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Demographic transition and material welfare of households: Evidence from South and South-East Asia

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Abstract

The present study aims to investigate the demographic effects of the age structure transition on the material welfare of households in South and South-East Asia. In the midst of a substantial demographic transition with large cohorts of young adults who reached their working-ages and low dependency ratios, households hold huge opportunities to accumulate assets and gain access to essential facilities that will lift up their economic standards of living. To explore the demographic dividend that South and Southeast Asian states hold, a fixed-effects model, derived from the economic convergence theory, on a subnational panel data set is used. A particular feature of this study is that the traditional proxy for economic growth, income per capita, is replaced by an asset-based indicator. The asset-based index is comparable across place and time and is highly correlated with human development, income, and life expectancy. The results imply that a considerable fraction of the economic performance these districts experienced is attributable to changes in the age structure. With further increase of the working-age cohort relative to the dependent population, districts from the South and South-East Asian states, under the appropriate policies, could accelerate their economic convergence with the rest of the region.

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CONTENTS

I. Introduction

This study attempts to explore the separate effects of the demographic transition through its major channels population growth, mortality, fertility, and age structure on the material welfare of households. The particular focus is to study how changes in the age structure impede or encourage wealth accumulation. Thus, the working-age ratio, as a major proxy for the changes in the age structure, is introduced in a welfare analysis that uses an alternative measure of wealth based on asset ownership. In contrast with the typically used measures in the literature, such as income or consumption expenditure, an asset-based index can better identify the socio-economic status of households, especially when data on income and expenditures is unavailable or hard to collect.

Numerous studies have sought to explain economic performance through a great number of economic, policy, institutional, geographic, and demographic variables. However, one striking feature of the literature is the predominantly poor attention it pays for the demographic factors. Once the population growth was included in the early traditional econometric analysis as an explanatory variable alone to explain cross-country differences in income growth, the results showed significant negative effects. In the late 1980s, this dogma changed, once the econometric techniques were refined by improvements brought by a better understanding of the demographic phenomena. These years were dominated by the neutralistic views which assume no significant effect when controlling for a sufficient number of relevant variables. However, in less than one decade, Bloom, Williamson, 1998 introduced the age structure factor into the literature, arguing that different combinations of mortality and fertility have different effects on economic growth with respect to the economic and institutional environment where the transition develops (Bloom, Williamson, 1998). In recent years, more and more economists have investigated this belief and found even more consistent evidence to support the underlying importance of the demographic transition to population growth.

The demographic transition is a change from high mortality and fertility rates to low mortality and fertility rates (Bloom, Williamson, 1998). During this transition economic growth is impeded due to the high rates of population growth at the young ages, resulting in a larger share of dependents from the total population. However, this first transformation is temporary and generally lasts for two decades, until the initial young cohort reaches the prime working ages, creating a bulge into the workforce (Bloom, Williamson, 1998). Over time the bulge of working individuals leads its way from the prime working ages, through saving, reproduction, and eventually to retirement ages creating another bulge into the dependent population, but this time concentrated among the old group (Bloom, Canning, Malaney, 1999). This transition creates growth prospects for an economy to build physical and human capital.

It is generally confirmed that young and old people tend to consume more output than they generate, unlike working-age people whose contribution to output and savings is much higher than their consumption (Bloom, Canning, Malaney, 1999). Thus, a higher ratio of working-age individuals to old and young delivers big prospects of investing in human capital and infrastructure. Under these circumstances, savings and investments in education are more likely to occur. However, several studies highlight the potential failure of these behavioral

changes to develop if combined with the inappropriate policies and poor infrastructure. Two main regions are at the center of this comparative analysis, which made possible the exploration of the demographic transition and its effects. East Asia's economic miracle and Africa's demographic disaster, two clear examples of how demographic transformations might enrich or ruin an economy and its people.

Growth effects of the demographic transition do not capture entirely the unpaid work and workers' productivity into the informal sectors when using income per capita or other non-asset-based indicators as a proxy for measuring income growth and thus economic welfare of individuals (Filmer, Pritchett, 2001, Howe, Hargreaves, Huttly, 2008). Hence, for an accurate analysis we do must account for these differences and include an indicator capable of capturing the whole effect of the age structure transition. IWI (International Wealth Index) provided by the Global Data Lab (GDL) is an asset-based wealth index derived from 165 household surveys in 97 low and middle-income countries, which has the capability to better capture the socio-economic status of the households in a cross country comparative analysis (Smits, Steendijk, 2015). This index is proved to be more strongly correlated with human development, health (life expectancy), and education than income per capita (Smits, Steendijk, 2015).

