optimal level, rural and urban infrastructure services will decrease. Therefore, under increased congestion conditions, the provisions of infrastructure in urban areas cannot be efficiently delivered for every urban person, i.e., the level of services is lower than the optimal standard. At the same time, rural infrastructure provisions will lessen the quantity of services partially because more government budgets are shifted toward urban infrastructure, and partially because the efficiency needed to provide standard basic services are lowered. Additionally, the provisions of standard basic services are more difficult to meet because of conditions such as geography or dispersed living locales. The shared move between urban population and infrastructure express the adjustment to the proficient equilibrium, which is basically the same mechanism as Tiebout's model (1956), which expects a self-directive equilibrium of city systems based on mobility.

The Effect of Urbanization (N) on Incomes of the Poor

As we realize that growth is basically accompanied with urbanization, in this subsection our interest focuses onto how the effect of urbanization impacts the poor by passing through pro-poor growth that directly assists the poor. We assume that the incidence of poverty is a non-increasing function in urbanization (N), as in Ravallion (2001). Based on Kraay (2006), we start deriving the sources of growth that affect poverty and compartmentalize them into three components: growth in average incomes, the sensitivity of poverty to growth in average incomes, and changes in relative incomes. By doing so, we denote that an additive poverty measure (P_t) is expressed as

$$P_t = \int_0^{H_t} f(y_t(p))dp \tag{3.26}$$

where $y_t(p)$ is the income of the p^{th} percentile of the income distribution at time t in which are showed as a function of average income, μ_i, and the Lorenz curve, $L_i(p)$, i.e., $y_t(p) = \mu_i\left(\frac{dL_i(p)}{dp}\right)$; $H_t = H_t(N)$ is the fraction of the national population below the poverty line, z (or the poor), and the non-increasing function of urbanization $(\frac{dH_t}{dN} < 0)$; and $f(y_t(p)) = \left(\frac{z - y_t(p)}{z}\right)^{\theta}$ is the Foster-Greer-Thorbecke index[18] where θ is the aversion for poverty.

We apply the Leibnitz's rule by differentiating the poverty measure in Equation (3.26) with respect to time, and then obtain the proportionate change in poverty:

$$\frac{\dot{P}_t}{P_t} = \frac{1}{P_t}\left\{\frac{dH_t}{dt} f(y_t(p)) - \frac{d0}{dt} f(y_t(p)) + \int_0^{H_t} \frac{df(y_t(p))}{dy_t(p)} \frac{dy_t(p)}{dt} \frac{y_t(p)}{y_t(p)} dp\right\} \tag{3.27}$$

However, when we evaluate the poverty measures at the poverty line, the poverty measures are zero. Thus, the term involving the derivative of the upper limit of integration will be zero, that leads to $\frac{dH_t}{dt} = 0$. We rearrange Equation (3.27) and obtain

$$\frac{\dot{P}_t}{P_t} = \int_0^{H_t} \eta_t(p).g_t(p)dp \tag{3.28}$$

[18] See Chapter II for details.

where $\frac{\dot{P}_t}{P_t}$ is always negative; $\eta_t(p) = \frac{df(y_t(p))}{dy_t(p)} \frac{y_t(p)}{P_t}$ is the elasticity of the poverty measure with respect to the income of the p^{th} percentile; and $g_t(p) = \frac{dy_t(p)}{dt} \frac{1}{y_t(p)}$ is the growth rate of each percentile.

To decompose the effects of growth in average incomes, we add the growth rate in average incomes and obtain

$$\frac{\dot{P}_t}{P_t} = \mu \int_0^{H_t} \eta_t(p)dp + \int_0^{H_t} \eta_t(p)\left(g_t(p) - \mu\right)dp \qquad (3.29)$$

where μ is the growth rate in average incomes (or the actual growth rate) and also the function of urbanization (from Equation (3.8)).

Equation (3.29) defines the three sources of "pro-poor growth," as mentioned earlier. The first term in Equation (3.29) is the first two sources of pro-poor growth (growth in average incomes and the sensitivity of poverty to growth in average incomes), i.e., the growth elasticity of poverty. This first term is comprised of the growth rate in average incomes, μ, multiplied by the sensitivity of the poverty measure to changes in average incomes, $\eta_t(p)$. The second term in Equation (3.29) is the last source of pro-poor growth (changes in relative incomes), i.e., the inequality effect of poverty reduction. This second term consists of the growth rate of income in the p^{th} percentile relative to average income growth and the sensitivity of poverty to growth in that percentile.

The implication of the inequality effect of poverty reduction is that the effect can be negative, positive, or even zero depending on whether growth is conveyed with enlarging or reducing inequality between the poor and the non-poor. If the inequality effect of poverty reduction is negative (positive), this means that growth led to a change of income distributions in favor of the poor (the non-poor). If the effect is zero, this means that growth proportionally contributes benefits to the poor and the non-poor.

Kakwani et al. (2004) state that “the Lorenz curve can change in an infinite number of ways and thus the ex-ante analysis of change in poverty is not possible under general situation. However, we can make an ex-post analysis of change if we have household surveys of at least two periods.” Thus, before we investigate the effect of urbanization on poverty, we need to make an assumption on the inequality effect of poverty because the inequality effect of poverty reduction was expressed by the Lorenz curve. In this analysis, we necessarily assume that the change in inequality proportionally shifts in the Lorenz curve at all points, i.e., the poor and the non-poor proportionally benefits from the shift of average incomes (the inequality effect of poverty is zero.)

Recall Equation (3.29), we, therefore, can obtain

$$\frac{\dot{P}_t}{P_t} = \mu \int_0^{H_t} \eta_t(p)dp \qquad (3.30)$$

Second, we start to investigate the effect of urbanization on pro-poor growth by differentiating with respect to N and derive as follows:[19]

$$\frac{d\dfrac{\dot{P}_t}{P_t}}{dN} = \frac{d\left(\mu\left(-\dfrac{z}{P_t.(\theta+1).y_t'(p)\big|_{p=H_t}}\right)\right)}{dN} \qquad (3.31)$$

$$\frac{d\dfrac{\dot{P}_t}{P_t}}{dN} = -\left(\frac{z}{P_t(\theta+1)y_t'(H_t)}\frac{d\mu}{dN} - \mu\frac{z}{P_t(\theta+1)}y_t'(H_t)^{-2}\frac{dy_t'(H_t)}{dH_t}\frac{dH_t}{dN}\right) \qquad (3.32)$$

[19] See Appendix A.3 for details.

We assume that $\mu > 0$, i.e., the growth rate is increasing. And we also know that

$\frac{z}{P_t(\theta+1)y_t'(H_t)} > 0$; $\frac{z}{P_t(\theta+1)} > 0$; $y_t'(H_t)^{-2} > 0$; and $\frac{dH_t}{dN} < 0$. However, when we evaluate incomes of the poor at the poverty line, the poor's income will be equal to z. This means that $y_t'(H_t) = z > 0$, and then $\frac{dy_t'(H_t)}{dH_t} = \frac{dz}{dH_t} = 0$. Thus, the second term is zero, i.e., $-\mu \frac{z}{P_t(\theta+1)} y_t'(H_t)^{-2} \frac{dy_t'(H_t)}{dH_t} \frac{dH_t}{dN} = 0$. We can obtain the final equation:

$$\frac{d\frac{\dot{P}_t}{P_t}}{dN} = -\left(\frac{z}{P_t(\theta+1)y_t'(H_t)} \frac{d\mu}{dN} \right) = -\left(\frac{z}{P_t(\theta+1)z} \frac{d\mu}{dN} \right)$$

$$\frac{d\frac{\dot{P}_t}{P_t}}{dN} = -\frac{1}{P_t(\theta+1)} \frac{d\mu}{dN} \qquad (3.33)$$

Since $\frac{1}{P_t(\theta+1)}$ is always positive, the sign of Equation (3.33) is determined by the sign of $\frac{d\mu}{dN}$, i.e., the effect of urbanization on the growth rate in average incomes. Recall the optimal level of urbanization, N^*, from Equation (3.13) and the effect of urbanization on the growth rate, $\frac{d\mu}{dN}$, from the first subsection.

From Equation (3.33), we can draw three propositions of urbanization effects on incomes of the poor as follows:

Proposition 1*: At the point when urban population is smaller than the optimal urban population* $(N < N^*)$, $\frac{d\mu}{dN} > 0$. *Thus, Equation (3.33) is negative:* $\frac{d\frac{\dot{P}_t}{P_t}}{dN} < 0$.

An increase of urbanization before the optimal level (N^*) can increase poverty reduction outcomes. In other words, a number of the poor who can escape from poverty will increase at a decreasing rate as urbanization increases. The marginal effects of urbanization effect on poverty are reduced to zero.

Proposition 2*: At the point of optimal urbanization* $(N = N^*)$, $\frac{d\mu}{dN} = 0$ *. Thus, Equation (3.33) is zero:* $\frac{d\frac{\dot{P}_t}{P_t}}{dN} = 0$.

When urbanization is at the optimal level (N^*), the rate of poverty reduction outcomes is zero, i.e., at the optimal level (N^*), there are still a number of the poor who may escape from poverty, but this amount will complement those in the previous period at the level of N^* . The marginal effect of urbanization effect on poverty reduction outcomes is equal to zero.

Proposition 3*: At the point when urban population is greater than the optimal urban population* $(N > N^*)$, $\frac{d\mu}{dN} < 0$ *. Thus, Equation (3.33) is positive:* $\frac{d\frac{\dot{P}_t}{P_t}}{dN} > 0$.

As urbanization increases beyond the optimal level (N^*), there is a higher level of urbanization leading to $\frac{d\frac{\dot{P}_t}{P_t}}{dN} > 0$. This means that urbanization will worsen poverty reduction outcomes, i.e., higher urbanization will reduce a number of the poor who can escape from poverty far more than lower urbanization does. As urbanization increases, the marginal effect of urbanization effect on poverty becomes increasingly negative.

Summary of the Theoretical Model

In this chapter, we have derived an analytical framework in order to analyze the effect of the urbanization process on poverty conditions. The economic growth model is used as an application to examine welfare improvement in terms of consumption based on incomes and infrastructure. From a comparative static perspective, our theoretical models are unambiguous and reveal how urbanization affects poverty reduction outcomes in terms of income and welfare through infrastructure.

In the first model, we demonstrate explicitly and theoretically that urbanization directly affects basic infrastructure that can improve the standard of living in cities and country sides, especially for those who are poor. Our model shows that infrastructure-enhancing provisions complement the level of urbanization up to some point. As concerns about the optimal urbanization level, urbanization will increase the standard of rural and urban living through infrastructure such that basic education or health care in the less urbanization state is increasingly more effective than those in the higher urbanized state. The optimal level of urbanization is determined and responds according to the initial level of economy composition and budget allocations; however the level of infrastructure provisions are still subjected to congestion at the optimal level of urbanization.

Under proportionate benefits from growth, the second model explicitly shows the effect of urbanization on the poor who are being below the poverty line. The model shows that an increase in urbanization will reduce an overall number of the poor. Furthermore, the second model reveals the relationship between urbanization levels and the rate of poverty change, thus, a change in the number of the poor reflects upon poverty reduction outcomes. A larger number of the poor can escape from beneath the poverty line at the optimal state of urbanization than those poor that reside in a too-high or too-low urbanization state.

In the next chapter, we develop an empirical methodology to estimate the qualitative relationship between urbanization and poverty. The estimation results are provided in Chapter V. In addition to capturing the results of urbanization effects on poverty reduction outcomes, we estimate the effect of urbanization on various channels of poverty reduction outcomes (i.e., education, health, and growth of productivity) in order to show the robustness of the potential effects of urbanization through the basic channels of poverty reduction outcomes.

CHAPTER IV

EMPIRICAL METHODOLOGY

This chapter is devoted to developing an empirical methodology to investigate the "direct" and "channeled effects" of urbanization on poverty reduction outcomes. First, we examine the "direct effect" of urbanization on poverty by utilizing non-monetary and monetary poverty indicators. Using several indicators of poverty allows us to capture the effects of the different aspects of urbanization. Second, we examine the "channeled effects" of urbanization through the possible channels of poverty reduction outcomes, which pass through an available stock of rural and urban infrastructures such as basic education needs, basic health care, and potential productivity (i.e., the agricultural and non-agricultural growth rates).

The organization of this chapter starts with the subsection that empirically overviews the relationship between urbanization and poverty reduction outcomes. The second subsection describes the empirical methodology. To estimate the relationship for non-monetary poverty indicators, we begin by using standard panel data methods such as fixed effects and random effects estimations for checking the robustness of the results when we employ the instrumental variable (IV) estimation method in the context of the generalized method of moments (GMM) framework to deal with potential endogeneity problems and to allow for general heteroskedasticity in the errors.

Furthermore, we also apply the dynamic panel GMM estimation. This estimation method is performed in an attempt to explore the effect of urbanization on the growth rate of monetary poverty indicators (the pro-poor growth rate). This estimation allows for internal instruments to be utilized in order to deal with any endogeneity problems among the possible simultaneity of urbanization and monetary poverty indicators.

In the third subsection, we present the details for the data categories and sources of the data used in this study. The fourth subsection discusses testable hypotheses, which are derived from our study and discussions in the theoretical chapter. Finally, the last subsection is empirical model specifications for the “direct” and “channeled effects” of urbanization on poverty reduction outcomes.

Urbanization and Poverty

In this subsection of the chapter, we discuss the effects of urbanization on poverty reduction outcomes. This analysis is crucial for three main reasons. First, according to our theoretical chapter, urbanization needs to be treated as an explanatory variable in the quadratic form in order to examine the relationship between urbanization and a composite index of poverty. Establishing this type of relationship suggests that the effects via urbanization will reflect to the best degree of urbanization to promote poverty reduction outcomes. Second, a number of studies have shown a direct relationship between urbanization and the monetary dimension of well-being, especially the economic growth rate (Wheaton and Shishido 1981; Jones and Kone 1996; Handerson 2003). All these studies treat urbanization as not strictly exogenous. Our goal is to allow urbanization to be endogenous and to examine poverty and establish a link between urbanization and income, which affects the poor.

Finally, economies of scale based on the optimal degree of urbanization that enable us to analyze those provisions of infrastructure that not only promote economic growth rates, but also raises the level of consumption for the poor and delivers the basic needs in order to reduce poverty (Dreze and Murthi 2001; Jayasuriya and Wodon 2002; Wodon and Ryan 2002; Ramadas et al. 2002; Liu et al. 2003). If a link between urbanization and human well-being levels is established, then resources could be better utilized by appropriate government policies by leveraging socioeconomic patterns between rural and urban areas in a country to alleviate overall poverty conditions.

Therefore, the general form of the relationship between urbanization and poverty reduction outcomes is

$$Poverty_{it} = f(Urban_{it}, Urban_{it}^2, X_{it}) + u_{it} \qquad (4.1)$$

This can be parametered as

$$Poverty_{it} = \beta_0 + \beta_1 Urban_{it} + \beta_2 Urban_{it}^2 + \beta_j X_{it} + u_{it} \qquad (4.2^*)$$

Or, alternatively for the growth rate model[20] as

$$Povertyg_{it} = \beta_0 + (\alpha - 1) iPoverty_{it} + \beta_2 Urban_{it} + \beta_3 Urban_{it}^2 + \beta_j X_{it} + u_{it} \qquad (4.2^{**})$$

where $Poverty_{it}$ is defined as a poverty indicator;

$Povertyg_{it} = \ln Poverty_{it} - \ln Poverty_{i,t-1}$ (the rate of changes of a poverty indicator);

$iPoverty_{it} = Poverty_{i,t-1}$ (the initial level of a poverty indicator); $Urban_{it}$ is urbanization;

$Urban_{it}^2$ is the squared value of urbanization; X_{it} is a set of control variables; and

$u_{it} = n_i + \nu_{it}$ is a composite error of unobserved country-specific effects (η_i) and a vector of idiosyncratic disturbances (ν_{it}). A set of control variables consists of economic

[20] Details of this equation model are derived and provided in the estimation methodology subsection (the dynamic panel GMM estimation).

and socio-demographic variables, and government institutional variables depending on estimations of each poverty indicator.[21]

One empirical issue is that standard panel data estimations (fixed and random effects) might not be consistent in our analysis due to the potential of endogeneity on which the error process is correlated with some right-hand-side (RHS) variables. Some unobserved factors might include economic shocks or unexpected political events. When regressors are endogenous, the parameter estimators will be inconsistent. For instance, random shocks such as economic crises in a country may have an impact on rural-urban migration. Higher unemployment or job-seeking uncertainty is likely to affect the patterns of migration. Urban population would prefer to migrate to their native rural areas for jobs in agricultural sectors or to move to a country's geographic neighbors if there is a free trade area or no control borders. Economic crises may also influence other economic and socioeconomic variables. The composition of random shocks is a high potential source for endogeneity; in this case, the right-hand-side variables will be correlated with the error term, and then become endogenous regressors. We adopt the instrumental variable (IV) estimation to correct for endogeneity problems by using an appropriate set of instruments.[22]

A secondary empirical issue is that the standard errors of the IV estimators would suffer from the presence of heteroskedasticity[23] of unknown form and invalid statistical inference. We correct for this issue on our poverty model by using the IV approach in the context of the GMM discussed in the next subsection.