The analysis is performed on a sub-national panel data which includes numerous regions from twelve different states from South and South-East Asia, namely India, Pakistan, Nepal, Bangladesh, Afghanistan, Cambodia, Laos, Myanmar, Indonesia, Thailand, Vietnam, and the Philippines. The data was collected through various health and demographic surveys at different time points for each country. Although the surveys were held by different entities in different years, which means that the information collected varies among surveys, Smits and Steendijk, 2015 solved this limitation by carefully choosing a set of assets that makes possible ranking households on the same scale. Their comparative index IWI runs from a situation in which a household has no possessions to a situation in which possesses all assets (Smits, Steendijk, 2015). Based on the same surveys, GDL provides a rich database with numerous socioeconomic, demographic, and health variables for sub-national regions, which is extensively used in the current study.

Because the demographic transition is more visible in these states, creates a favorable setting that helps us to test our hypothesis and draw valuable inferences that remain valid for the remaining period of the demographic transition these states are about to experience. With a large bulge in the working-age ratio and a low dependency rate, households in South and South-East Asia are able to increase savings and acquire essential assets that will lift up their economic status. In the midst of a demographic transition which is likely to last for another two decades, South and South-East Asian states have the potential to harness huge gains and converge with the rest of the region (Navaneetham, Dharmalingam, 2012). Thus, what is interesting to study are the different demographic patterns across these states which will allow us to econometrically explore the impact of the demographic dividend on the economic performance of households.

Two features distinguish this study from the rest of the literature. Firstly, using an asset-based index broadens our understanding of economic performance in those regions where poverty prevails and information on income and expenditure is unavailable. All previous studies focused on the convergence model from the growth literature to explain the impact of

demographic factors, however, none of these studies have sought to rely on other measures besides the standard proxies e.g. income or output growth and thus ignoring the potential constraints imposed by these indices. Lastly, this study combines data at the subnational level from different countries to account for heterogeneity across regions within the same borders. This is even more important in low and middle-income countries where is an unequal distribution of infrastructure and different access to world trade. Although this analysis is conditioned by the limited number of surveys held and some potential bias induced by the surveys themselves, which is extensively covered throughout this paper, yet is nevertheless a contribution to the existing literature.

II. LITERATURE OVERVIEW

In this section, a chronological overview of the existing literature is presented throughout three parts. The first part starts by introducing the early views on population growth dominated by the pessimistic view, gradually moving forward to the neutralistic standpoints which governed the end of the last century. In the second part, we discuss all major studies conducted to analyze the true effects of the demographic transition which introduced age-structure as the dominant force. The last part explores the demographic trends in Asia based on the existing literature.

1. OPPOSITE VIEWS ON THE ECONOMIC EFFECTS OF POPULATION GROWTH

For decades, economists have studied and debated the impact of demographic changes on economic growth. In the early studies, the focus was on the economical effects of population growth, with numerous proponents having opposite views on either weighting more the benefits "Population optimists" (Kuznets, 1967) or the losses "Population pessimists", credited to the Malthus' theory (Ehrlich, 1968). The pessimists claim that population growth hinders economic growth through reducing rates of savings and investments while increasing unemployment and poverty (Bloom, Freeman, 1986). This thinking gain popularity in the late 1940s, when the rapid population growth after the Second World War raised concerns about the capacity of the food supply and natural resources to support this new wave of consumers in a world with fixed resources and slow technical progress (Bloom, Canning, Sevilla, 2003). In addition to the impact on the demand for fixed resources, economists found out that there is a potentially negative effect on the provision of capital. A larger population requires more resources, and thus a larger part of the investments are used to supply their needs, reducing capital per worker (Bloom, Canning, Sevilla, 2003).

As the world changed, technological progress, in both sectors, agriculture, and industry, occurred, which turned the pessimist thinking into an optimistic one (Bloom, Canning, Sevilla, 2003). These developments encouraged many economists to revise their initial opinions about the negative effects of population growth. Economists such as Simon Kuznets and Julian Simon asserted that the rapid population growth can be a potential economic asset (Kuznets, 1967, Simon, 1981). The underlying explanation is that population growth creates pressure which stimulates technological change within the old traditional framework and adoption of novel innovative techniques to build economies of scale and capital which offsets the scarcity of resources and thus induce economic growth (Kuznets, 1967). In addition, the higher the rate of population growth the greater the demand for capital formation to equip and absorb the additional labor force. Capital formation is defined two-fold, human, and material capital. Human capital requires efficient investments in the quality of human beings through education, training services, health infrastructure, while material capital embodies research and development services to generate more sustainable assets and commodities which require minimum input (Kuznets, 1967).