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[21] More on this is discussed in the subsection of model specifications.
[22] See discussions of the appropriate set of instruments in the empirical results chapter.
[23] See Appendix B.1 for details.

Estimation Methodology

The various estimation methods used are partially for the purpose of checking the robustness of this study's results on different econometric model specifications. Thus, as a baseline, we estimate an equation using fixed effects (FE) and random effects (RE) estimators. Then we use the GMM-IV estimation method in our estimation to correct for endogenous right-hand-side variables and other consistent estimators of the variance-covariance matrix. And we finally employ the dynamic panel GMM estimation for the growth rate model.

Fixed Effects and Random Effects[24]

The standard model is

$$y_{it} = x_{it}'\beta + \eta_i + \nu_{it} \tag{4.3}$$

where y_{it} is the dependent variable, x_{it} is a vector of explanatory variables, η_i is the unobserved time-invariant country-specific effects, ν_{it} is a vector of idiosyncratic disturbances, $i = 1,...,N$, and $t = 1,...,T$.

The fixed effects model allows for the possibility that there is arbitrary correlation between the country-specific effects, η_i , and the observed explanatory variables, x_{it} . In order to estimate this model, we first obtain the country specific means by averaging over $t = 1,...,T$:

$$\bar{y}_i = \bar{x}_i\beta + \eta_i + \bar{\nu}_i \qquad \text{where} \quad \bar{y}_i = T^{-1}\sum_{t=1}^{T} y_{it} \text{ ; } \bar{x}_i = T^{-1}\sum_{t=1}^{T} x_{it} \text{ ; and } \bar{\nu}_i = T^{-1}\sum_{t=1}^{T} \nu_{it} \tag{4.4}$$

[24] This discussion is heavily based on Wooldridge (2002) and some based on Gujarati (2003).

Subtracting the country-level means from each observation, we obtain

$$y_{it} - \bar{y}_i = (x_{it} - \bar{y}_i)\beta + (\nu_{it} - \bar{\nu}_i) \tag{4.5}$$

So that the fixed effects are swept in Equation (4.5) and this can to be estimated by the Ordinary Least Square (OLS) to obtain consistent estimates of the parameter vector, β. Due to the elimination of the unobserved specific effect, it is crucial to note that the fixed effects model cannot include any observable time-invariant explanatory variables, for instance we have no regional dummy variables among the explanatory variables.

The random effects model, on the other hand, requires the assumption that the country-specific effects, η_i, and the observed explanatory variables, x_{it}, are not correlated with one another, and combines the country-specific effects with the error term to form a composite disturbance term, $(\eta_i + \nu_{it})$. Note that the composite errors are serially correlated due to the existence of the time-invariant unobserved effects in the error term. Thus, the random effects approach uses the generalized least square (GLS) estimation to cope with this serial correlation problem. However, if individual-specific effects are correlated with any of the explanatory variables, the random effects estimates will be inconsistent. The random effects estimator can be written:

$$\hat{\beta}_{RE} = \left(\sum_{i=1}^{N} X_i^{'} \hat{\Omega}^{-1} X_i \right)^{-1} \left(\sum_{i=1}^{N} X_i^{'} \hat{\Omega}^{-1} y_i \right) \tag{4.6}$$

A Hausman (1978) specification test can test the appropriateness of the fixed effects model relative to the random effects model. The test examines the difference between fix effects and random effects estimates. If $\hat{\beta}_{FE}$ and $\hat{\beta}_{RE}$ is an M x 1 vector of estimates, then the Hausman statistic, H, can be computed as follows:

$$H = (\hat{\beta}_{FE} - \hat{\beta}_{RE})' \left[A\hat{V}ar(\hat{\beta}_{FE}) - A\hat{V}ar(\hat{\beta}_{RE} \right]^{-1} (\hat{\beta}_{FE} - \hat{\beta}_{RE}) \quad (4.7)$$

where $AVar(.)$ denotes the asymptotic variance; the test statistic H is asymptotically distributed as χ^2_M under the null hypothesis.

Under the null hypothesis, unobserved individual effects are uncorrelated with observed explanatory variables. Both the fixed effects and the random effects are consistent, but the random effect is efficient. A statistically significant difference between the two estimators is evidence against the nonexistence of correlation between the country-specific unobserved effects and the observed explanatory variables as assumed by the random effect model. This would support the fixed effects model against the random effects.

The consistency of standard estimation methods relies on the strict exogeneity assumption that the error term is uncorrelated with any of the regressors within any period. A number of empirical studies have concerned themselves with this specific issue including the research on urbanization and poverty.

Panel GMM-IV Estimation[25]

In order to correct for the violation of strict exogeneity, a standard way to deal with endogenous explanatory variables can be employed through the utilization of instrumental variables (IV) procedures. A secondary issue involves the presence of heteroskedasticity. In this case, the standard IV coefficient estimators are consistent, yet the usual variance estimators yield standard errors that are invalid for statistical inference. The widely employed approach used to cope with both issues, endogeneity and heteroskedasticity of unknown form can be handled using the generalized method of

[25] See Appendix B.1 for details.

moments (GMM), first developed by Hansen (1982). The efficient GMM constructs an estimator based on orthogonality conditions to produce consistent estimates in the presence of heteroskedasticity of unknown form; it may suffer from poor finite sample performance. Hence, the standard IV estimators might be preferable to GMM estimators if there is no concern as to heteroskedasticity.

Valid instruments should be correlated with the included endogenous explanatory variables, but orthogonal to the error term. To test the validity of the instruments, the Hansen (1982) test for overidentifying restrictions is applied to jointly test the appropriateness of the instruments. The null hypothesis for the Hansen test is that the instruments are valid such that they are uncorrelated with the errors. Under the null hypothesis, the test statistic is distributed as $\chi^2_{(L-k)}$, where L is the number of instruments, and k is the number of parameters in the model.

Dynamic Panel GMM Estimation[26]

As discussed in the theoretical model chapter, we are inspired to examine the effect of urbanization on the pro-poor growth rate, i.e., the dynamic relationship between urbanization and poverty reduction outcomes in terms of the monetary dimension. Various empirical studies have recently attempted to examine a variety of interests in several fields on the growth rate, especially economic growth works such as Beck et al. (2000), Bond et al. (2001), and Rioja and Valev (2004). All the works mentioned above are based on dynamic panel data techniques developed by Anderson and Hsiao (1982), Arellano and Bond (1991), and Blundell and Bond (1998). These papers apply a recently developed instrumental variable technique to take care of endogeneity problems as well.

[26] This subsection is heavily based on Arellano and Bond (1991), Bond et al. (2003), and Rioja and Valev (2004).

Therefore, we apply these methods to estimate the effect of urbanization on the pro-poor growth rate.

We use the instrumental variable estimator developed by Anderson and Hsiao (1982), Arellano and Bond (1991), and Blundell and Bond (1998). This allows us to obtain consistent estimates of the parameters in the growth equation in the presence of dynamics and endogenous explanatory variables. This approach can be explained in the following.[27]

Equation (4.3) is rewritten as a dynamic panel data model:

$$y_{it} = \alpha y_{i,t-1} + x_{it}\beta + \eta_i + \nu_{it} \quad \text{for } i = 1,\ldots,N \text{ and } t = 1,\ldots,T \tag{4.8}$$

where y_{it} is the growth rate; x_{it} includes variables that potentially affect the growth rate; and η_i is a set of unobserved, time-invariant, country specific effects.

We first-difference the dynamic equation to eliminate the individual specific effects, η_i:

$$y_{it} - y_{i,t-1} = \alpha(y_{i,t-1} - y_{i,t-2}) + (x_{it} - x_{i,t-1})'\beta + (\nu_{it} - \nu_{i,t-1}) \tag{4.9}$$

The differenced lag of the growth rate $(y_{it} - y_{i,t-1})$ in Equation (4.8) is endogenous, and x contains endogenous dependent variables. We need instruments to consistently estimate Equation (4.9). These can be obtained under the assumption that the error terms in Equation (4.8) are serially uncorrelated, that is $E[\nu_{it}\nu_{is}] = 0$. The following moment conditions yield appropriate instruments for the differenced lagged dependent variable and endogenous explanatory variables.

[27] See Appendix B.2 for details.

$$E\left[y_{i,t-s}\Delta\nu_{it}\right]=0 \qquad \text{for } t=3,\ldots,T \text{ and } s\geq 2 \qquad (4.10)$$

$$E\left[x_{i,t-s}\Delta\nu_{it}\right]=0 \qquad \text{for } t=3,\ldots,T \text{ and } s\geq 2 \qquad (4.11)$$

The moment conditions in Equations (4.10) and (4.11) allow us to employ appropriately lagged levels of the variables as instruments for the first-differenced endogenous variables. However, in this case where lagged levels of the series are weakly correlated with subsequent first-differences, the Arellano and Bond (1991) differenced GMM estimator tends to suffer from a bias problem in a small sample (Blundell and Bond 1998).

To deal with this problem, Arellano and Bover (1995) and Blundell and Bond (1998) propose an estimator that makes use of additional information in levels. This new estimator is referred to as the system GMM estimator. This approach combines two sets of equations—one set in first-differences and the other set in levels—into a system of equations. This also introduces additional $T-2$ linear moment restrictions given by:

$$E\left[(\eta_i+\nu_{it})\Delta y_{i,t-1}\right]=0 \qquad (4.12)$$

$$E\left[(\eta_i+\nu_{it})\Delta x_{i,t-1}\right]=0 \qquad (4.13)$$

The system GMM estimator utilizes the moment conditions in Equation (4.9) through (4.13) to consistently estimate the parameters of interest in Equation (4.8). The consistency of the GMM estimator relies on the assumption of white noise errors in the level equation. If the errors are serially correlated, the GMM estimator will lose its consistency. We, therefore, apply the test for the second-order autocorrelation in the differenced equation. The test statistic developed by Arellano and Bond (1991) falls within the null hypothesis in that there is no second-order serial correlation.

Data Description and Sources

The data used in the empirical estimations are based on an unbalanced panel data set that comprises 143 countries for the cross sections with variation between six-time periods and nine-time periods for the time series (5-year intervals that cover the period of 1960 to 2005). The data description and sources are explained as follows:[28]

Dependent Variable

The HDI is obtained from the 2007/2008 United Nations Human Development Report (HDR), UNDP.[29] The HDI measures the index of human development by equally weighting three dimensions of human development: Health, through life expectancy at birth, Education through the adult literacy rate and the gross schooling enrollment rate, and Income, through a decent standard of living measured by GDP per capita. The magnitude of the HDI ranges between zero and one, and is displayed up to three decimal points. A higher HDI means that a country has increased human development.

The Foster-Greer-Thorbecke (FGT) generic class of additive poverty indicators is comprised of three indices measured by the headcount index (HI: the proportion of population living in a household with income or consumption per person below the poverty line), the poverty gap (PG: the mean distance below the poverty line as a proportion of the poverty line), and the square poverty gap (SPG: the severity of poverty in a population as it allows comparison among the poor). The poverty line in this study

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[28] Also see Appendix E for a summary of data description and sources.
[29] Data were obtained from http://hdr.undp.org/en/media/hdr_20072008_en_complete.pdf (accessed November 2007).

used to evaluate the poor is set at 1 U.S. $ (1993 PPP$) a day per person. The data set on these three indices are obtained from the World Bank's *PovCalNet.*[30]

For education outcomes,[31] the primary school net enrollment data set is obtained from the Barro and Lee (2000) data set on education attainment across countries.[32] The primary school net enrollment ratio is defined as the total primary school enrollment (both sexes) of the official primary school age group expressed as a percentage of the population from the same age group. In this study, we use the net enrollment educational attainment of the total population aged 15 and over for the data set. The youth literacy rate is usually defined as the percentage of the population aged 15-24 years who can read and write, with comprehension, a short, simple statement regarding their everyday lives. The youth literacy rate data set is obtained from the 2007 World Development Indicator (WDI) CD-ROM, the World Bank.

For health outcomes,[33] the infant mortality rate is defined as the number of child deaths between birth and the age of one, as expressed per 1,000 live births. The indicator is used as a measure of children's well-being and the level of effort being made to maintain child health. Life expectancy at birth is the average number of years that a newborn baby is expected to live if the age-specific mortality rates effective at the year of birth apply throughout his or her lifetime. Both data sets are obtained from the 2007 WDI CD-ROM.

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[30] *PovCalNet* is an interactive computational tool developed by staff of the Bank's research group to allow users to replicate the calculations made by the Bank's researchers in estimating the extent of absolute poverty in the world. The data set is available at: http://iresearch.worldbank.org/PovcalNet/jsp/index.jsp (accessed May 2007).

[31] The definitions are based on the United Nations Educational, Scientific, and Cultural Organization (UNESCO).

[32] Data were obtained from http://www.cid.harvard.edu/ciddata/ciddata.html (accessed May 2007).

[33] The definitions are based on the United Nations Children's Fund (UNICEF).

For decent standard of living outcomes via agricultural and non-agricultural outputs,[34] agricultural value added per worker is a measure of agricultural productivity in terms of constant 2000 U.S. $. Value added in agriculture measures the outputs of the agriculture sector less the value of intermediate inputs. Agriculture comprises value added from forestry, hunting, and fishing as well as cultivation of crops and livestock production, and the non-agricultural percentage of GDP is a measure of non-agricultural (i.e., industries and services) productivity. Both data sets are obtained from the 2007 WDI CD-ROM.

Urbanization

Urbanization is measured by urban population as a percent of total population. The urban percentage is the proportion of a country's total national population that resides in urban areas. Any person not residing in an area classified as urban is counted in rural populations. However, definitions of urban population vary slightly from country to country. The data used for urbanization are obtained from the World Urbanization Prospects: The 2005 Revision, the Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat.[35] The data ranges between zero and one and a few countries are excluded, such as Singapore or Hong Kong, which are considered as having no rural population.

Other Explanatory Variables

The 2007 WDI CD-ROM provides the source of additional data used in the empirical analysis: GDP per capita (constant 2000 US dollars per person), openness

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[34] The definitions are based on the World Bank (WB).
[35] Data were obtained from http://esa.un.org/unup (accessed May 2007).

(ratio of import and export to GDP), official development assistance (ODA: the form of aids from other countries shown as a percentage of Gross Nation Income), inflation, the agricultural share of GDP, the government consumption share of GDP, and national population density. Note that for donor countries, we substitute the zero value of the ODA for donor countries.

The national road density data between 1963 and 1989, and 2004 (used for 2005) are obtained from the World Road Statistics (WRS), the International Road Federation (IRF)[36], while the years 1990 to 2000 are obtained from the 2007 WDI CD-ROM. The variable *freedom* is calculated by a simple average of the index of political and civil liberties data set titled "Freedom in the World Country Ratings" compiled by Freedom House.

Data on schooling years are obtained from the Barro and Lee (2000) data set. Agricultural labor force as a percent of the total labor force data set is obtained from the Food and Agriculture Organization (FAO), United Nations.[37] Data on the yearly long run average rainfall in each country are constructed by the Tyndall for Climate Change Research.[38] The International Monetary Fund (IMF) CD-ROMs including the 1972-1989 historical Government Finance Statistics (GFS) and the 2007 GFS provide the data for the share of government expenditures on health and education of the total expenditures and the degree of decentralization. The degree of decentralization is the ratio of sub-national share of expenditures as a percentage of total expenditures.

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[36] Data were obtained from http://www.irfnet.org/cms/pages/en/viewpage.asp (accessed May 2007).
[37] Available online at http://faostat.fao.org (accessed May 2007).
[38] Data were obtained from http://www.cru.uea.ac.uk/~timm/cty/obs/TYN_CY_1_1.html (accessed May 2007).

The Hypothesis Framework

As mentioned previously, we develop our empirical analysis by using a variety of poverty indicators to examine the “direct effect” of urbanization on poverty. For non-monetary poverty measures, we use the UNDP’s Human Development Index (HDI). The HDI is a comprehensive index that is calculated by an arithmetic average of three standard human development aspects: education, health, and a decent standard of living.[39] This reveals that a higher value of the HDI means less poverty. For strict monetary poverty measures, we utilize a data series from Foster-Greer-Thorbecke (FGT):[40] the headcount index (HI), the poverty gap (PG), and the square poverty gap (SPG).

The HDI measures the human well-being of individuals as the average overall achievements in three aspects and poverty is multidimensional. The HDI assesses conditions of poverty in a given country and represents a real picture of the quality of standard of living in that country. However, the HDI has a disadvantage in that it is subject to criticisms and the problem of the normalization assumption, as discussed in Chapter II. Therefore, we alternatively disaggregate the HDI into three specific aspects and check the “channeled effects” of urbanization within each of these aspects. In particular, this provides a robust set of results, which examine three compositions of the HDI. Thus, we employ the basic indicators to depict each accomplishment aspect of a higher standard of living. For education outcomes, we use primary school net enrollment and youth literacy rate. For health outcomes, we employ the infant mortality rate and life expectancy at birth. For decent standard of living outcomes, we utilize an agricultural

[39] See Chapter II for details.
[40] See Chapter II for details and discussed later in this chapter.

value added per worker and the non-agricultural percentage of GDP. Since most of the poor participate in agricultural sectors, we expect that the enhancement of technology in agricultural and non-agricultural sectors by the effect of urbanization will raise productivity and lead to higher incomes for the poor.