In his analysis and contrary to his beliefs, Simon Kuznets recorded a negative significant correlation between population growth and growth in per capita product (Kuznets, 1967). Before succumbing his beliefs to the pessimistic dogma, he explained why this happened. The answer is that for the sample of countries that he used for conducting his empirical work, which is the largest possible set of data available at that time, the negative correlation is due to the difference between the developed and underdeveloped countries, the latter offsetting the positive effects of the former one (Kuznets, 1967). The author explains that this is not due to the underlying effects of population growth, but instead due to the failure of underdeveloped countries to respond to this trend, which gave power to the pessimistic views to support their beliefs. He argued that the Malthusian trap is stimulated by the limited capacity of institutions to provide the appropriate economic and social conditions, coupled with the cultural constraints on the application of new knowledge and technology together with the conflicting tendencies among ethnic communities, tribes, castes, representing the core element of political instability (Kuznets, 1967). Another important aspect is the heterogeneous demographic growth across lower and upper economic and social groups within a country. Since the lower economic groups own smaller capital reserves and follow different demographic patterns with high fertility and mortality rates, demographic growth will have harmful effects. Therefore, not channeling the capital resources to decreasing the capital-output ratio creates income inequalities among these groups which will ultimately lead to social unrest (Kuznets, 1967). Apart from the extension of policies to cover the disparities between different groups within underdeveloped economies, policy interventions must as well be implemented cautiously with respect to the stage of development. Since a substantial input into education at an early stage might fail in enhancing the capital-output ratio, while in a later stage this might have a considerable contribution (Kuznets, 1967).

Although extensive research was conducted for several decades, this was not enough in predicting the true effects of population growth due to various limitations of the empirical models and data. Therefore, in the mid-1980s the improvements in the underlying theory and empirical models shifted the debate to a different standpoint, which became the new dominant view, namely population neutralism. The neutralist theory, as its name suggests, implies no or little correlation between population and economic growth. The advocates of this third view support that once controlling for other factors such as openness to trade, educational attainment, geographic characteristics, institutional and social factors there is little cross-country evidence for a significant interaction between population and economic growth (Bloom, Freeman, 1986, Bloom, Canning, Sevilla, 2002).

Bloom and Freeman, 1986, in their paper examined the relationship between average annual population growth rate and average annual growth rate of gross national product per capita using a linear regression model with contemporaneous and lagged data for the period 1965-1984 on a large sample of developing countries. In their analysis, they identified three main channels through which population growth can influence economic growth: the ratio of the labor force to population, allocation of labor across sectors, and productivity of labor within sectors (Bloom, Freeman, 1986). Their findings reported little and insignificant aggregated results to support either view, pointing out that while each group, either pessimist or optimists, are focusing on stressing out various channels through which population growth stimulates or hinders economic growth, they fail in observing the offsetting trend of the separate effects during following years (Bloom, Freeman, 1986). In addition, their study emphasized the different patterns of demographic change across time and country groups,

which indicates the importance of the components of demographic change in studying their economic effects. Therefore, countries with similar population growth rates might have different birth and death rates with different effects on labor supply and thus different economic experiences (Bloom, Freeman, 1986).

Subsequent to their earlier paper, Bloom, Freeman, 1988, investigated their beliefs in the neutralist theory on a data set composed of developing countries from 1965-1985 and found little association between population growth and economic growth. To address this matter the authors decomposed population growth into its two major components birth rate - death rate and labor force, the ratio of persons of working-age to non-working age (aged 15-64) (Bloom, Freeman, 1988). Their attention is directed on the labor market consequences through increases in the labor supply and productivity through the sectoral allocation of the labor force (Bloom, Freeman, 1988). Their findings suggested that countries with similar population growth rates had different patterns within the demographic structure, with distinctive birth and death rates which exhibited different associations between income growth and population growth, with slightly negative correlations between high birth and death rates and slightly positive for relatively low birth and death rates. Overall, the aggregate results for the whole period were not significant from zero, being slightly negative over the period 1980-1985[1]. The study concludes that the timing and components of population growth with respect to their economic experiences are crucial elements for identifying the true effects of population growth.