Therefore, the testable hypotheses derived from the theoretical chapter and the above discussions are as follows:

Hypothesis 1: On average, there is an optimal level of urbanization such that a country with an optimal level of urbanization will be best suited for an increased standard of living as proxied by the HDI. On the one hand, an increase of urbanization in a country that has an urbanization level below the optimal level of urbanization would be expected to improve upon the standard of living for the poor. On the other hand, a country with an urbanization level beyond the optimal level of urbanization would be anticipated to have a lower standard of living.

Hypothesis 2: On average, different regions react differently to a same increase in urbanization.

Alternatively, the level of urbanization development used for assessing a country’s human well-being would be regional categories, rather than worldwide categories. Hence, we include regional dummy variables in the regression for East Asia (EASIA), Middle East and North Africa (MENA), and Latin America and the Caribbean (LAC). Note that the region of Sub-Saharan Africa is omitted.

Hypothesis 3: With poverty in terms of the monetary dimension measured by a series of the FGT index, there is an optimal level of urbanization such that a country with the optimal level of urbanization will have the highest pro-poor growth rate. A negative effect on the growth rate of poverty reduction outcomes is determined by a level of urbanization that is either below or beyond optimal levels of urbanization.

Hypothesis 4: The optimal level of urbanization leads to better provisions of infrastructures on different basic channels in order to reduce poverty. The optimization of urbanization will not only sufficiently deliver the basic services (education and health) to individuals, especially for the poor, but also maximize the growth rate of agricultural and non-agricultural productivities, which in turn contribute and trickle down into promoting poverty reduction outcomes.

Model Specifications

In this subsection, we describe the specific empirical models used to analyze the effect of urbanization on poverty reduction outcomes according to the subsection of the hypothesis framework. For the first hypothesis, the general functional forms of poverty determinants are expressed respectively as follows:

$$HDI_{it} = f(Urban_{it}, Urban_{it}^2, X_{it}) + u_{it} \quad (4.14)$$

$$HDI_{it} = f(Urban_{it}, X_{it}) + u_{it} \quad (4.15)$$

where HDI_{it} is the Human Development Index (HDI); $Urban_{it}$ is the urban percentage as the ratio of urban population to the total population (Urbanization); $Urban_{it}^2$ is the squared value of the urban percentage; X_{it} is a set of control variables consisting of economic, socio-demographic, and government institutional variables; and $u_{it} = n_i + \nu_{it}$ is a composite error of unobserved country-specific effects (η_i) and a vector of idiosyncratic disturbances (ν_{it}).

It is important to note that since the HDI is measured for human well-being, which is based on a scale of 0 to 1, a country with a higher value of the HDI will have less poverty.

From Equations (4.14)—(4.15), we adopt the following model specifications:

$$HDI_{it} = \beta_0 + \beta_1 Urban_{it} + \beta_2 Urban_{it}^2 + \beta_j X_{it} + u_{it} \quad (4.16)$$

$$HDI_{it} = \beta_0 + \beta_1 Urban_{it} + \beta_j X_{it} + u_{it} \quad (4.17)$$

The working hypotheses is that a coefficient multiplying with $Urban$ is positive ($\beta_1 > 0$) and with $Urban^2$ is negative ($\beta_2 < 0$). In Equation (4.16), the best (optimal) degree of urbanization is, therefore, given by[41]

$$Urban^* = -\frac{\beta_1}{2\beta_2} \quad (4.18)$$

For the second hypothesis, we introduce interaction terms between urbanization and regional dummy variables for East Asia (*UrbanEASIA)*, Middle East and North Africa *(UrbanMENA)*, and Latin America and the Caribbean *(UrbanLAC)* into Equation (4.17). Thus, the model specification is as follows:

$$HDI_{it} = \beta_0 + \beta_1 Urban_{it} + \beta_2 UrbanEASIA + \beta_3 UrbanMENA + \beta_4 UrbanLAC + \beta_j X_{it} + u_{it} \quad (4.19)$$

The coefficients of new interaction terms will depend on regional patterns of economic development. However, the expected sign of overall urbanization effects for a particular region is expected to be positive holding all else constant, i.e., the urbanization effect on the HDI is positive.

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[41] This expression is simply derived by taking the partial derivative of Equation (4.16) with respect to urbanization ($Urban$): $\frac{\partial HDI}{\partial Urban} = \beta_1 + 2\beta_2 \overline{Urban}$, where $\overline{Urban}$ represents the mean value of urbanization in our sample.

The set of control variables used in Equations (4.16)—(4.17) and (4.19) consists of GDP per capita to capture a country's level of economic development, the degree of decentralization, openness, the level of the official development assistant (ODA), freedom, road density, and population density. We expect GDP per capita, the degree of decentralization, openness, the ODA, freedom, and road density to have a positive causal relationship with the HDI (poverty reduction outcomes). GDP per capita raises the standard of living, especially for daily necessary subsistence. The degree of decentralization measured by the share of sub-national expenditures of total government expenditures reflects information on how local government's basic service provisions respond to the needs of their residents.

More openness on exports and imports is likely to stimulate market expansion for domestically produced goods leading to higher employment and accessible consumption. The level of the ODA captures the role of development aid that aims to assist and promote economic development in the country. Although there are presumably proportionate and disproportionate uses for financial development assistance in a recipient country's budget spending, the expected effect of this variable is positive on the HDI. Freedom is calculated by averaging the values of political rights and civil liberties and measuring them on a scale of 1 to 7, with 1 being the highest level of freedom. We expect that a lower value of the variable *freedom* has a positive impact on poverty alleviation. Road density is used to control for the role of geography in which population reside and for available infrastructure in comparison to the size of a country. Population density is used to control for differences between the population and land usage. A large amount of population will cause congestion and worsen the overall standard of living whereas economies of scale based on population density will lead to efficient provisions for basic services. Thus, the expected impact of population density on the HDI is ambiguous.

To test the third hypothesis, when poverty variables are measured in terms of the monetary dimension by a series of the FGT index, we adopt the dynamic panel GMM estimation to estimate the effect of urbanization on the pro-poor growth rate (poverty reduction outcomes). From the standard dynamic model, we obtain the poverty model:

$$\ln Pov_{it} - \ln Pov_{i,t-1} = f(Pov_{i,t-1}, Urban_{it}, Urban_{it}^2, X_{it}) + u_{it} \quad (4.20)$$

$$Povg_{it} = \beta_0 + \beta_1 iPov_{it} + \beta_2 Urban_{it} + \beta_3 Urban_{it}^2 + \beta_j X_{it} + u_{it} \quad (4.21)$$

where $\beta_1 = (\alpha - 1)$; $Povg_{it} = \ln Pov_{it} - \ln Pov_{i,t-1}$ is the rate of changes of the FGT index; $iPov_{it} = Pov_{i,t-1}$ is the initial level of the FGT index, which consists of the headcount index (HI), the poverty gap (PG), and the square poverty gap (SPG); and X_{it} is a set of traditional control variables.

As discussed in Chapter III (Equations (3.28) and (3.29)), since the proportionate change in poverty is theoretically expected to be negative (i.e., pro-poor growth, which reduces a number of the poor), the optimal level of urbanization in this calculation will be inversely similar to Equation (4.18). We test for the convex function in terms of a negative coefficient for the linear term ($Urban : \beta_2 < 0$) and a positive coefficient for the quadratic term ($Urban^2 : \beta_3 > 0$).

We include the initial level of the FGT index based on the convergence hypothesis. The convergence hypothesis states that the lower the starting level, the higher the rate of growth. This variable is expected to have a diminishing marginal effect. The set of control variables used in Equation (4.21) consists of inflation, the government consumption share of GDP, the agricultural share of GDP, openness, and years of schooling. Since we presumed that high inflation in low and middle income countries have an adverse effect on the pro-poor growth rate, we expect a negative coefficient of inflation on the pro-poor growth rate. We would expect that increased government spending in non-productive expenditures would retard income improvement of the poor. Additionally, we expect that an increase of the government consumption share of the GDP has a negative impact on the pro-poor growth rate.

We also control differences for the agricultural share of GDP relating to urbanization in terms of a linked relationship between urban and rural areas. Although the agricultural sectors are seen as having a smaller effect on growth than the non-agricultural sectors, a higher share of agricultural sectors will result in larger outcomes of poverty reduction because most of the poor in developing countries usually participate much more in growth in agricultural sectors. We would expect that the agricultural share of GDP has a positive impact on the pro-poor growth rate. Openness and years of schooling controlled for difference are also expected to promote pro-poor growth. More openness to trade implies a better market effectiveness to produce and increase employment, especially low-skilled laborers who are usually the poor (Figini and Santarelli 2002, 2006). Schooling years captures better education and in turn makes it easier to improve labor skills and develop new innovations.

To test the last hypothesis, we also examine the “channeled effects” of urbanization through three poverty reduction outcomes based on basic infrastructure: education, health, and a decent standard of living, as mentioned previously. The test of the optimal degree of urbanization in this hypothesis can be observed in the calculation in Equation (4.18). However, on the one hand, if the proxies used in estimates for the "channeled effects" are a benevolent index, urbanization will exhibit the concave function to these proxies. On the other hand, if the proxies used are a malevolent index, the estimates of urbanization will show the convex function to these proxies.

Thus, the functional form and the model specification of the education outcomes are expressed by

$$EduOut_{it} = f(Urban_{it}, Urban_{it}^2, X_{it}) + u_{it} \qquad (4.22)$$

$$EduOut_{it} = \beta_0 + \beta_1 Urban_{it} + \beta_2 Urban_{it}^2 + \beta_j X_{it} + u_{it} \qquad (4.23)$$

where $EduOut_{it}$ is measure by the primary school net enrollment and the youth literacy rate; and X_{it} is a set of control variables consisting of GDP per capita, freedom, the education expenditure share of the total expenditure, and population density.

GDP per capita is used to control differences for income per capita. It is likely that higher income per capita has been associated with higher education levels and better policies. We also control for the education expenditure share of the total expenditure since we expect that a higher share of education spending will improve education. We include population density to control differences for population compared to land uses. We expect that population density will be ambiguous in terms of delivering educational services.

The health outcomes are given as follows:

$$HealOut_{it} = f(Urban_{it}, Urban_{it}^2, X_{it}) + u_{it} \qquad (4.24)$$

$$HealOut_{it} = \beta_0 + \beta_1 Urban_{it} + \beta_2 Urban_{it}^2 + \beta_j X_{it} + u_{it} \qquad (4.25)$$

where $HealOut_{it}$ is measured by the infant mortality rate and life expectancy at birth; and X_{it} is a set of control variable consisting of GDP per capita, freedom, health expenditure shares of the total expenditure, and years of schooling.

Most of these variables are anticipated to have similar effects to those in the education outcomes equation. However, the variables *schooling years* and *freedom* can be different. We believe that increased years of schooling are likely to have a positive impact on better health outcomes concerning higher education. Freedom captures the level of political rights and civil liberties on a scale of 1 to 7, with 1 being the highest level of freedom. This variable reflects a protection from external impediments such as lack of health care. We would expect that this variable has a negative coefficient on the infant mortality rate and a positive coefficient on life expectancy at birth.

The last “channeled effect” proposed is a decent standard of living aspect in which the HDI takes into consideration into its calculation by using GDP per capita. The relative contributions of an economic sector to poverty reduction are linked into the direct and indirect effects on growth that helps the poor. Hence, the roles of agricultural and non-agricultural outputs are used to assess the effect of urbanization on poverty reduction outcomes by enhancing productivity (or proper technology), which is another large contribution from urbanization. The productivity in agricultural and non-agricultural sectors is a crucial role in designing and passing effective poverty reduction strategies, which in turn trickle down into an improvement in living standards for the poor.

In this estimation, we use the dynamic panel GMM approach in order to adequately capture the effect of urbanization and the ways in which to improve a decent standard of living (through enhancing productivity) in terms of the growth rate, rather than the percentage changes. A decent standard of living outcome via agricultural and non-agricultural productivities can be specified as follows:

$$\ln ProdOut_{it} - \ln ProdOut_{i,t-1} = f(ProdOut_{i,t-1}, Urban_{it}, Urban_{it}^2, X_{it}) + u_{it} \quad (4.26)$$

$$ProdOutg_{it} = \beta_0 + \beta_1 i ProdOut_{it} + \beta_2 Urban_{it} + \beta_3 Urban_{it}^2 + \beta_j X_{it} + u_{it} \quad (4.27)$$

where $ProdOutg_{it} = \ln Prodout_{it} - \ln ProdOut_{i,t-1}$ is measured by the growth rate of the agricultural value added per worker and the non-agricultural percentage of GDP; $iProdOut_{it}$ is the initial level the agricultural value added per worker and the non-agricultural percentage of GDP; and X_{it} is a set of control variables consisting of the agricultural labor force share of the total labor force, openness, schooling years, and precipitation. Note that precipitation is amounts of rainfall only used for the estimation of the agricultural value added per worker.

The agricultural labor force share of the total labor force is used to control for differences in the amount of labor that is employed in agricultural sectors. Note that employment in agricultural sectors also reflects the proportion of employment in industrial and service sectors. We expect a negative relationship between the agricultural force share and productivity outcomes since there are adoptions of new technologies such as machines or fertilizers that replace the labor force in agricultural sectors. At the same time, we expect that there must be a negative impact on the agricultural force share of non-agricultural outputs per GDP. Since non-agricultural products usually come from industrial and service sectors, these two sectors are attractive to the employment of agricultural labor force. Thus, absorption of the labor force in agriculture would decrease the potential non-agricultural outcome. We also controlled for openness to trade and years of schooling because increases in these variables are expected to have a positive impact on productivity outcomes. Finally, precipitation is used to control for the impact of rainfall amounts in each year on agricultural production. We expect a positive impact on agricultural sectors, due to many agricultural products relying heavily on rainfall.

CHAPTER V

EMPIRICAL RESULTS

In this chapter, we present the results obtained from implementing empirical approaches in the previous chapter. In the first subsection of the chapter, we examine the optimal degree of urbanization on poverty reduction outcomes with the baseline on fixed effects and random effects estimates and then provide the generalized method moments (GMM) instrumental results. In addition to results, we examine the effect of urbanization on poverty in different regions relative to the rest of the world. In the second subsection, we examine and discuss the empirical evidence of the effect of urbanization on the pro-poor growth rate by using the dynamic panel GMM estimation. The last subsection reports findings concerning the "channeled effects" of urbanization through potential infrastructure transmission for poverty reduction outcomes.

Urbanization and Poverty Reduction Outcomes

As discussed earlier, our analysis uses the model specification based on equations (4.17)—(4.19) where the dependent variable is the HDI representing poverty reduction outcomes. Note that the improvement of the HDI for a country indicates increased poverty reduction outcomes (or less poverty). The econometric estimates are shown in Table 1, where Columns (1)—(3) reveal the quadratic form for urbanization, and Columns (4) and (5) report the linear form for urbanization.

Results of fixed effects and random effects are reported in Columns (1) and (2). We conduct the Hausman specification test to compare fixed effects and random effects models. The test, which asymptotically follows a chi-square distribution with 7 degrees of freedom, generates the p-value of 0.000. Hence, we reject the null hypothesis that estimators from the random effects model would be consistent and efficient. Therefore, we prefer using fixed effect results from Column (1). The coefficients of urbanization and squared urbanization variables show the concave shape and both are statistically significant at the 1% level. By taking the partial derivative with respect to urbanization, these results exhibit that there is an optimal degree of urbanization for poverty reduction outcomes.

However, as discussed earlier, our analysis is concerned with the potential of endogeneity. Especially by the fact that economic shocks may influence urbanization levels, income per capita, the donor's policies concerning aid in developing countries, the recession on competitiveness on international trade, and its own government spending, which in turn means expenditure decentralization, as well as the ability to reduce the level of poverty. The instrumental variable (IV) estimator is used to deal with endogeneity problems. By implementing the IV approach, we require an appropriate set of instruments. It is important to note that the lagged values of the independent variables makes for a good set of instruments if the errors do no exhibit autocorrelation. Thus, we adopt the Wooldridge autocorrelation test to parsimoniously validate the lagged values of the independent variables for a set of instruments.[42] In this model specification, the autocorrelation test results reinforce the hypothesis in that there is no first-order autocorrelation in the data and it cannot be rejected at the 10% significance level.[43]

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[42] See Wooldridge (2002) pp 282-283.

[43] Drukker (2003) provides simulation results showing that the autocorrelation test contains adequate size and power properties in reasonably sized samples. He has also proposed a user-written program, *xtserial*, to perform this autocorrelation test in STATA. The test for autocorrelation in this panel data yields the following results: F (1, 34) = 2.514, Prob > F = 0.1221.