To further test the neutralist theory, Kelley, Schmidt, 1995 examined the separated effects of the population growth components. In their analysis they found out that the aggregate effect of population growth in the 1980s was negative (see footnote 1), while during the 1960s and 1970s the aggregate impact was not significant from zero, whereas the separate effects were sizable, offsetting each other. The cross-sectional evidence shows the strong autocorrelation between past and current growth rates, which can be translated into the positive impact of past births through contributing to the current labor force supply and the negative impact of current birth rates which deter savings and investments compensated by the positive impact of current death rates. However, these trends differ across countries situated at different stages of development e.g. an increase in the current death rate decreases economic growth in LDCs, where mortality is concentrated in the younger and working-age individuals, while in DCs the effect is somewhat positive, mortality occurring among retired cohort whose members are unproductive and capital consumers (Kelley, Schmidt, 1995). Their study concludes that population growth contains both positive and negative effects which might vary over short or long time periods and by stage of economic development.

2. INTRODUCING AGE STRUCTURE INTO THE GROWTH LITERATURE

Exploring the true benefits of population growth

[1] An explanation of the negative economic effect from the 1980s is that it represented a particular period plagued with world recession, wars, droughts and other adverse consequences which felt strong in the countries with high rates of population growth (LDC).

In 1998 Bloom and Williamson found out that the whole technical literature missed a critical dimension of the demographic dynamics, namely, the variations in the age structure. According to them, countries are passing through various phases of demographic transitions during which the dependent and working-age population are growing at different rates. This trend was more accentuated in East Asia, during 1965-1990, where the working-age population grew at a faster pace than the dependent population. Hence, an increase in the working-age ratio creates a bulge into the economically active population, referred to as the demographic dividend. In their paper "*Demographic transitions and economic miracles in emerging Asia*" the analysis on 78 Asian and Non-Asian countries showed a strong correlation between the growth of working-age population and economic growth, proxied by GDP per capita, explaining nearly one-third of the East Asian countries' economic miracle. Three possible channels of impact were identified, precisely: increase in the labor input, saving rates, and investments in human capital. Three-quarters of this growth is owed to the increase of savings rates which triggered capital accumulation, once the heavy burden of the youth cohort faded away. A tenth was caused by the share of working-age to total population growth (representing the pure demographic effect). Whereas, the remaining growth was accounted for the rise in the investments share. Thereby, the discovery made population dynamics to be the single most significant determinant of Asian growth.

The demographic gift given by the Asian miracle made it possible for economists to study the connection between the two driving forces, economic growth, and population growth. The different patterns across the Asian continent revealed that the demographic divergence between the South Asian, South-East, and East Asian countries contributed to the economic divergence between these regions (Bloom, Williamson, 1998). Bloom, Canning, Malaney, 1999[2] provided strong evidence of feedback from high-income rates to age structure changes through fertility reduction. Although income stimulates demographic transition, the large part of the effect comes from the exogenous force of the demographic transition. This explains why East Asia benefited from an interaction between population change and income growth, while South Asia remained caught in a population-income trap (Bloom, Canning, Malaney, 2000). Therefore, policies aimed at creating the demographic convergence between these areas can bring economic convergence in the long run.

The demographic transition can take longer than 50 years to operate and starts with the decline in infant mortality rates, as shown in Figure 1, mainly due to increased access to vaccines, antibiotics (as spillovers from the developed world), sanitation, safe water, and better nutrition (Bloom, 2011), which produce a large youth cohort to enter the working force two decades later (Bloom, Williamson, 1998, Bloom, Canning, Malaney, 1999). Since the presence of more children requires more resources, the beginning of the transition has a negative impact on economic growth, which diminish gradually with the decline in fertility rates, until it reaches the replacement levels (2.1 children per women) (Bloom, 2011). The difference between fertility and mortality rates represents the population growth rate as shown in Figure 1, which must accompany the demographic transition to deliver changes in the age structure, as explicitly shown in Figure 2. Once the youth cohort reaches the working ages, the demographic dividend is available for being harness, marking the second stage of the

[2] Note that the cited paper is an earlier draft of the Population and Development Review paper published by the same authors, which contains the theoretical and empirical workings in more detail than the final paper published in 2000.

transition. During this stage, resources previously used in child-rearing are transferred for establishing physical and human capital, such as investments in training activities, infrastructure, research, and development (Bloom, 2011). In addition, the female empowerment and participation rates in the workforce are increasing with the decline in fertility. A further boost to savings occurs with greater longevity induced by the medical progress that has occurred during this period which delivers incentives to the working-age cohort to save for longer retirement periods (Bloom, 2011). Some decades later, the swollen cohort reaches the retirement ages which again impedes economic growth, marking the end of the demographic transition. It is important to mention that the demographic dividend may or may not be realized, depending on the economic, political and social environment (Bloom, Williamson, 1998, Bloom, Canning, Malaney, 1999).

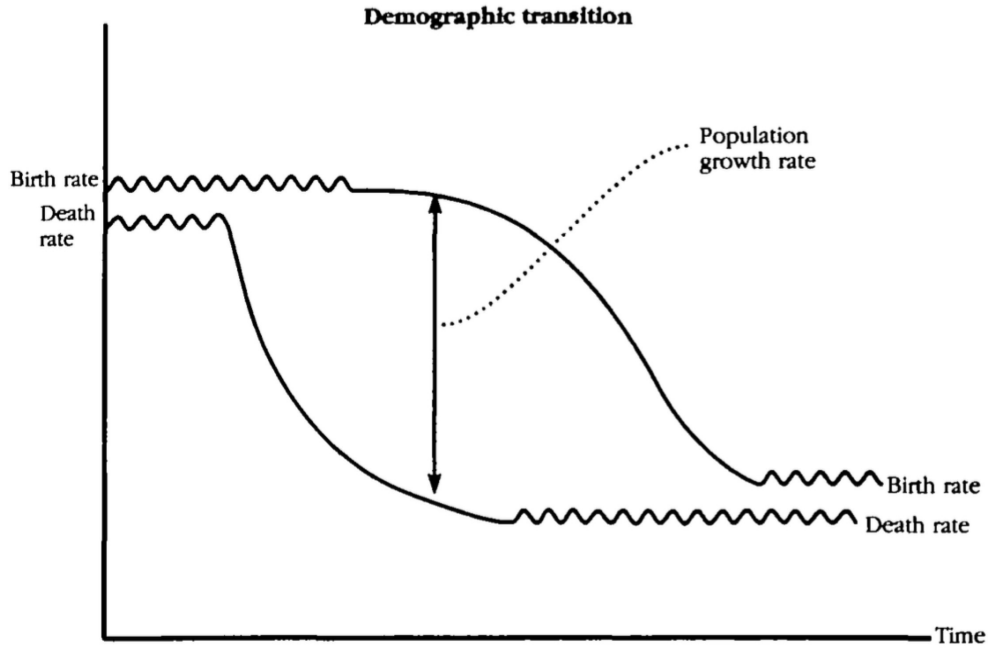

Figure 1: The Demographic Transition. Source: Bloom and Williamson (1998)

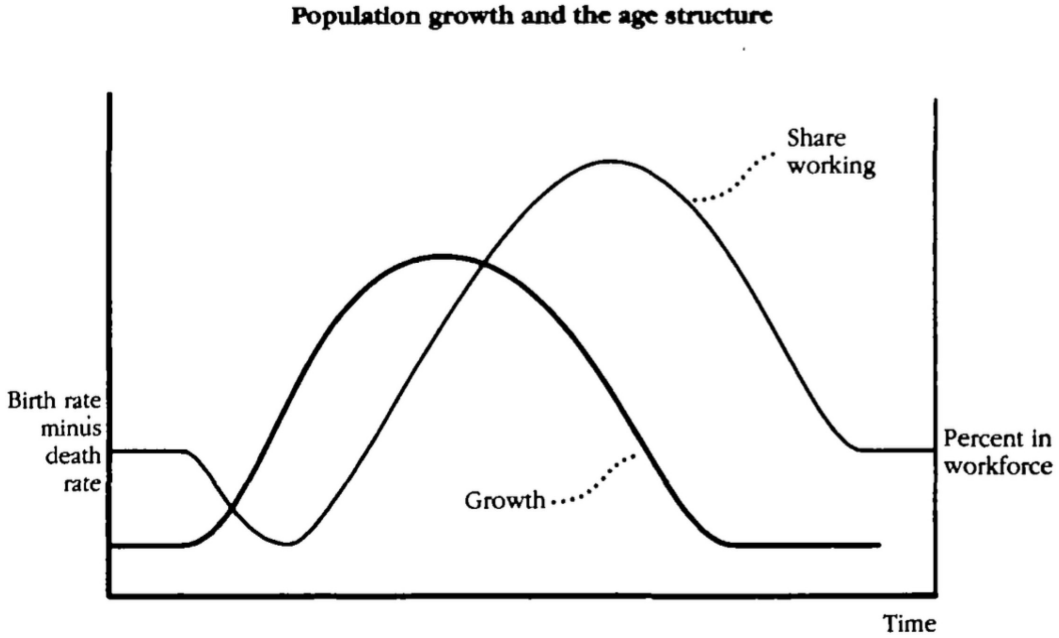

Figure 2: Population Growth and Age Structure. Source: Bloom and Williamson (1997)