Table 1: Estimates of Urbanization and Poverty Reduction Outcomes

Dependent Variable	**Human Development Index (HDI)**				
	Quadratic form			**Linear form**	
Independent Variable	**(1) FE**	**(2) RE**	**(3) GMM**	**(4) GMM**	**(5) GMM**
Urbanization	0.215 **	0.440 **	0.481 *	0.050 *	0.103 **
	(0.065)	(0.134)	(0.191)	(0.023)	(0.030)
Urbanization^2	-0.245 **	-0.334 **	-0.355 *		
	(0.052)	(0.092)	(0.142)		
GDP per Capita [a]	0.072 **	0.071 **	0.050 **	0.055 **	0.062 **
	(0.007)	(0.006)	(0.012)	(0.008)	(0.007)
Degree of Decentralization	0.029 #	0.032 *	0.068 #	-0.034	-0.072 *
	(0.016)	(0.015)	(0.041)	(0.034)	(0.033)
Openness	-0.003	0.002	0.047 *	-0.014	0.009
	(0.005)	(0.005)	(0.023)	(0.012)	(0.012)
ODA	0.028	-0.109	-0.209	-0.175	0.221
	(0.115)	(0.097)	(0.368)	(0.201)	(0.210)
Freedom	0.0001	0.0002	-0.004	-0.005	0.0008
	(0.001)	(0.001)	(0.006)	(0.004)	(0.004)
Population Density [a]	0.078 **	0.006	0.011	-0.014 **	-0.001
	(0.016)	(0.005)	(0.014)	(0.004)	(0.005)
Road Density [a]	0.002	0.004	-0.005	0.012 *	-0.007
	(0.002)	(0.003)	(0.012)	(0.006)	(0.007)
Urbanization x EASIA Dummy					-0.102 **
					(0.028)
Urbanization x MENA Dummy					-0.096 **
					(0.029)
Urbanization x LAC Dummy					-0.066 **
					(0.017)
Hansen Test (*p* -value)			0.5034	0.1401	0.2431
Time Dummies	Yes	Yes	Yes	No	No
No. of observations	232	232	142	116	116
R-squared	0.9464 (Within)				

** significant at 1%; * at 5%; # at 10%

[a] The variable is in the form of logarithm.

Numbers in parenthesis are robust standard errors.

Hausman Specification Test (1) vs (2) : chi(15) = 74.70 and Prob>chi2 = 0.0000

The null hypothesis of Hansen Test is that the instruments used are not correlated with the residuals.

In all specifications from Columns (3)—(5), the Hansen Test (*p*-value) for overidentifying restrictions reveal that we fail to reject the null hypothesis of joint validity of the instruments used for, as discussed earlier. Column (3) in Table 1 presents the results from the GMM estimation.[44] The coefficients of both urbanization variables are statistically significant at the 5% level. The optimal level of urbanization is (0.481/2x0.355) = 0.677 with strong and significant coefficients. From the optimal level of urbanization, a one-standard deviation (0.203) increase in urbanization leads the HDI to be 0.015 (or 1.5 percentage points) less over five years, ceteris paribus.[45] However, it is important to note that the optimal degree of urbanization should vary with the level of development, as discussed in the theoretical chapter.

As we expected, GDP per capita is statistically significant at the 1% level and is positively associated with an improvement of the HDI. A one percentage point increase in urbanization will lead to an increase in the HDI by 5 percentage points, all else constant. Additionally, we obtain a positive impact from the degree of decentralization and openness to trade. The degree of decentralization is included in the regression as a measure of government decentralization. A one percentage point increase in the degree of decentralization is associated with an increase in the HDI by 6.8 percentage points, all else constant. Note that this estimated coefficient shows a weak significance at the 10% level. The results for openness suggest that higher international trade is positive for poverty reduction outcomes. The coefficient of openness is positive and statistically

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[44] We test the presence of heteroskedasticity for the IV approach to see whether we will look for GMM or IV by using *ivhettest* in STATA. The results are Pagan-Hall general test statistic = 7.491, *p*-value = 0.0062. This means that the hypothesis that the disturbance is homoskedastic can be rejected at the 1% significance level.
[45] The figure 0.015 is the difference in the amount derived by substituting the different levels of urbanization in the quadratic form of urbanization. That is 0.015 = $\{(0.481x0.677)-(0.355x0.677^2)\}-\{(0.481x0.880)-(0.355x0.880^2)\}$, where one standard deviation (0.203) is obtained from the descriptive statistics based on the sample in this estimation.

significant at the 5% level. Holding every thing constant, a one point increase in openness is associated with an increase in the HDI by 4.7 percentage points.

Furthermore, the coefficients of the ODA and road density have a different impact from what we anticipated, but they are not statistically significant. At the same time, the results for population density and freedom are also insignificant. The coefficient of population density is positive, which means that efficiency of public provisions increases with a higher concentration of population. The coefficient of freedom is negative because we expected that a reduction in freedom would reduce the HDI. Note that freedom is measured on a scale of 1 to 7, with 1 being the highest level of freedom.

In Table 1, Columns (4) and (5) examine the linear relationship between urbanization and poverty reduction outcomes (the HDI). Column (4) reports that the marginal effect of urbanization on the HDI is positive and statistically significant at the 5% level. The economic interpretation of urbanization is that a one percentage point increase in urbanization leads to an increase in the HDI by 5 percentage points, all else constant. A country with higher urbanization will have a higher level of standard of living leading to a better outcome of poverty reduction such that basic service provisions are met and the living standard is improved by the effectiveness of economies of scale. However, our estimated coefficient of urbanization yields higher points than other studies reveal such as Akçay (2006)[46]. Sizable differences in our estimation would be addressed by econometric issues such as endogeneity problems.[47]

[46] Urbanization is used as one of the control variables to examine the effect of corruption on the HDI on which the estimated coefficient of urbanization yields 0.002 by using the OLS.

[47] For this model specification, we use the lagged values of the independent variables as a set of instrument variables and test for autocorrelation in the panel data- the results yield: F (1, 34) = 2.978, Prob > F = 0.0935. This means that the hypothesis that there is no first-order autocorrelation in the data cannot be rejected at the 5% significance level.

In Column (5), we include the interaction dummies for different regions to measure the different effects of urbanization on the HDI. The results reveal that the coefficients of urbanization and the interaction terms are statistically significant. We can see that the positive effect of urbanization on the HDI varies and depends upon regions and level of development. Holding other things constant, we begin with East Asia: in this region when 10 percentage points increase in urbanization will increase in the HDI by (0.103–0.102)x10 = 0.01 percentage point. Second, when urbanization increases 10 percentage points in Middle East and North Africa, the HDI will increase by (0.103–0.096)x10 = 0.07 percentage point. Finally, in Latin America and the Caribbean, when 10 percentage points increase in urbanization, the HDI will increase by (0.103–0.066)x10 = 0.37 percentage point. The evidence supports our hypothesis in that patterns of urbanizations effect on poverty reduction outcomes vary by regions.

However, the results from Columns (4) and (5) exhibit positive effects of urbanization on the HDI; what we derived from the theoretical chapter, the empirical results from Column (3), and our actual data set still convince us that there is an optimal level of urbanization necessary to promote the highest level of the HDI (poverty reduction outcomes). For example, although the urbanization level in Latin America countries is, on average, higher than that of East Asian countries, the HDI still varies between the two regions. This can be observed through a comparison of Bolivia, Argentina, and Thailand. In fact, the 2005 urbanization level of Bolivia (0.644) is higher than that of Thailand (0.325), but the 2005 HDI of Thailand (0.781) is higher than that of Bolivia (0.695). At the same time, Thailand has a lower 2005 urbanization level than that of Argentina (0.906), but the 2005 HDI of Argentina (0.869) is higher than that of

Thailand. We also see this analogous evidence when we compare developing and developed countries such as Venezuela and Switzerland. For example, Venezuela's 2005 urbanization level is 0.881 with a 2005 HDI at 0.792, while Switzerland has a lower 2005 urbanization level at 0.675 and a higher level of HDI at 0.955. Therefore, we should focus on the results of the optimal level of urbanization in order to provide the highest level of the HDI on which either the effect or the optimal level of urbanization on the HDI may be explained and taken into account, by not only historical and geographical backgrounds of each country, but also socioeconomic development of individual countries, across countries, and within regions.

Urbanization and Pro-poor Growth

In this subsection, we report the findings based on Equation (4.21). These findings are shown in Table 2 using the dynamic panel GMM-system estimation by the two-step approach. The results based on the two-step dynamic panel GMM-system estimate are likely to be superior when compared with the one-step approach.[48]

Concern about endogeneity problems is also addressed by the GMM-system estimation. As discussed previously, the GMM-system estimator uses "internal instruments" for endogenous variables in the persistent dependent variable, i.e., the income growth rate of the poor, and there may be no instruments suitable for most of the independent variables in an estimated equation. We, therefore, treat the 2-lagged value and earlier lagged values of potential endogenous variables as well as the dependent variable as a set of instrumental variables.

[48] According to Arellano and Bond (1991) and Blundell and Bond (1998), although the two-step approach is asymptotically more efficient, the two-step standard errors tend to be severely downward biased. Roodman (2006) proposed a user-written program on STATA, *xtabond2,* to compensate this disadvantage and to make available a finite-sample correction to the two-step covariance matrix derived by Windmeijer (2005).

In Table 2, Columns (1)—(3) report the results from the two-step dynamic panel GMM-system estimation for a series of the FGT index: the headcount index (HI), the poverty gap (PG), and the square poverty gap (SPG), respectively. It is important to note that the data presented in this subsection consist of a number of the poor in low and medium income countries, i.e., there is no developed country used in this sample for estimations. Since the proportionate change in poverty is always negative, we can derive the optimal level of urbanization that maximizes (in fact less poverty) the pro-poor growth rate. Column (1) uses the HI growth as pro-poor growth. By taking derivative with respect to urbanization, the optimal degree of urbanization is (15.354/2x15.650) = 0.491 with strong and significant coefficients at the 5% level. From the optimal level of urbanization, a one-standard deviation (0.190) increase in urbanization leads the HI growth rate to be 0.565 percentage point less over five years, ceteris paribus. This reveals that a number of the poor that can escape from being below U.S. 1$ income/consumption per day is much less than those at the optimal urbanization.

In Column (2), we employ the PG growth as pro-poor growth. The results report that both coefficients for urbanization are statistically significant at the 10% level. The optimal level of urbanization is (12.990/2x13.739) = 0.473 implying that a one-standard deviation (0.190) increase in urbanization leads the PG growth rate to be 0.496 percentage point less over five years, all else constant. Recall that the PG index measures how deep the mean aggregate income or consumption is of the poor from the established poverty line, i.e., the depth of poverty. This means that at optimal urbanization, the poor will, on average, keep better increasing their income/consumption close to the U.S. 1$ poverty line, rather than below or beyond optimal urbanization.

Table 2: Estimates of Urbanization and Pro-poor Growth

Dependent Variable (Growth Rate)	Headcount Index (HI)	Poverty Gap (PG)	Square Poverty Gap (SPG)
Independent Variable	**(1)**	**(2)**	**(3)**
Urbanization	-15.354 *	-12.990 #	-29.685 #
	(6.619)	(7.676)	(18.064)
Urbanization^2	15.650 *	13.739 #	29.684 #
	(6.994)	(7.425)	(15.981)
Initial Level of Dependent Variable	-0.543 **	-0.426 #	-1.122 **
	(0.113)	(0.244)	(0.259)
Inflation [b]	-0.077	0.176	0.259
	(0.290)	(0.450)	(0.395)
Openness [a]	-0.066	-0.529	-0.272
	(0.485)	(0.374)	(1.121)
Agricultural Share [a]	0.994 *	1.223 #	1.980 #
	(0.491)	(0.729)	(1.042)
Schooling	0.035	0.142	0.058
	(0.113)	(0.108)	(0.253)
Government Consumption Share [a]	0.177		1.041
	(0.390)		(0.748)
Hansen Test (*p* -value)	0.990	0.989	0.994
Serial Correlation Test (*p* -value)	0.748	0.301	0.643
Time Dummies	Yes	Yes	Yes
No. of observations	117	117	117

** significant at 1%; * at 5%; # at 10%
[a] The variable is in the form of logarithm.
[b] The variable is in the form of logarithm (1+variable).
Numbers in parenthesis are robust standard errors.
The null hypothesis of Hansen Test is that the instruments used are not correlated with the residuals.
The null hypothesis of Serial Correlation Test is that the errors difference regression shows no second-order serial correlation.

In Column (3), we utilize the SPG growth as pro-poor growth. Remember that the SPG index is the distributional measure that captures differences in income levels among the poor, i.e., the severity of poverty that reflects inequality among the poor. Both urbanization coefficients are statistically significant at the 10% level. Thus, the optimal level of urbanization is (29.685/2x29.684) = 0.500. A one-standard deviation (0.190) increase in urbanization leads the SPG growth rate to be 1.072 percentage points less over five years, all other things constant. This means that inequality among the poor will, on average, keep better decreasing than stay below or beyond optimal urbanization.

It is also important to note that the coefficients at the initial levels of each index in Columns (1)—(3) are statistically negative. These results imply that once a government has implemented policies to promote strong pro-poor growth, the convergence hypothesis would be supported in that the higher number of poor, the increased effectiveness of pro-poor growth, and vice versa. We also control differences for agricultural outputs by using the agricultural share of GDP. As we expected, the agricultural share of GDP in Columns (1)—(3) is a statistically positive and significant coefficient. The role of agriculture in poverty reduction, especially for developing countries, plays a very crucial part to promote direct and indirect effects for the poor (Thirtle et al. 2003; Christiaensen et al. 2006). Specifically for Column (1) by the headcount index, a one percentage point increase in the agricultural share of GDP is associated with a 0.994 percentage point of the higher pro-poor growth rate, all else constant. Moreover, the remainders of the control variables are statistically insignificant, and the signs of coefficients of openness and the government consumption share of GDP differ from what is expected.

Urbanization and Channels of Poverty Reduction Outcomes

As discussed in the previous chapter, we do not only attempt to investigate the effects of urbanization on human well-being (less poverty) and incomes for the poor (the pro-poor growth rate), but we also investigate the effects through the transmission channels on poverty reduction outcomes such as education outcomes, health outcomes, and productivity outcomes (agricultural and non-agricultural outputs).

The following subsections report the results from the effects of urbanization through the basic education channel, the basic health channel, and the potential productivity channel. For the first two channels, we apply the IV estimation procedure to obtain the findings. We also address model specifications and a few econometric issues from these empirical analyses. For the last channel, we employ the dynamic panel GMM-system estimation to capture the growth rate of productivity. To test our hypothesis frameworks, the quadratic form to urbanization is used to investigate the optimal level of urbanization while also examining the impact of urbanization on the channels of poverty reduction outcomes.

The Basic Education Channel

In this subsection, we estimate the effect of urbanization for the basic education channel based on Equation (4.23). We utilize the primary school net enrollment and the youth literacy rate as independent variables in order to capture the basic education channel with a quadratic form for urbanization and a set of traditional control variables, which include GDP per capita, public expenditure on education (as a share of total expenditure), freedom ,and national population density. The estimation results are given in Table 3.

It is important to note that endogenous regressors that may cause potential endogeneity problems from random shocks such as GDP per capita, public expenditure on education, and urbanization are treated by a set of instruments[49] used in the literature (Pritchett and Summer 1996; Filmer and Pritchett 1997): for income by whether or not a country's primary export is oil and for public expenditure on education by education spending as the share of total expenditure of a country's geographic neighbors. For urbanization, we adopt the same idea of instruments for public expenditure on education by presuming that rural-urban migration in one country would correlate with the level of urbanization in neighborhood countries. For example, economic shocks affect urban employment in a country, with the subsequent move of investments to another country's urban areas according to similar economic factors. The pattern of rural-urban migration in a neighborhood country would be stimulated by feasible investment mobility. Hence, we use urbanization of a country's geographic neighbors as a set of instruments for urbanization.

Columns (1) and (2) in Table 3 report the results of the effect of urbanization on the basic education channel. Column (1) presents the results from IV estimations by using the primary school net enrollment. The optimal level of urbanization is (3.379/2x2.730) = 0.619. From the optimal level of urbanization, a one-standard deviation (0.225) increase in urbanization leads the primary school net enrollment to be 0.138 (or 13.8 percentage points) less over five years, ceteris paribus. Column (2) also reports the results from the IV estimations by using the youth literacy rate. The optimal level of urbanization is (2.813/2x1.788) = 0.787. A one standard deviation (0.205) increase in urbanization is associated with the youth literacy rate to be 0.075 (or 7.5 percentage points) less over five years, all else constant.

[49] The test for autocorrelation in panel data yields the following results: F (1, 30) = 621.914, Prob > F = 0.0000. This means that the hypothesis that there is no first-order autocorrelation in the data can be rejected at the 1% significance level. Their internal lagged values are not an appropriate set of instruments for the GMM-IV estimation.