The demographic dividend has two major economic effects, as identified by Bloom, Freeman 1988, Bloom, Canning, Malaney, 1999. The two effects are: the "accounting" effect which indicates changes in the size and age-structure of the population at fixed labor participation rates which reflects fluctuations in the working-age individuals per capita and the "behavioral" effect which indicates changes in labor supply due to changes in labor participation rates and productivity e.g. increased savings and investments in child education (Bloom, Freeman 1988, Bloom, Canning, Malaney, 1999). However, these effects are not automatic, depending on the capacity of an economy to equip its individuals with physical and human capital to absorb them into productive employment (Bloom, Canning, Malaney, 1999). Therefore, without the appropriate policies, the additional labor supply can lead to unemployment, political instability, and deterioration of human capital, and thus transforming the demographic dividend into a burden (Bloom, Canning 2004).

After discussing the effects is important to mention the mechanisms through which the demographic dividend is delivered. Three major mechanisms are identified in the literature, labor supply, savings, and human capital (Bloom, Canning, Sevilla, 2003). The first mechanism, labor supply has two components, one representing the mechanical effect of the relative increase in the number of the non-dependent working-age individuals to dependents, given fixed participation rates and full absorption of the labor market (Bloom, Canning, Sevilla, 2003). The second relates to the fall in family size encouraging women to enter the labor market accompanied by the diversion of resources to the education of children leading toward a more educated workforce. The next mechanism, savings, works through two channels as well, the accounting effect and the behavioral effect. The accounting effect refers to the ratio of working-age individuals, who have higher economic output and savings, to the young and old who consume more than they produce. Whereas, the behavior effect relates to the increased private household savings since improved health and longevity create greater pressure to prepare for their retirement and make savings easier and more attractive (Bloom, Canning, Sevilla, 2003). The last mechanism through which the demographic dividend is delivered is human capital. As the age-structure changes, the way people live changes too, which brings different attitudes towards education, retirement, family, women empowerment, and the labor market. Therefore, parents are likely to invest more in their children's education, families start saving more, small family sizes increase women participation in the labor market, altogether delivering a high-quality workforce and great investments into human capital. Finally, all these mechanisms are highly dependent on the flexibility of the market, the reliance on the domestic financial markets, and macroeconomic policies (Bloom, Canning, Sevilla, 2003).

Many studies followed to investigate the magnitude of the demographic dividend with a focus on particular regions, such as East Asia's economic miracle (Bloom, Williamson, 1998, Bloom, Canning, Malaney, 1999, 2000, Mason, 2001, Mason, Kinugasa, 2008, Bloom, Finlay, 2009, Ogawa et al, 2009) or Africa's demographic burden (Bloom, Canning, Sevilla, 2003, Bloom, Canning, Finlay, Fink, 2007), while other studies focused on one country such as the „Celtic Tiger"[3] (Bloom, Canning, 2004) or India (Chandrasekhar, J Ghosh, 2006, James, 2008, Mody, Aiyar, 2011, Kumar, 2014).

[3] Term referring to the economy of the Republic of Ireland during the period 1960 – 1990.

The separated effects of the demographic transition

As discussed earlier, falling in **mortality** rates [4] have a strong positive impact on economic performance. The instruments used to measure mortality are total mortality rates, infant mortality rates, and life expectancy. Among all, total mortality has neither positive nor negative significant effect on economic growth, since the ratio of economically active people remains the same (Bloom, Williamson, 1998). However, several studies confirm the sizable effect of increased longevity on income growth through various channels (Bloom, Canning, Malaney, 1999, Bloom, Canning, Sevilla, 2003, Bloom, Canning, Sevilla, 2004, Bloom, Canning, Mansfield , Moore, 2007, Bloom, Canning, Hu, et al, 2010). First, a higher life expectancy means healthier people and hence a healthier workforce which is a more productive workforce. Second, healthy people have higher expectations for longer retirement ages which stimulates them to save more for these ages. Third, healthy children mean less physical and mental disabilities and higher cognitive abilities, which leads to better school attendance and achievements, resulting in a more educated workforce. Finally, a healthy population creates better prospects for foreign direct investments (Bloom, 2011). An additional indirect channel through which mortality influences economic growth is through its effect on fertility rates. Hence, a decline in infant mortality creates pressure on couples to reduce the number of births because more children born survive, inducing a more sustainable fertility pattern (Pace, Ham-Chande, 2016).