Table 3: Estimates for Urbanization and Education Outcomes

Dependent Variable	Education Outcomes: Primary School Net Enrollment (% aged >15)	Education Outcomes: Youth Literacy Rate (% aged 15-24)
Independent Variable	**(1) IV [b]**	**(2) IV [c]**
Urbanization	3.379 *	2.813 #
	(1.596)	(1.519)
Urbanization^2	-2.730 *	-1.788 #
	(1.261)	(1.086)
GDP per Capita [a]	-0.013	-0.067
	(0.043)	(0.113)
Population Density [a]	-0.023 #	0.022
	(0.012)	(0.037)
Education Expenditure Share	0.208 #	-0.380
	(0.123)	(0.348)
Hansen Test (*p* -value)	0.6028	0.6250
Time Dummies	Yes	Yes
No. of observations	116	81

** significant at 1%; * at 5%; # at 10%

[a] The variable is in the form of logarithm.

Numbers in parenthesis are robust standard errors.

The null hypothesis of Hansen Test is that the instruments used are not correlated with the residuals.

[b] The IV heteroskedasticity test yields *p* -value = 0.916. The hypothesis that the disturbance is homoskedastic can not be rejected.

[c] The IV heteroskedasticity test yields *p* -value = 0.374. The hypothesis that the disturbance is homoskedastic can be rejected.

In Column (1), the coefficients of the education expenditure share of the total expenditure and population density are statistically significant at the 10% level. Education expenditure is pro-poor spending to directly deliver basic education for the poor. A one percentage point increase in education expenditure share is associated with an increase in the primary school net enrollment by 0.208 percentage point, all else constant. In this estimate, population density shows a negative impact with respect to education outcomes. Holding all else constant, a one percentage point increase in population density leads to a decrease in the primary school net enrollment by 0.023 percentage point. Note that the coefficients of GDP per capita in Columns (1) and (2) are negative. These results differ from the expected impact of income on education outcomes; however these coefficients are not statistically significant.

The Basic Health Channel

For health outcomes, we employ the infant mortality rate and life expectancy at birth to capture the basic health channel with a quadratic form to urbanization based on Equation (4.25). The model specifications also include a set of control variables: GDP per capita, public expenditure on health (as a share of total expenditure), years of schooling, and freedom. The estimation results are reported in Table 4.

Similar to the basic education channel, econometric issues from our random error terms are sufficient to be of concern. Specifically, potential endogeneity problems may cause biased and inconsistent estimators. A set of appropriate instruments[50] is called for in dealing with endogeneity problems. These instrument variables for health outcomes are similar to those of education outcomes. It is important to note that we use health spending as the share of total expenditure, instead of the share of education spending.

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[50] The test for autocorrelation in panel data yields the following results: F (1, 40) = 48.290, Prob > F = 0.0000. This means that their internal lagged values are not an appropriate set of instruments for the GMM-IV estimation.

Table 4: Estimates of Urbanization and Health Outcomes

Dependent Variable	Health Outcomes	
	Infant Mortality Rate	**Life Expectancy at Birth**
Independent Variable	**(1) IV [b]**	**(2) IV [c]**
Urbanization	-455.392 *	66.275 *
	(204.355)	(39.140)
Urbanization^2	336.150 #	-48.945 #
	(187.948)	(29.263)
GDP per Capita [a]	-7.647	1.788
	(6.004)	(1.387)
Schooling	-0.608	0.226
	(2.959)	(0.438)
Health Expenditure Share	-26.733	-19.080
	(109.713)	(14.952)
Freedom	0.238	-1.019 **
	(1.620)	(0.333)
Hansen Test (*p* -value)	0.1172	0.1006
Time Dummies	Yes	Yes
No. of observations	115	112

** significant at 1%; * at 5%; # at 10%

[a] The variable is in the form of logarithm.

Numbers in parenthesis are robust standard errors.

The null hypothesis of Hansen Test is that the instruments used are not correlated with the residuals.

[b] The IV heteroskedasticity test yields *p* -value = 0.124. The hypothesis that the disturbance is homoskedastic can not be rejected.

[c] The IV heteroskedasticity test yields *p* -value = 0.494. The hypothesis that the disturbance is homoskedastic can not be rejected.

Columns (1) and (2) in Table 4 present the results of the effect of urbanization on the basic health channel. Both estimations are tested for the IV heteroskedasticity. From Table 4, it shows that the presence of heteroskedasticitiy can be excluded from the outcomes. Column (1) presents the results of using the infant mortality rate as a channel of health outcomes. Since the infant mortality rate is expressed as the number of infant deaths between birth and the age of one per 1,000 live births, optimal urbanization will minimize the infant mortality rate in terms of the convex function. The optimal level of urbanization is, therefore, (455.392/2x366.150) = 0.622. From the optimal level of urbanization, a one-standard deviation (0.212) increase in urbanization leads the infant mortality rate to be 15.108 infants per 1,000 live births more over five years, holding other things constant. Column (2) reports the results of health outcomes by using life expectancy at birth. By utilizing the derivative, we enable to calculate the optimal level of urbanization that is (66.275/2x48.945) = 0.677. A one standard deviation (0.206) increase in urbanization leads life expectancy at birth to be 2.077 years less over five years, all else constant.

While other regressors included in these estimates are not statistically significant, the coefficient of freedom in Column (2) is statistically significant at the 1% level. Recall that freedom is based on a scale of 1 to 7, with 7 being the lowest level of freedom. We use freedom to capture human well-being and deprivation that would reflect on increased physical protection and from external impediments, such as the lack of accessible health care. As expected, this coefficient associates with a negative sign, but this result shows an expected positive impact on life expectancy at birth.

The Potential Productivity Channel

In this subsection, we apply the dynamic panel GMM-system estimation based on Equation (4.27) in order to capture the “channeled effect” of urbanization on the productivity growth rate. The potential productivity channel is agriculture value added per worker and non-agricultural outputs per GDP. Recall that the value added per worker from agriculture is the outputs of the agriculture sectors less the value of intermediate inputs, while the non-agricultural outputs are the outputs from industries and services.

The model specifications include initial level of productivity, agricultural labor force (the percentage share of total labor force), openness, years of schooling, annual precipitation and a quadratic form to urbanization. It is important to note that in this estimation we instrument for all time varying RHS variables, which are treated all as potentially endogenous by random shocks. A set of appropriate instruments consists of the two periods and earlier lagged values of potential endogenous variables and the persistent dependent variable. The estimation results of the channeled urbanization effects on potential productivity outcomes are presented in Table 5.

Column (1) in Table 5 reports the estimations using agriculture value added per worker as a channel of productivity outcomes. As we hypothesized, the coefficients of both urbanization variables exhibit the concave function to the optimal level of urbanization. By utilizing a derivative with respect to urbanization, the optimal degree of urbanization is (2.345/2x2.214) = 0.529 with strong and significant coefficients at the 1% level. From the optimal level of urbanization, a one-standard deviation (0.235) increase in urbanization leads the agriculture value added per worker growth rate to be 0.122 less over five years, ceteris paribus. As alluded to earlier for the convergence hypothesis, the initial value of agriculture value added per worker associates with the growth rate in a strong negative direction as well as that of non-agricultural outputs per GDP.

Whilst other regressors have the expected sign of coefficients and are not statistically significant, the coefficient of agricultural labor force is negative and statistically significant at the 1% level. The economic interpretation of this coefficient is that a one percentage point increase in agricultural labor force would lead to a 0.606 percentage point decreased growth rate of agriculture value added per worker, all else constant. Thus, a release of excessive labor (unproductive labor) from agricultural sectors to other sectors increases the growth rate of agriculture value added per worker. For example, through higher employment, labor demands in other sectors will increase for both low-skilled and skilled workers or through the improvement of human capital endowment that is realized through an increased standard of education.

Table 5: Estimates of Urbanization and Productivity Outcomes

Dependent Variable (Growth rate)	Productivity Outcomes	
	Agriculture Value Added Per Worker	**Non-Agricultural Outputs per GDP**
Independent Variable	**(1)**	**(2)**
Urbanization	2.345 **	0.889 **
	(0.768)	(0.212)
Urbanization^2	-2.214 **	-0.681 **
	(0.842)	(0.214)
Initial Level of Dependent Variable	-0.401 **	-0.560 **
	(0.113)	(0.500)
Agricultural Labor Force [a]	-0.606 **	-0.035
	(0.145)	(0.021)
Openness [a]	0.041	0.078 **
	(0.077)	(0.019)
Schooling	0.038	0.005
	(0.029)	(0.534)
Precipitation [b]	0.043	
	(0.030)	
Hansen Test (*p* -value)	1.000	1.000
Serial Correlation Test (*p* -value)	0.309	0.977
Time Dummies	Yes	Yes
No. of observations	515	532

** significant at 1%; * at 5%; # at 10%

[a] The variable is in the form of logarithm.

[b] The values of this variable are normalized by calculting into the unit of metre.

Numbers in parenthesis are robust standard errors.

The null hypothesis of Hansen Test is that the instruments used are not correlated with the residuals.

The null hypothesis of Serial Correlation Test is that the errors difference regression shows no second-order serial correlation.

The productivity of non-agricultural outputs per GDP is reported in Column (2) in Table 5. The urbanization coefficients are both statistically significant at the 1% level. With respect to concavity of urbanization, we derive the optimal degree of urbanization to be (0.889/2x0.681) = 0.653. From the optimal level of urbanization, a one-standard deviation (0.240) increase in urbanization leads the growth rate of non-agriculture outputs to be 0.039 less over five years, ceteris paribus. Note that variables *schooling* and *agricultural labor force* are not statistically significant, as seen by the expected sign.

In addition, the coefficient of openness is positive and statistically significant at the 1% level. The economic interpretation of this coefficient is that a 10 percentage point increase in openness would lead to a 0.78 percentage point higher for the growth rate of non-agriculture outputs per GDP. The effect of trade liberalization is consistent with alleviating household poverty via human capital investment and a price transmission that can provide a higher quality of goods and services with lower costs (McCulloch et al. 2001 and Figini and Santarelli 2002, 2006).

CHAPTER VI

CONCLUSION

This study explored the effect of urbanization on poverty reduction outcomes using panel data from a sample of 143 countries for a variety of the periods 1965-2005.[51] Since poverty is a multi-dimensional state of being without the basic living necessities, we employed different estimation approaches for different poverty measures and for basic channels for poverty reduction outcomes. First, we adopted the HDI that takes into account basic human well-being achievements, to estimate the non-monetary poverty measure using the instrument variable (IV) method in the context of the generalized method of moments (GMM). We also attempted to examine how the impact of urbanization for particular regions is relatively different from each other.

Second, we investigated the effect of urbanization on the growth rates of three monetary poverty measures: the headcount index (HI), the poverty gap (PG), and the square poverty gap (SPG), using the dynamic panel GMM estimation. Finally, we examined potential transmission channels for the urbanization effect through the basic education channel, the health channel (both by the IV estimation), and the potential productivity channel (by the dynamic panel GMM estimation).

When considering monetary and non-monetary dimensions, we develop a theoretical framework based on Devaranjan et al. (1996) and Kraay (2006) in that we incorporate the multifaceted dimensions of poverty into a model. Our model will determine the economic direction of urbanization on poverty reduction outcomes in order

[51] The sample sizes and time periods are different in each regression.

to empirically implement our study purposes. We find that the strong relationship between the level of urbanization and poverty reduction outcomes is a non-linear structure such that the level of urbanization is both positively and negatively associated with poverty reduction outcomes. There must be an optimal level of urbanization to satisfy a country's best standard of living, everything else being constant. The optimal urbanization level for each country depends on the relative transition of economic development, socioeconomic structures and the allocation of public resources.

As mentioned earlier, when urbanization increases, a number of the poor can earn more income/consumption to escape from the U.S. $1 poverty line. In developing countries, a certain level of urbanization can increase the larger number of poor, which escape poverty. However, the poor will be either better off or worse off, in terms of the basic provisions needed for a better standard of living, dependant upon whether the poor are living in under or over urbanization (under or beyond the congestion point).

Our estimated threshold for optimal urbanization ranges from 47.3 percent to 78.7 percent of the national total population. We also find that the performance of urbanization in different regions provides various magnitudes of impact on poverty reduction outcomes. Furthermore, our empirical analysis confirms that the effect of urbanization on poverty reduction outcomes contributes to basic need provisions (education and health care) and the productivity outputs by a significant non-linear relationship.

Our findings have important implications to appropriate policies for decision makers, especially in developing countries. First, this study will contribute to assisting in the designing of both short and long-term urban policies such as urban growth and rural-urban migration phenomena. These trends of urbanization, which are inevitably happening, will have a significant impact on poverty. Second, the link between the role of rural and urban areas is unconnected. If urbanization is either too high or too low, it will affect the performance of poverty reduction outcomes. Additionally, a government properly determines how public resources will be spent in both areas can also sustain poverty reduction outcomes. In this respect, the appropriate allocation of public resources should remain balanced between urban (large, medium, and small) and rural areas.

In addition, this study can be extended for future research. The mechanism of city-size distribution might be examined to understand how urban concentration based on the urbanization level could reduce poverty for both urban and rural areas. From the urbanization process, it is worthy to focus on the concentration of urban poverty from both non-monetary and monetary dimensions. Finally, the mechanism of urbanization itself might be extended to the analysis of economic development for poverty reduction such as macroeconomic aspects, job opportunity, and human settlement and mobility.

APPENDIX A

THEORETICAL APPENDIX

Appendix A.1

The preference utility of an agent for consumption, $u(c)$ over time are given by

$$U = \int_0^\infty u(c)e^{-\rho t}dt \qquad \text{where } u_c > 0,\ u_{cc} < 0 \qquad \text{(A1)}$$

Subject to the growth rate of private capital stock with respect to time $(\dot{k})$:

$$\dot{k} = (1-\tau)y - c \qquad \text{(A2)}$$

where c is consumption and ρ is the rate of time preference and strictly positive.

The production function is expressed below:

$$y = Ag(N)f(k, N, G_u, G_r) = Ag(N)k^\alpha N^\gamma G_u^\beta G_r^\theta \qquad \text{(A3)}$$

where $\alpha \geq 0, \gamma \geq 0, \beta \geq 0, \theta \geq 0$; $\alpha + \gamma + \beta + \theta = 1$; $0 \leq N \leq 1$; A is positive and constant; and $f_k > 0$; $f_N > 0$; $f_{G_u} > 0$; $f_{G_r} > 0$; $g_N > 0$; $g_{NN} < 0$

The budget constraint of government is balanced and finances the infrastructure expenditures through the flat tax rate given. The budget constraint is below:

$$\tau * y = G_u + G_r = G \qquad \text{(A4)}$$

where G is the total government infrastructure expenditures and τ is the flat tax rate.

Let the share (λ) of total government infrastructure expenditures to shift government spending into urban area is a linear function of the urban percentage. Thus, the new budget constraint is given below:

$$\tau * y = G_u + G_r = (\lambda(N))G + (1-\lambda(N))G = G \qquad \text{(A5)}$$

where $0 \le \lambda(N) \le 1$ and $\lambda_N > 0$.

We substitute Equations (A3) and (A4) into (A5) to obtain the new budget constraint:

$$\dot{k} = (1-\tau)Ag(N)k^{\alpha}N^{\gamma}(\lambda G)^{\beta}((1-\lambda)G)^{\theta} - c \qquad \text{(A6)}$$

We set up and solve the Hamiltonian system as follow:

$$H = u(c)e^{-\rho t} + V\left\{(1-\tau)Ag(N)k^{\alpha}N^{\gamma}(\lambda G)^{\beta}((1-\lambda)G)^{\theta} - c\right\} \qquad \text{(A7)}$$

$$\frac{dH}{dc} = \dot{u}(c)e^{-\rho t} - V = 0 \qquad \text{(A8)}$$

We differentiate H with respect to k and set the result equal to $-\dot{V}$:

$$\frac{dH}{dk} = V\left\{\alpha(1-\tau)Ag(N)k^{\alpha-1}N^{\gamma}(\lambda G)^{\beta}((1-\lambda)G)^{\theta}\right\} = -\dot{V} \qquad \text{(A9)}$$

We differentiate (A8) with respect to time, t :

$$\dot{u}_c(c)e^{-pt} - \rho e^{-\rho t}u_c(c) = \dot{V} \qquad \text{(A10)}$$

We substitute (A10) into (A9):

$$e^{-\rho t}\left[\dot{u}_c(c) - \rho u_c(c)\right] = -V\alpha(1-\tau)Ag(N)k^{\alpha-1}N^{\gamma}(\lambda G)^{\beta}((1-\lambda)G)^{\theta} \qquad \text{(A11)}$$

From Equation (A9), we substitute for V into (A11):

$$e^{-\rho t}\left[\dot{u}_c(c) - \rho u_c(c)\right] = -u_c(c)e^{-\rho t}Z \qquad \text{(A12)}$$

where $Z = \alpha(1-\tau)Ag(N)k^{\alpha-1}N^{\gamma}(\lambda G)^{\beta}((1-\lambda)G)^{\theta}$

From Equation (A12), we get

$$\left[\dot{u}_c(c) - \rho u_c(c)\right] = -u_c(c)Z$$

$$\frac{\dot{u}_c(c)}{u_c(c)} = \rho - Z \qquad \text{(A13)}$$

Now let $u(c) = \dfrac{c^{1-\sigma}}{1-\sigma}$, then $u_c(c) = c^{-\sigma}$ and $u_{cc}(c) = -\sigma c^{-\sigma-1}$ (A14)

$$\dot{u}_c(c) = \frac{\partial u_c}{\partial c} * \frac{\partial c}{\partial t} = u_{cc}(c)\dot{c} \qquad \text{(A15)}$$

We substitute Equations (A14) and (A15) into Equation (A13) yields:

$$\frac{-\sigma c^{-\sigma-1}\dot{c}}{c^{-\sigma}} = \frac{-\sigma\dot{c}}{c} = \rho - Z$$

$$\frac{\dot{c}}{c} = \frac{Z-\rho}{\sigma}$$

$$\mu = \frac{\dot{c}}{c} = \frac{\alpha(1-\tau)Ag(N)k^{\alpha-1}N^{\gamma}(\lambda G)^{\beta}((1-\lambda)G)^{\theta} - \rho}{\sigma} \qquad \text{(A16)}$$

Equation (A16) is the steady-state rate of growth in consumption.