In the literature, two mechanisms are more representative when studying the effect of improved life expectancy, and thus improved health, on economic growth, specifically labor productivity and savings. With regard to the workforce productivity, a representative study is Bloom, Canning, Sevilla, 2004 that regresses life expectancy on economic growth, controlling for several other variables which can cause potential bias in the results (Bloom, Canning, Sevilla, 2004). One explanatory variable is substantial, specifically workforce experience, which might potentially capture some of the effects in health, especially in countries with high life expectancies, assuming that older workforces hold higher levels of experience (Bloom, Canning, Sevilla, 2004). Their findings show a positive and statistically significant effect of good health on aggregate output, through labor productivity increase, even when controlling for work experience, with a 1-year improvement in life expectancy leading to an increase of 4% in output (Bloom, Canning, Sevilla, 2004). With respect to savings, Bloom, Canning, Graham, 2003 is one prominent paper that addresses this matter. This paper uses a standard life-cycle model to explain the effects of longevity on savings rates on a cross-country panel of national savings rates (Bloom, Canning, Graham, 2003). Their findings suggest that increases in longevity tend to increase the relative length of retirement age and thus raising the need for retirement income, increasing the savings rates among working-age individuals (Bloom, Canning, Graham, 2003). However, the effect is temporary, confirming the plausible assumptions of the life-cycle saving literature, that once the demographic disequilibrium phase flattens out, the higher savings rates are offset by the increased old age-dependent population (Lee, Mason, Miller, 2000, Bloom, Canning, Graham, 2003). In practice, these dividends are largely dependent on the institutional arrangements, such as social security

[4] It is important to indicate that mortality rates are concentrated at the lower end of the age distribution, among the infants and young children who are more exposed to infections and underlying health conditions. This is the reason why many economists use infant mortality in their analysis for a more accurate investigation.

provisions, retirement laws, and respectively, labor market legislation (Bloom, Canning, Graham, 2003).

The importance of health is even higher in countries where poverty prevails since the main asset of poor people is their own work capacity to generate resources for achieving the minimum standards of living. Thus, those individuals who are confronted with poverty, are more sensitive to changes in their health status (Bloom, 2011). This explains why the central piece of poverty alleviation programs is the improvement in the health status of poor people. Recent findings suggest that a 10 year gain in life expectancy is expected to increase economic growth by 1 additional percentage point, which is relatively significant for economies with 2-3 percentage point growth rates and within the reach of realizing this improvement (Bloom, 2011).

Fertility is another major component of the demographic transition that captures significant effects on economic growth. Decreases in fertility rates mark the beginning of the second phase of demographic transition and the immediate mechanical effect is lowering youth dependency rates. Lower dependency ratios are accompanied by behavioral effects, such as increased female labor participation rates and higher investments in physical and human capital, through greater savings for old age retirement and higher input in child health and education (Bloom, Canning, Fink, Finlay, 2009). However, fertility decline is not an automatic process subsequent to the fall in mortality rates, in fact, is driven by numerous exogenous factors. In most OLS and panel fixed-effects regressions the major determinants of fertility rates are education, infant mortality, and income (Bloom, Canning, Malaney, 1999, Bloom, Canning, Fink, Finlay, 2009, Murtin, 2013). Out of all, education exhibited the strongest significant and negative influence, when proxied by primary school attainment rates (Murtin, 2013). There are many mechanisms through which rising education decreases fertility, but one is more considerable, precisely rising female education. Hence, exposing women to a wider world will automatically delay marriage and lower family sizes, which in turn releases resources that might be used for better education of children or as investments in the economic-social status of the family (Bloom, Canning, Fink, Finlay, 2009, Pace, Ham-Chande, 2016). Infant mortality is significantly negatively associated with fertility, its effects being discussed in the previous paragraph, whereas total mortality exhibits mixed results (Murtin, 2013). Lastly, income shows a significant negative association with fertility, mostly through its positive effect on women's workforce participation rates (Bloom, Canning, Fink, Finlay, 2009). However, these effects depend on the institutional and policy framework of a country, and its capacity to absorb the freed human capital into the labor market. Therefore, is imperative for governments of the developing world to take responsibility for improving access to the labor market and quality services, contraceptive use, and abolishing abortion laws (Bloom, Canning, Fink, Finlay, 2009).