Appendix A.2

From Equation (A16), we can rewrite the functional form: $\mu = h(N, G_u, G_r, A)$

The impact of urbanization on the growth rate in consumption is the following:

$$\frac{d\mu}{dN} = \frac{\alpha(1-\tau)Ak^{\alpha-1}G^{\beta+\theta}}{\sigma}\left[N^{\gamma}\lambda^{\beta}(1-\lambda)^{\theta}g_N + g\lambda^{\beta}(1-\lambda)^{\theta}\gamma N^{\gamma-1} + gN^{\gamma}(1-\lambda)^{\theta}\beta\lambda^{\beta-1}\lambda_N - gN^{\gamma}\lambda^{\beta}\theta(1-\lambda)^{\theta-1}\lambda_N\right] \tag{A17}$$

And then we can obtain

$$\frac{d^2\mu}{dN^2} = \frac{\alpha(1-\tau)Ak^{\alpha-1}G^{\beta+\theta}}{\sigma}\frac{d}{dN}\left[N^{\gamma}\lambda^{\beta}(1-\lambda)^{\theta}g_N + g\lambda^{\beta}(1-\lambda)^{\theta}\gamma N^{\gamma-1} + gN^{\gamma}(1-\lambda)^{\theta}\beta\lambda^{\beta-1}\lambda_N - gN^{\gamma}\lambda^{\beta}\theta(1-\lambda)^{\theta-1}\lambda_N\right] \tag{A18}$$

This above equation can be simply written as

$$\frac{d^2\mu}{dN^2} = C\frac{d}{dN}\left[Q + R + S + T\right] \tag{A19}$$

where $C = \dfrac{\alpha(1-\tau)Ak^{\alpha-1}G^{\beta+\theta}}{\sigma} > 0$ and $Q = N^{\gamma}\lambda^{\beta}(1-\lambda)^{\theta}g_N$; $R = \lambda^{\beta}(1-\lambda)^{\theta}\gamma N^{\gamma-1}$;

$S = N^{\gamma}(1-\lambda)^{\theta}\beta\lambda^{\beta-1}\lambda_N$; $T = -N^{\gamma}\lambda^{\beta}\theta(1-\lambda)^{\theta-1}\lambda_N$

Note that $\lambda_{NN} = 0$, then the derivatives of the terms in the bracket are

$$\frac{dQ}{dN} = \gamma N^{\gamma-1}\lambda^{\beta}(1-\lambda)^{\theta}g_N + N^{\gamma}\beta\lambda^{\beta-1}\lambda_N(1-\lambda)^{\theta}g_N - N^{\gamma}\lambda^{\beta}\theta(1-\lambda)^{\theta-1}\lambda_N g_N + N^{\gamma}\lambda^{\beta}(1-\lambda)^{\theta}g_{NN} \tag{A20}$$

$$\frac{dR}{dN} = \gamma N^{\gamma-1}\lambda^{\beta}(1-\lambda)^{\theta}g_N + g\beta\lambda^{\beta-1}\lambda_N(1-\lambda)^{\theta}\gamma N^{\gamma-1} - g\lambda^{\beta}\theta(1-\lambda)^{\theta-1}\lambda_N\gamma N^{\gamma-1} + g\lambda^{\beta}(1-\lambda)^{\theta}\gamma(\gamma-1)N^{\gamma-2} \tag{A21}$$

$$\frac{dS}{dN} = g_N N^{\gamma}(1-\lambda)^{\theta}\beta\lambda^{\beta-1}\lambda_N + g\gamma N^{\gamma-1}(1-\lambda)^{\theta}\beta\lambda^{\beta-1}\lambda_N - gN^{\gamma}\theta(1-\lambda)^{\theta-1}\beta\lambda^{\beta-1}\lambda_N^2 + gN^{\gamma}(1-\lambda)^{\theta}\beta(\beta-1)\lambda^{\beta-2}\lambda_N \tag{A22}$$

$$\frac{dT}{dN} = -g_N N^{\gamma}\lambda^{\beta}\theta(1-\lambda)^{\theta-1}\lambda_N - g\gamma N^{\gamma-1}\lambda^{\beta}\theta(1-\lambda)^{\theta-1}\lambda_N - gN^{\gamma}\theta(1-\lambda)^{\theta-1}\beta\lambda^{\beta-1}\lambda_N^2 + gN^{\gamma}\lambda^{\beta}\theta(\theta-1)(1-\lambda)^{\theta-2}\lambda_N \tag{A23}$$

The first term of Equations (A20)—(A22), and the second term of Equation (A20) are positive whereas the rest of all terms in Equations (A20)—(A23) are negative. We can demonstrate that

The first terms of Equation (A20) and Equation (A21):

$$(\gamma N^{\gamma-1}\lambda^{\beta}(1-\lambda)^{\theta} g_N) + (\gamma N^{\gamma-1}\lambda^{\beta}(1-\lambda)^{\theta} g_N) = \frac{2g_N \lambda^{\beta}(1-\lambda)^{\theta}\gamma N^{\gamma}}{N} \quad \text{(A24)}$$

The second term of Equation (A20) and the first term of Equation (A22):

$$(N^{\gamma}\beta\lambda^{\beta-1}\lambda_N(1-\lambda)^{\theta} g_N) + (g_N N^{\gamma}(1-\lambda)^{\theta}\beta\lambda^{\beta-1}\lambda_N) = \frac{2g_N \beta\lambda^{\beta}\lambda_N(1-\lambda)^{\theta} N^{\gamma}}{\lambda} \quad \text{(A25)}$$

The third term of Equation (A20) and the first term of Equation (A23):

$$(-N^{\gamma}\lambda^{\beta}\theta(1-\lambda)^{\theta-1}\lambda_N g_N) + (-g_N\theta\lambda^{\beta}\lambda_N(1-\lambda)^{\theta} N^{\gamma}) = -\frac{2g_N\theta\lambda^{\beta}\lambda_N(1-\lambda)^{\theta} N^{\gamma}}{1-\lambda} \quad \text{(A26)}$$

Thus, the sum of Equations (A24)—(A26) is equal to

$$2g_N\lambda^{\beta}(1-\lambda)^{\theta} N^{\gamma}\left\{\frac{\gamma}{N} + \lambda_N\left(\frac{\beta}{\lambda} - \frac{\theta}{1-\lambda}\right)\right\} \quad \text{(A27)}$$

Appendix A.3

The rate of poverty measure change is written as

$$\frac{\dot{P}_t}{P_t} = \mu \int_0^{H_t} \eta_t(p)dp \qquad \text{(A28)}$$

where $\eta_t(p) = \frac{df(y_t(p))}{dy_t(p)} \frac{y_t(p)}{P_t} = -\frac{\theta}{P_t} \frac{y_t(p)}{z} \left(1 - \frac{y_t(p)}{z}\right)^{\theta-1}$; $f(y_t(p)) = \left(1 - \frac{y_t(p)}{z}\right)^{\theta}$

$$\frac{\dot{P}_t}{P_t} = \mu \int_0^{H_t} -\frac{\theta}{P_t} \frac{y_t(p)}{z} \left(1 - \frac{y_t(p)}{z}\right)^{\theta-1} dp \qquad \text{(A29)}$$

$$\frac{\dot{P}_t}{P_t} = -\mu \frac{\theta}{P_t z} \int_0^{H_t} y_t(p) \left(1 - \frac{y_t(p)}{z}\right)^{\theta-1} dp \qquad \text{(A30)}$$

Let $D = \int_0^{H_t} y_t(p) \left(1 - \frac{y_t(p)}{z}\right)^{\theta-1} dp$ (A31)

and $\psi = \left(1 - \frac{y_t(p)}{z}\right)$ (A32)

Apply the integral by part to Equation (A31): $\int udv = uv\Big| - \int vdu$

$u = y_t(p)$ $\qquad\qquad$ $du = y_t'(p)dp$

$dv = \left(1 - \frac{y_t(p)}{z}\right)^{\theta-1} dp$ $\qquad\qquad$ $v = -\frac{z}{y_t'(p)} \frac{\left(1 - \frac{y_t(p)}{z}\right)^{\theta}}{\theta} = -\frac{z}{y_t'(p)} \frac{\psi^{\theta}}{\theta}$

We can obtain

$$D = -y_t(p) \frac{z}{y_t'(p)} \frac{\psi^{\theta}}{\theta}\Big|_0^{H_t} - \int_0^{H_t} -\frac{z}{y_t'(p)} \frac{\psi^{\theta}}{\theta} y_t'(p)dp$$

$$D = -0 + 0 + \int_0^{H_t} \frac{z}{y_t'(p)} \frac{\psi^{\theta}}{\theta} y_t'(p)dp = \frac{z}{\theta} \int_0^{H_t} \psi^{\theta} dp \qquad \text{(A33)}$$

Note that $-y_t(p)\frac{z}{y_t'(p)}\frac{\psi^\theta}{\theta}\Big|_{p=0} = 0$ because $y_t(0) = 0$, and $-y_t(p)\frac{z}{y_t'(p)}\frac{\psi^\theta}{\theta}\Big|_{p=H_t} = 0$

because $\psi = \left(1 - \frac{y_t(H_t)}{z}\right) = \left(1 - \frac{z}{z}\right) = 0$.

From Equation (A30), $d\psi = -\frac{y_t'(p)}{z}dp$, then rearrange $dp = -\frac{z}{y_t'(p)}d\psi$. And we know

that if $p = H_t$, then $\psi = 0$ and if $p = 0$, then $\psi = 1$.

Thus, Equation (A33) can be written as

$$D = -\frac{z}{\theta}\int_0^1 -\frac{z}{y_t'(p)}\psi^\theta d\psi = \frac{z}{\theta}\frac{z}{(\theta+1)y_t'(p)\big|_{p=H_t}} \qquad \text{(A34)}$$

Substitute Equation (A32) into Equation (A28) to obtain

$$\frac{\dot{P}_t}{P_t} = -\mu\frac{\theta}{P_t z}\frac{z}{\theta}\frac{z}{(\theta+1)y_t'(p)\big|_{p=H_t}} = -\mu\frac{z}{P_t(\theta+1)y_t'(p)\big|_{p=H_t}} \qquad \text{(A35)}$$

That is the proportionate change in poverty.

APPENDIX B

EMPIRICAL METHODOLOGY APPENDIX

Appendix B.1

The GMM-IV Panel[52]

Estimations

First, we are interested in the equation, which is expressed in matrix notation:

$$y = X\beta + u , \qquad E(uu') = \Omega \qquad \text{(B.1.1)}$$

where X is the matrix $n \times K$ of regressors; n is the number of observations; K is the number of parameters; the error term u is distributed with mean zero; and the covariance matrix Ω is $n \times n$.

The standard IV estimator is a special case of a generalized method of moments (GMM) estimator. We apply the assumption that instrument Z are exogenous and can be expressed as $E(Z_i u_i) = 0$. The L instruments generate a set of L moments as follows:

$$g_i(\hat{\beta}) = Z_i'\hat{u}_i = Z_i'(y_i - X_i\hat{\beta}) \qquad \text{(B.1.2)}$$

where g_i is L x1. The exogenous instruments means that there must have L moment conditions, or orthogonality conditions, that are able to obtain at the true value of β:

$$E(g_i(\beta)) = 0 \qquad \text{(B.1.3)}$$

We obtain each sample moment from the L moment conditions as:

[52] This section of the Appendix is mainly drawn from Baum et al. (2003) and some based on Wooldridge (2002).

$$\bar{g}(\hat{\beta}) = \frac{1}{n}\sum_{i=1}^{n} g_i(\hat{\beta}) = \frac{1}{n}\sum_{i=1}^{n} Z_i'(y_i - X_i\hat{\beta}) = \frac{1}{n}Z'\hat{u} \qquad \text{(B.1.4)}$$

There are two conditions to consider: First, when the equation is exactly identified or $K = L$, and it is possible to select an estimator for β that can satisfy; the IV estimator is intuitively the GMM estimator when $\bar{g}(\hat{\beta}) = 0$. Second, when the equation is over identified or $L > K$, it is not able to obtain a $\hat{\beta}$ that satisfies all L sample moment conditions equal to zero. In the latter case, an $L \text{ x } L$ weighting matrix W is used to generate a quadratic form in the moment conditions. Then the GMM objective function can be derived as follows:

$$J(\hat{\beta}) = n\bar{g}(\hat{\beta})'W\bar{g}(\hat{\beta}) \qquad \text{(B.1.5)}$$

The objective function $J(\hat{\beta})$ will be minimized to obtain $\hat{\beta}$ that is a GMM estimator of β by the first order condition: $\frac{dJ(\hat{\beta})}{d\hat{\beta}} = 0$. This yields the GMM estimators as follows:

$$\hat{\beta}_{GMM} = (X'ZWZ'X)^{-1}X'ZWZ'y \qquad \text{(B.1.6)}$$

An efficient GMM estimator is concerned with choosing the optimal weighting matrix to minimize the asymptotic variance matrix of the moment condition: g .Let S denote this variance matrix $L \text{ x } L$ that can be expressed as:

$$S = \frac{1}{n}E(Z'uu'Z) = \frac{1}{n}E(Z'\Omega Z) \qquad \text{(B.1.7)}$$

The efficient GMM estimator is obtained by using $W = S^{-1}$. Thus, the efficient GMM estimator and associated asymptotic variance are given by:

$$\hat{\beta}_{EGMM} = (X'ZS^{-1}Z'X)^{-1}X'ZS^{-1}Z'y \qquad \text{(B.1.8)}$$

$$V(\hat{\beta}_{EGMM}) = \frac{1}{n}(Q_{XZ} S^{-1} Q_{XZ})^{-1} \tag{B.1.9}$$

To estimate S, we need to make some assumption about the covariance matrix of the distribution term Ω. Let $\hat{S}$ denote the consistent estimator of S, which is written as:

$$\hat{S} = \frac{1}{n}(Z'\Omega Z) \tag{B.1.10}$$

A feasible efficient two-step GMM estimator can be derived by the following three steps:

1. Estimate the equation by IV, and then save residuals.
2. Construct an optimal weighting matrix from the saved residuals:

   $$\hat{W} = \hat{S}^{-1} = \left(\frac{1}{n}(Z'\hat{\Omega}Z)\right)^{-1}$$

3. Estimate the efficient GMM estimator and its variance-covariance matrix by using the optimal weighting matrix:

   $$\hat{\beta}_{EGMM} = (X'Z(Z'\hat{\Omega}Z)^{-1} Z'X)^{-1} X'Z(Z'\hat{\Omega}Z)^{-1} Z'y \tag{B.1.11}$$

   $$V(\hat{\beta}_{EGMM}) = (X'Z(Z'\hat{\Omega}Z)^{-1} Z'X)^{-1} \tag{B.1.12}$$

Note that the results for $\hat{\beta}_{EGMM}$ and $V(\hat{\beta}_{EGMM})$ will be different depending on the restrictive assumptions imposed on Ω: homoskedasticity, heteroskedasticity, and clustering.

The Test of Endogeneity of the Regressors

The assumption established in the fixed effects model and the random effects model is that none of the explanatory variables is uncorrelated with the error term. This assumption gives us the consistency of parameter estimators from the random effects and fixed effects estimations. To avoid the problem of endogenous explanatory variables, we apply the Hausman (1978) specification test for endogeneity to the interested equation.

The test investigates the difference between two estimators given by $D = \sqrt{NT}(\beta_{IV} - \beta_{LS})$. Under the null hypothesis of no endogeneity, both estimators are consistent and $D = 0$. On the other hand, the alternative hypothesis shows that $D \neq 0$. The Hausman test statistic is distributed as χ^2 and given by

$$H_0 = (\beta_c - \beta_e)'(V_c - V_e)^{-1}(\beta_c - \beta_e) \qquad \text{(B.1.13)}$$

where β_c and β_e are the coefficient vector from the consistent and efficient estimators, respectively; and V_c and V_e are the covariance matrix for the consistent and efficient estimators, respectively.

The Test of Exogeneity of Subset of Instruments

In the context of efficient GMM estimator, the C-test or Difference-in-Sargan test is applied and calculated from the difference between two Sargan test statistics developed by Sargan (1958). According to Hayashi (2000) and Baum et al. (2003), the general idea of this test is to compare two J statistics from two separate GMM estimators having the same coefficient vertor $\hat{\beta}$, one treats more variables as endogenous, then utilizes the entire set of overidentifying restrictions (restricted and fully efficient), while the other utilizes only some instruments (unrestricted and inefficient, but consistent). The C-test has a Chi-square distribution with the degree of freedom equal to the number of suspected instrument being tested. The null hypothesis is that the specified variables are proper instruments (orthogonal). If the difference is large above a Chi-square critical value, we reject the null hypothesis and conclude that these variables are endogenous and need proper instruments. The C-test can be expressed as:

$$C = J(\beta) - J_1(\beta_1) \sim \chi^2_{K-K_1} \qquad \text{(B.1.14)}$$

where $J(\beta) - J_1(\beta_1)$ is the difference between the first model (restricted and fully efficient) and the second model (unrestricted and inefficient, but consistent); and $K - K_1$ is the number of suspected instruments to be tested.

The Hansen Test (Generalized Sargan Test) of Over-identifying Restrictions

The Hansen $J(\hat{\beta})$ statistic, developed by Hansen (1982), is asymptotically distributed as a χ^2_q, where $q = L - K$ equal to the total number of instruments minus the number of parameters in the model. This is a joint test of valid orthogonality conditions and correct model specification. The null hypothesis is that the instruments are valid and suitable for the model being estimated. It is expressed by Equation (B.1.5) as:

$$J(\hat{\beta}) = n\bar{g}(\hat{\beta})'W\bar{g}(\hat{\beta}) \sim \chi^2_q \qquad \text{(B.1.15)}$$

where χ^2_q is a Chi-square distribution with $(L - K)$ degree of freedom corresponding to the number of overidentifying restrictions.

Appendix B.2

The Dynamic GMM Panel[53]

Estimations

We begin by considering a simple autoregressive (AR(1)) model with unobserved individual-specific effects:

$$y_{it} = \alpha y_{i,t-1} + \eta_i + \nu_{it} \qquad \text{where } |\alpha| < 1;\ i = 1,\dots,N;\ t = 1,\dots,T; \qquad \text{(B.2.1)}$$

And $u_{it} = \eta_i + \nu_{it}$ has the standard error components structure:

$$E[\eta_i] = 0,\ E[\nu_{it}] = 0,\ E[\nu_{it}\eta_i] = 0 \qquad \text{for } i = 1,\dots,N \text{ and } t = 1,\dots,T \qquad \text{(B.2.2)}$$

We assume that the transient errors are serially uncorrelated:

$$E[\nu_{it}\nu_{is}] = 0 \qquad \text{for } i = 1,\dots,N \text{ and } s \neq t \qquad \text{(B.2.3)}$$

And that the initial conditions $y_{i,t}$ are predetermined

$$E[y_{it}\nu_{it}] = 0 \qquad \text{for } i = 1,\dots,N \text{ and } t = 2,\dots,T \qquad \text{(B.2.4)}$$

We first-difference (B.2.1) to eliminate the unobserved individual-specific effects, then:

$$y_{it} - y_{i,t-1} = \alpha(y_{i,t-1} - y_{i,t-2}) + (\nu_{it} - \nu_{i,t-1}) \qquad \text{(B.2.5)}$$

This implies that the first period that we observe is $t = 3$:

$$y_{i3} - y_{i2} = \alpha(y_{i2} - y_{i1}) + (\nu_{i3} - \nu_{i2}) \qquad \text{(B.2.6)}$$

Thus, these observation imply the following $m = 0.5(T-1)(T-2)$ moment restrictions

$$E[y_{i,t-s}\Delta\nu_{it}] = 0 \qquad \text{for } t = 3,\dots,T \text{ and } S \geq 2 \qquad \text{(B.2.7)}$$

---

[53] This section of the Appendix is mainly drawn from Baltagi (1995); Bond et al. (2001), Bond (2002); and Behr (2003).

For the first observable period when $t = 3$, y_{i1} is a valid instrument for $(y_{i2} - y_{i1})$ because it is highly correlated to $(y_{i2} - y_{i1})$, but uncorrelated to $(\nu_{i3} - \nu_{i2})$. Analogous to the second observable period when $t = 4$, both y_{i1} and y_{i2} are valid instruments for $(y_{i2} - y_{i1})$ since both are uncorrelated with $(\nu_{i4} - \nu_{i3})$. Then recursive periods through period $t = T$ yields a set of instruments given by $(y_{i1}; y_{i2}; ...; y_{i,T-2})$ .Therefore, we can write more simply as

$$E(Z_i^{'} \Delta \nu_i) = 0 \qquad \text{(B.2.8)}$$

where Z_i is the $(T-2)$ x m matrix defined by

$$Z_i = \begin{bmatrix} (y_{i1}) & . & 0 \\ . & (y_{i1}; y_{i2}) & . \\ . & . & . \\ 0 & . & (y_{i1}; ...; y_{i,T-2}) \end{bmatrix} \text{ and } \Delta \nu_i^{'} = (\nu_{i3} - \nu_{i2}; ...; \nu_{iT} - \nu_{i,T-1})$$

(B.2.9)

There error term in (B.2.5) is a differenced, which implies that

$E(\Delta \nu_i \Delta \nu_i^{'}) = \sigma_\nu^2 (I_N \otimes H)$ where

$$H = \begin{bmatrix} 2 & -1 & 0 & .. & . & 0 \\ -1 & 2 & -1 & .. & . & 0 \\ . & . & . & .. & . & . \\ . & . & . & .. & . & . \\ 0 & 0 & 0 & .. & 2 & -1 \\ 0 & 0 & 0 & .. & -1 & 2 \end{bmatrix} \text{ is } (T-2)x(T-2).$$

The one-step estimator minimizes

$$J_N = \left(N^{-1} \sum_{i=1}^{N} Z_i^{'} \Delta \nu_i \right) W_N \left(N^{-1} \sum_{i=1}^{N} Z_i^{'} \Delta \nu_i \right) \qquad \text{(B.2.10)}$$

$$W_N = W_{N1} = \left[N^{-1} \sum_{i=1}^{N} Z_i^{'} H Z_i \right] \quad \text{(B.2.11)}$$

$$\hat{\alpha} = \left[(\Delta y_{-1})^{'} Z (Z^{'} (I_N \otimes H) Z)^{-1} Z^{'} (\Delta y_{-1}) \right]^{-1} x \left[(\Delta y_{-1})^{'} Z (Z^{'} (I_N \otimes H) Z)^{-1} Z^{'} (\Delta y) \right]$$

(B.2.12)

The first-differenced generalized method of moments (GMM) estimator from Arellano and Bond (1991) employs the moment restrictions. This means that there is the use of the lagged of levels dated $(t-2)$ and earlier as instruments in first-differences. To improve the efficiency of estimator, the results in the Arellano and Bond (1991) two-step GMM estimator yields the following:

$$\hat{\alpha}_2 = \left[(\Delta y_{-1})^{'} Z W^{-1} Z^{'} (\Delta y_{-1}) \right]^{-1} x \left[(\Delta y_{-1})^{'} Z W^{-1} Z^{'} (\Delta y) \right] \quad \text{(B.2.13)}$$

where $W = \sum_{i=1}^{N} Z_i^{'} (\Delta \hat{v}_i)(\Delta \hat{v}_i)^{'} Z_i$; $\Delta \hat{v}_i = \Delta y_i - \hat{\alpha} \Delta y_{i,-1}$ and $\hat{\alpha}$ is the one-step GMM estimator of α.

The consistent estimate of the asymptotic variance of $\hat{\alpha}_2$ is given by the first term of the right-hand-side of (B.2.12), that is

$$aVar(\hat{\alpha}_2) = \left[(\Delta y_{-1})^{'} Z W^{-1} Z^{'} (\Delta y_{-1}) \right]^{-1} \quad \text{(B.2.14)}$$

Introducing additional explanatory (exogenous or predetermined) variables changes the matrix of instruments, Z.

For $T = 4$, when x is strictly exogenous,

$$Z_i = \begin{bmatrix} y_{i1}; x_{i1}; \ldots; x_{i4} & 0 \\ 0 & y_{i1}; y_{i2}; x_{i1}; \ldots; x_{i4} \end{bmatrix}$$

When x is predetermined,

$$Z_i = \begin{bmatrix} y_{i1}; x_{i1}; x_{i2} & 0 \\ 0 & y_{i1}; y_{i2}; x_{i1}; x_{i2}; x_{i3} \end{bmatrix}$$

And when x is endogenous,

$$Z_i = \begin{bmatrix} y_{i1}; x_{i1} & 0 \\ 0 & y_{i1}; y_{i2}; x_{i1}; x_{i2} \end{bmatrix}$$

However, the Arellano and bond (1991) estimators have in general been found to be poor estimators in the finite sample properties, in terms of bias and imprecision. This occurs when the lagged levels of the series are only weakly correlated with subsequent first-differences. Thus, Blundell and Bond (1998) introduce an estimator by combining the moment conditions for both differences and levels. This new estimation is called the System GMM Estimator. They consider the additional assumption that

$$E[\eta_i \Delta y_{i2}] = 0 \qquad \text{for } i = 1,...,N \qquad \text{(B.2.15)}$$

Therefore, the further moment conditions yield

$$E[u_{it} \Delta y_{i,t-1}] = 0 \qquad \text{for } i = 1,...,N \text{ and } t = 3,4,...,T \qquad \text{(B.2.16)}$$

If X contains endogenous variables such that $E[x_{i,t} \nu_{i,t}] \neq 0$ for $i = 1,...,N$ and $s \leq t$, then the instrument matrix for this system is written as

$$Z_i^D = \begin{bmatrix} [y_{i1}; x_{i1}^{'}] & 0 & .. & 0 \\ 0 & [y_{i1}; y_{i2}; x_{i1}^{'}; x_{i2}^{'}] & .. & 0 \\ 0 & 0 & \ddots & 0 \\ . & . & . & . \\ . & . & . & . \\ 0 & 0 & 0 & [y_{i1}; y_{i2};...; y_{i,T-2}; x_{i1}^{'}; x_{i2}^{'};...; x_{i,T-1}^{'}] \end{bmatrix}$$

$$Z_i^L = \begin{bmatrix} [y_{i2}; x_{i2}^{'}] & 0 & .. & 0 \\ 0 & [y_{i2}; y_{i3}; x_{i2}^{'}; x_{i3}^{'}] & .. & 0 \\ 0 & 0 & \ddots & 0 \\ . & . & . & . \\ . & . & . & . \\ 0 & 0 & 0 & [y_{i2}; y_{i3};...; y_{i,T-2}; x_{i2}; x_{i3}^{'};...; x_{i,T-1}^{'}] \end{bmatrix}$$

$$Z_i = \begin{bmatrix} Z_i^D & 0 \\ 0 & Z_i^L \end{bmatrix}$$

The Blundell and Bond (1998) first step estimator uses the covariance matrix given by

$$V = Z^{'} AZ = \sum_{i=1}^{N} Z_i^{'} A_T Z_i \qquad \text{(B.2.17)}$$

$A = (I_N \otimes G^{D.L})$ where $G^{D.L} = \begin{bmatrix} H_i^D & 0 \\ 0 & H_i^L \end{bmatrix}$ and

$H_i^D = H$ as given above and $H_i^L = \begin{bmatrix} 1 & 0 & . & 0 \\ 0 & 1 & . & 0 \\ . & . & \ddots & . \\ . & . & & \\ 0 & 0 & 0 & 1 \end{bmatrix}$

The two-step GMM estimator uses the residuals of the first step estimation to estimate the covariance matrix $\hat{V}$.

The resulting two-step estimator is given by;

$$\hat{\delta}_{SYS} = (XZ\hat{V}^{-1}Z^{'}X)^{-1} X^{'} Z\hat{V}^{-1} Z^{'} y \qquad \text{(B.2.18)}$$

where X is a matrix of explanatory variables (including lagged values of the dependent variable) for both the first-differenced and the level equations.

Identification Tests

The Hansen Test (Generalized Sargan Test) of Over-identifying Restrictions

The null hypothesis for this test is that instruments are valid in that they are not correlated with the errors in the first-differenced equation. The test statistic is given by the value of the objective function in (B.2.10), evaluated at the optimal second-step GMM estimates derived from (B.2.18). Therefore,

$S = N\left(\frac{1}{N}\sum_{i=1}^{N} Z_i^{'}\hat{v}_{i2}\right)^{'} W_{N2}\left(\frac{1}{N}\sum_{i=1}^{N} Z_i^{'}\hat{v}_{i2}\right) \sim \chi_q^2$, where q is equal to the total number of instruments minus the number of parameters in the model.

Second-order Serial Correlation

Let $y = X\delta + v$ the first-difference equation. The vector of residuals is given by:

$\hat{v} = y - X\hat{\hat{\delta}} = v - X(\hat{\hat{\delta}} - \delta)$

where $\hat{\hat{\delta}}$ is an estimator in (B.2.18), with an appropriate Z and $\hat{V}^{-1}$.

The consistency of the GMM estimators is based on the assumption that $E\left[v_{it}v_{i,t-2}\right] = 0$.

where v is a vector of first-differenced errors. The test statistic for the second-order serial correlation, based on residuals from the first-difference equation, is given by:

$m = \frac{\hat{v}_{-2}^{'}\hat{v}_{i^*}}{\hat{v}^{1/2}} \tilde{a} N(0,1)$ under the null of $E\left[v_{it}v_{i,t-2}\right] = 0$ and

$$\hat{v} = \sum_{i=1}^{N} v_{i,-2}^{'}\hat{v}_{i^*}v_{i^*}^{'}\hat{v}_{i(-2)} - 2\hat{v}_{-2}^{'}X(X^{'}ZW_{N2}Z^{'}X)^{-1}X^{'}ZW_{N2}(\sum_{i=1}^{N} Z_i^{'}\hat{v}_i\hat{v}_{i^*}^{'}\hat{v}_{i(-2)}) + \hat{v}_{-2}^{'}XA\hat{V}ar(\hat{\delta})X^{'}\hat{v}_{-2}$$

An asterisk denotes variables that have been trimmed to match the second lag of the first-difference error term.

APPENDIX C

DATA DESCRIPTION AND SOURCES

Table C1 : Data Description and Sources

Variable	Variable Description	Data Source
A) Measures of Poverty		
Human Development Index (HDI) *	The index of a country ranges between 0 and 1. Its calculation is based on 3 components: Health through life expectancy at birth, Education through the adult literacy rate and the gross schooling enrollment rate, and Income through a decent standard of living measured by GDP per capita. A higher rating index indicates that a country has a higher level of human development.	The 2007/2008 Human Development Report; The United Nations Development Programme (UNDP: accessed November 2007)
Headcount Index *	The proportion of population that is poor as the percentage of the population living below a certain threshold, i.e., people with their incomes or consumptions below the established poverty line or, in short, the incidence of poverty.	*PovCalNet*; The World Bank (accessed May 2007)
Poverty Gap *	The degree of how the mean aggregate income or consumption of the poor differs from the established poverty line, i.e., the depth of poverty.	*PovCalNet*; The World Bank (accessed May 2007)
Square Poverty Gap *	The distributional measure captures differences in income levels among the poor, i.e., the severity of poverty to reflect inequality among the poor.	*PovCalNet*; The World Bank (accessed May 2007)
B) Measures of Urbanization		
Urban Percentage	A country rated on a scale of 0 to 1. This index means that urban population as a percentage of total population is the proportion of a country's total national population that resides in urban areas. Any person not residing in an area classified as urban is counted in the rural population. Definitions of urban populations vary slightly from country to country. A country with a relatively higher urban percentage indicates more urbanized people living in urbanized areas than those in the other country.	The World Urbanization Prospects: The 2005 Revision; Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat (accessed May 2007)

Variable	Variable Description	Data Source
C) Channels of Poverty Reduction Outcomes		
Primary School Net Enrollment *	The primary school net enrollment ratio defined as the total primary school enrollment (both sexes) of the official primary school age group expressed as a percentage of the population from the same age group. In this study, we use the net enrollment educational attainment of the total population aged 15 and over.	Barro, J. Robert and Jong-Wha Lee, 2000 (accessed May 2007)
Youth Literacy Rate *	The percentage of the population aged 15-24 years who can both read and write, with comprehension, a short, simple statement concerning an individuals everyday life	The 2007 World Development Indicators CD-ROM; The World Bank
Infant Mortality Rate *	The probability of a child dying between birth and the age of one, expressed per 1,000 live births. The indicator is used as a measure of children's well-being and the level of effort being made to maintain child health.	The 2007 World Development Indicators CD-ROM; The World Bank
Life Expectancy at Birth *	The average number of years a new born infant would be expected to live if health and living conditions at the time of its birth remained the same throughout its life. It also reflects the quality of care they receive when they are sick.	The 2007 World Development Indicators CD-ROM; The World Bank
Agricultural Value Added per Worker *	A measure of agricultural productivity is in terms of constant 2000 U.S. $. Value added in agriculture measures the outputs of the agriculture sector less the value of intermediate inputs. Agriculture comprises value added from forestry, hunting, and fishing as well as cultivation of crops and livestock production.	The 2007 World Development Indicators CD-ROM; The World Bank
Non-agricultural Outputs per GDP	A measure of non-agricultural outputs as a percentage share of GDP. Non-agricultural sectors comprise of occupations in industry and service sectors.	The 2007 World Development Indicators CD-ROM; The World Bank

Variable	Variable Description	Data Source
D) Other Explanatory Variables		
GDP per Capita*	GDP per capita is gross domestic product divided by mid-year population. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes, and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in 2000 constant U.S. dollars.	The 2007 World Development Indicators CD-ROM; The World Bank
Degree of Decentralization	An indicator is as a percentage of a sub-national share of expenditures of the total expenditures. The indicator is measured on a scale of 0 to 1.	The 1972-1989 historical and the 2007 GFS CD-ROMs; The International Monetary Fund (IMF) and The World Bank Decentralization Thematic Group
Openness	Openness is calculated from the summary of import and export as a percentage of GDP. This indicator exhibits a country's openness to international trade.	The 2007 World Development Indicators CD-ROM; The World Bank
Official Development Assistances (ODA) *	ODA is as a percentage of GNI that is the percent of a country's Gross National Income (GNI) received in the form of aid from other countries. The ratio is measured between 0 and 1. Gross National Income or GNI (formerly GNP) is the sum of value added by all resident producers plus any product taxes (less subsidies) not included in the valuation of outputs plus net receipts of primary income (compensation of employees and property incorporation).	The 2007 World Development Indicators CD-ROM; The World Bank
Population Density	A number of population per squared kilometer	The 2007 World Development Indicators CD-ROM; The World Bank
Road Density	A length of road per squared kilometer	The World Road Statistics (WRS); the International Road Federation (IRF: accessed May 2007) and the 2007 World Development Indicators CD-ROM; The World Bank

Variable	Variable Description	Data Source
Freedom	A simple average of the index of political rights and the index of civil liberties by the author. Political rights measure a country rating on a scale of 1 to 7 that indicates the degree of political rights in regards to the existence of free and fair elections, competitive parties, or other political groupings, an opposition that plays a significant role in political decision-making, and the rights of minority groups to self-government. A rating of 1 indicates the highest level of political rights (closest to the ideals) suggested in the survey. Civil liberties measure a country rating on a scale of 1 to 7 that indicates the degree of civil liberties in regard to aspects such as the degree of freedom of expression, assembly, association, education, religion, and an equitable system of rule of law. A rating of 1 indicates the highest level of civil liberties.	Freedom in the World 2005; Freedom House (accessed May 2007)
Inflation	The index refers to a general rise in prices for goods and services measured against a standard of purchasing power	The 2007 World Development Indicators CD-ROM; The World Bank
Agricultural Share of GDP	The percentage share of agriculture of GDP	The 2007 World Development Indicators CD-ROM; The World Bank
Years of Schooling	A measure of education attainment in terms of the average years of schooling for the total population over the age of 15 years	Barro, J. Robert and Jong-Wha Lee, 2000 (accessed May 2007)
Government Consumption Share of GDP *	The percentage share of general government final consumption expenditure of GDP This consumption includes all government current expenditures for purchases of goods and services (including compensation of employees)	The 2007 World Development Indicators CD-ROM; The World Bank
Education Expenditure Share	The percentage share of education spending of the total expenditure	The 1972-1989 historical and the 2007 GFS CD-ROMs; The International Monetary Fund (IMF)
Health Expenditure Share	The percentage share of health spending of the total expenditure	The 1972-1989 historical and the 2007 GFS CD-ROMs; The International Monetary Fund (IMF)

Variable	Variable Description	Data Source
Agricultural Labor Force	The percentage share of agricultural labor force of the total labor force	Food and Agriculture Organization (FAO); the United Nations (accessed May 2007)
Precipitation	The yearly long run average rainfall	The Tyndall for Climate Change Research (accessed May 2007)
E) Country Classifications		
List of countries' primary export is oil.	Whether a country in our sample is a member of the Organization of the Petroleum Exporting Countries (OPEC).	The Organization of the Petroleum Exporting Countries (accessed May 2007)
Classifications of countries by income level and region	Whether a country in our sample is a member of high income countries and in which region a country is categorized.	The World Bank (accessed May 2007)

* Definitions based on The World Bank (http://www.worldbank.org: accessed May 2007)

APPENDIX D

STATISTICAL DATA

Table D1 : Descriptive Statistics for Variables

Variable	Obs	Mean	Std. Dev.	Min	Max
A) Urbanization and Poverty Reduction Outcomes (83 countries, 7 time periods: 1975-2005)					
Human Development Index (HDI)	513	0.749	0.154	0.256	0.968
Urbanization	513	0.603	0.203	0.063	0.973
GDP per Capita (1000 U.S. $)	512	7.860	9.420	0.111	52.182
Degree of Decentralization	286	0.250	0.164	0.004	0.642
Openness	497	0.745	0.419	0.115	2.939
Official Development Assistances (ODA)	471	0.025	0.054	0	0.654
Population Density	513	104.998	131.880	1.219	1,023.404
Road Density	391	0.936	3.081	0.023	41.474
Freedom	494	2.902	1.773	1	7
B) Urbanization and Pro-poor Growth (89 countries, 5 time periods: 1980-2000)					
Headcount Index (HI)	236	0.158	0.185	0	0.741
Poverty Gap (PG)	236	0.0565	0.082	0	0.411
Square Poverty Gap (SPG)	236	0.029	0.050	0	0.288
Urbanization	236	0.491	0.190	0.050	0.905
Inflation	217	1.847	5.515	0.972	75.817
Openness	231	0.696	0.368	0.132	1.988
Agricultural Share of GDP	232	0.204	0.121	0.023	0.563
Years of Schooling	179	5.556	2.133	0.670	10.500

Variable	Obs	Mean	Std. Dev.	Min	Max
Government Consumption Share of GDP	229	0.138	0.051	0.042	0.294
C) Urbanization and Primary School Net Enrollment (66 countries, 6 time periods: 1975-2000)					
Primary School Net Enrollment	381	0.370	0.152	.005	.759
Urbanization	381	0.563	0.225	.032	.971
GDP per Capita (1000 U.S. $)	374	7.777	8.846	0.086	37.164
Population Density	381	103.640	125.580	1.808	946.490
Education Expenditure Share	228	0.138	0.066	0.009	0.429
D) Urbanization and The Youth Literacy Rate (69 countries, 7 time periods: 1975-2005)					
Youth Literacy Rate	448	0.873	0.182	0.146	0.999
Urbanization	448	0.516	0.205	0.032	0.964
GDP per Capita (1000 U.S. $)	408	3.106	3.838	86.0263	26.178
Population Density	448	100.248	147.136	0.924	1097.327
Education Expenditure Share	202	0.145	0.056	0.015	0.367
E) Urbanization and The Infant Mortality Rate (83 countries, 7 time periods: 1975-2005)					
Infant Mortality Rate	561	37.882	35.74708	2	155.400
Urbanization	561	0.578	.2116523	0.032	0.973
GDP per Capita (1000 U.S. $)	534	7.253	8.843	86.026	3.997
Years of Schooling	433	6.245	2.648	0.350	12.050
Health Expenditure Share	298	0.110	0.079	0.003	0.489
Freedom	519	3.071	1.866	1	7
F) Urbanization and Life Expectancy at Birth (83 countries, 7 time periods: 1975-2005)					
Life Expectancy at Birth	522	68.71599	9.008231	35.158	81.237
Urbanization	522	0.593	0.206	0.043	0.973
GDP per Capita (1000 U.S. $)	499	7.683	9.038	0.086	39.968

Variable	Obs	Mean	Std. Dev.	Min	Max
Years of Schooling	398	6.585	2.562854	0.890	12.050
Health Expenditure Share	284	0.114	0.082	0.003	0.489
Freedom	484	2.983	1.867	1	7
G) Urbanization and Agriculture Value Added per Worker (105 countries, 8 time periods: 1965-2000)					
Agriculture Value Added per Worker (1000 U.S. $)	665	4.606	8.043	0.074	47.225
Urbanization	665	0.468	0.235	0.023	0.949
Agricultural Labor Force	659	0.424	0.281	0.018	0.947
Openness	656	0.634	0.363	0.053	2.289
Years of Schooling	612	5.034	2.859	0.170	12.050
Precipitation	665	1.159	0.791	0.0229	3.726
H) Urbanization and The Non-agricultural Share of GDP (105 countries, 9 time periods: 1960-2000)					
Non-agricultural Share of GDP	698	0.218	0.164	0.007	0.931
Urbanization	698	0.456	0.240	0.024	0.949
Agricultural Labor Force	647	0.430	0.284	0.018	0.947
Openness	681	0.634	0.363	0.053	2.289
Years of Schooling	638	4.953	2.909	0.170	12.050

Table D2 ： Selected Correlation Matrix

Urbanization and Poverty Reduction Outcomes (HDI)

	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
(1)	1								
(2)	0.7457	1							
(3)	0.7419	0.5891	1						
(4)	0.2643	0.2543	0.4076	1					
(5)	0.1831	0.1084	0.1471	-0.2451	1				
(6)	-0.5074	-0.3733	-0.3714	-0.1790	0.0902	1			
(7)	-0.6704	-0.4644	-0.6307	-0.3381	-0.0505	0.2619	1		
(8)	0.0624	-0.0541	0.0858	-0.1507	0.3314	-0.0744	-0.0654	1	
(9)	0.0587	-0.0045	0.0897	0.0242	0.2923	0.1160	0.0257	0.2158	1

(1) Human Development Index (HDI)
(2) Urbanization
(3) GDP per Capita
(4) Degree of Decentralization
(5) Openness
(6) Official Development Assistances
(7) Freedom
(8) Population Density
(9) Road Density

Urbanization and Pro-poor Growth (HI, PG, and SPG)

	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
(1)	1								
(2)	0.9474	1							
(3)	0.8617	0.9766	1						
(4)	-0.5863	-0.4670	-0.3736	1					
(5)	-0.0696	-0.0571	-0.0480	0.1255	1				
(6)	-0.1977	-0.0990	-0.0428	0.0446	-0.1303	1			
(7)	0.6424	0.5176	0.4100	-0.6844	-0.0986	-0.3118	1		
(8)	-0.5574	-0.4620	-0.3815	0.5342	0.0255	0.3317	-0.6481	1	
(9)	-0.1005	-0.0039	0.0426	0.1912	-0.0364	0.3346	-0.3583	0.2643	1

(1) Headcount Index (HI)
(2) Poverty Gap (PG)
(3) Square Poverty Gap (SPG)
(4) Urbanization
(5) Inflation
(6) Openness
(7) Agricultural Share
(8) Years of Schooling
(9) Government Consumption Share

Table D3 : Checking for Multicollinearity by Variance Inflation Factor (VIF)

Urbanization and Poverty Reduction Outcomes (HDI)		
Independent Variable	**VIF**	**1/VIF**
Urbanization	32.51	0.030756
Urbanization^2	29.00	0.034479
GDP per Capita (U.S. $) [a]	5.01	0.199579
Degree of Decentralization	1.36	0.733105
Openness	1.35	0.742615
Official Development Assistances	1.76	0.569707
Freedom	2.20	0.453652
Population Density [a]	3.73	0.268343
Road Density [a]	4.29	0.233267
Mean VIF	9.02	If VIF is less than 10, then the model is merit.

Table D4 : The Hausman Tests for Endogeneity

Urbanization and Poverty Reduction Outcomes				
Dependent Variable	**HDI**			
Independent Variable	**Test Statistic**	**D.F.**	***p*-value**	**Result** ($\alpha = 0.10$)
Urbanization	1.430	10	0.234	Fail Reject H_0
Urbanizaiaton^2	1.780	10	0.184	Fail Reject H_0
GDP per Capita (U.S. $) [a]	5.310	10	0.023	Reject H_0
Degree of Decentralization	0.730	10	0.395	Fail Reject H_0
Openness	0.050	10	0.828	Fail Reject H_0
Official Development Assistances	3.330	10	0.071	Reject H_0
Freedom	1.490	10	0.225	Fail Reject H_0
Population Density [a]	6.090	10	0.015	Reject H_0
Road Density [a]	12.790	10	0.001	Reject H_0

H_0: There is no systematic difference in the coefficients
The validity of the Hausman test solely depends on the validity of full instruments used in the test. In our test, we use some of the internal lagged values for each variable.
[a] The variable is in the logarithm form.

Table D5 : GMM-IV First Stage Estimates

Dependent Variable	Urbanization (1)	Square of Urbanization (2)
First lagged Urbanization	1.725 **	
	(0.520)	
Second lagged Urbanization	-0.742 **	
	(0.053)	
First-lagged square of Urbanization		1.755 **
		(0.063)
Second-lagged square of Urbanization		-0.773 **
		(0.069)
No. of Observations	346	346
R-Square	0.9899	0.9855

** significant at 1%; * at 5%; # at 10%
Numbers in parenthesis are robust standard errors.

Table D6 : Fixed and Random Effects for Pro-poor Growth

Model (Growth Rate)	Fixed Effects			Random Effects		
	HI	PG	SPG	HI	PG	SPG
Urbanization	-20.016 #	-17.945	-18.474	-4.402	-2.092	-3.637
	(11.237)	(11.792)	(18.469)	(3.084)	(3.318)	(4.475)
Urbanization^2	16.724	15.868	-2.083	3.655	0.860	1.262
	(12.715)	(12.636)	(16.756)	(3.511)	(3.521)	(4.724)
Initial Level of Dep. Var.	-1.024 **	-0.696 **	-1.424 **	-0.585 **	-0.573 **	-0.869 **
	(0.177)	(0.256)	(0.171)	(0.138)	(0.141)	(0.151)
Inflation[b]	-0.174	-0.149	-0.214	-0.146	-0.141	0.008
	(0.199)	(0.195)	(0.198)	(0.164)	(0.168)	(0.220)
Openness[a]	0.527	-0.479	0.560	-0.137	-0.368	-0.079
	(0.547)	(0.575)	(0.855)	(0.305)	(0.329)	(0.509)
Agricultural Share[a]	1.111 #	0.707	1.035	0.800 *	0.416	0.527
	(0.637)	(0.675)	(0.968)	(0.387)	(0.405)	(0.408)
Schooling	0.393	0.067	1.143 *	-0.101	-0.160	-0.198 #
	(0.281)	(0.367)	(0.432)	(0.103)	(0.102)	(0.113)
Gov. Consumption Share[a]	-0.077		1.032	-0.058		0.423
	(0.559)		(0.776)	(0.367)		(0.440)
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes
No. of Observations	117	117	117	117	117	117

** significant at 1%; * at 5%; # at 10%
[a] The variable is in the form of logarithm.
[b] The variable is in the form of logarithm (1+variable).
Numbers in parenthesis are robust standard errors.

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VITA

Panupong Panudulkitti was born in Bangkok, Thailand. He graduated from King Mongkut's Institute of Technology Ladkrabang (KMITL) with a Bachelor's Degree in Civil Engineering (Construction) and from the Asian Institute of Technology (AIT) with a Master's Degree in Civil Engineering (Transportation). During his study at AIT, he was sponsored by the AIT partial scholarship. After he earned his Master's Degree, he worked at PlanPro Corp., Ltd., an engineering consulting company, and the Department of Highways as a transport/traffic engineer. Afterward, he turned to assist in the family business under the title of Assistant Manager.

In April 2002, he joined the Royal Thai Police as a Deputy Traffic Police Inspector. He began with the rank of Police Sub-Lieutenant and then Police Lieutenant. After August 2003, he took an educational term from the Royal Thai Police in order to pursue a Ph.D. in Economics at Georgia State University (GSU). During his studies, he served as a Graduate Research Assistant (GRA) in the Department of Economics with the last two years serving under the direct supervision of Dr. Mary Beth Walker. In addition to this, he served as a Graduate Teaching Assistant (GTA) in Econometrics at the graduate level. He accomplished the Ph.D. in Economics in December 2007 and also earned a Master's Degree in Economics in August 2005. His Dissertation was preceded by a research paper based on the IX Research Network on Inequality and Poverty (NIP) Meeting, which was held at the Universidad de los Andes, Bogotá, Colombia in October 2007.

Panupong’s research interests lie within the specialty areas of development economics, public finance, and urban economics. Upon obtaining his Ph.D., Panupong returned to serve as a Police Captain at the Metropolitan Traffic Police Division of the Royal Thai Police.