After clarifying the mechanisms through which mortality and fertility operate, it is for great importance to understand the endogenous nature of these two forces, before pursuing any econometric analysis. Fabrice Murtin, 2013 in his paper „*Long-Term Determinants Of The Demographic Transition"* uses a database [5] which contains most of the available statistical information on population growth, income, health, and education for a large panel of countries since 1870 to study the major determinants of health and fertility, proxied by

[5] The full sample gathered panel data on 70 countries at different years, from which 16 advanced countries in a balanced panel since 1870, 25 countries available from 1910, 29 in 1930, 37 in 1950, and 69 in 1960.

infant mortality, total mortality, life expectancy, and crude birth rate, respectively (Fabrice Murtin, 2013). Using long distant lagged instruments[6] and accounting for time and country fixed effects in an OLS, panel fixed effects, and GMM model to tackle potential reverse causality, found strong empirical results (Fabrice Murtin, 2013). According to him, primary schooling is the most robust determinant of fertility, whilst schooling and income are most significant for health (Fabrice Murtin, 2013). However, schooling explained much of the variation in health improvements, which makes education alone to be the main driving force of the demographic transition (Fabrice Murtin, 2013).

Because an economy's productive capacity is directly associated with the relative size of its working-age population to the entire population, it is important to distinguish between these two components when analyzing the effects of mortality and fertility during demographic transition. Bloom, Williamson, 1998 introduced the share of working-age people as the centerpiece of their analysis and found out that population growth in the working-age cohort has a powerful positive impact on economic performance (relative to the dependent cohort), while total population growth has a powerful negative impact, which diminishes gradually with more demographic variables added in the model (Bloom, Williamson, 1998). Subsequently, almost every study used decomposition analyses at the intra-state-level or country-level variation of economic growth to better capture the separate impact of age-structure forces on economic growth (Bloom, Canning, Malaney, 1999, Bloom, Canning 2004, Kelley, Schimdt, 2005, Bloom, Finlay, 2009, Bloom, Canning, Hu, et al, 2010, Aiyar, Mody, 2011). Hence, the annual growth rate of income per capita is decomposed into three components, namely the growth of output per capita, growth of labor participation rate, and growth of working-age ratio (aged 15-64) to the total population. However, for most of the studies, the second element, the labor participation rate is held constant due to the unavailability of reliable data. Despite fixed participation rates and occasionally missing data, these studies managed to explain important associations between growth and changes in the three components.

In this paragraph, we will discuss the three components of the decomposition analysis. The income per capita equals income per worker multiplied by the ratio of the active population to the total population (Bloom, Canning, Malaney, 1999). The income per worker denotes the average output delivered by each active person in an economy and can be decomposed in productivity within sectors and allocation of the workforce from low to high productive industries (Bloom, Canning, Malaney, 1999). Labor participation rates, as the name indicates, refers to the labor force share of the total working-age people (Bloom, Canning, Malaney, 1999). The third component, the working-age ratio to the total population indicates the individuals aged 15-64 who represent potential labor force (Bloom, Canning, Malaney, 1999). Low fertility rates, low infant mortality rates, and improved health influence each component through the channels already mentioned in the previous paragraphs, given reliable and efficient institutional and policy frameworks.

[6] With education (Primary schooling and Average years of schooling among adult population) lagged 40 and 30 years and income (GDP per working age adult) 60, 80, 100 years as instruments

3. DEMOGRAPHIC TRENDS AND ECONOMIC GROWTH THROUGHOUT ASIA

In this section, we will explore the major demographic trends across South[7] and South East[8] Asia in a comparative approach with East Asia[9]'s demographic progress miracle. The East Asian experience strongly acknowledged that population growth matters, which motivated economists to place it under close scrutiny (Bloom, Williamson, 1998, Bloom, Canning, Malaney, 1999). In the late 1990s, East Asia was ending its fast pace demographic transition in a strong economic position, completing its convergence with the Western countries. During those years and the beginning of the 2000s the focus of economists was entirely in studying East Asian takeoff, but once completed, the analysis turned its attention towards South-East and South Asia who are experiencing a similar demographic transition, however, distributed across a longer time span and less in magnitude.

Figures 3, 4, and 5 depict the different patterns of dependency ratio these regions experienced or are about to experience. The trends over time show the early decline in the dependency ratio in Eastern Asia, followed behind by South-Eastern and Southern Asia with a considerable lag. The demographic dividend appeared to last for a shorter period in Eastern Asia, which is already recording significant increases in the old-age dependency ratio, marking the beginning of the second stage of the demographic transition. South-Eastern and Southern Asia will enjoy a much longer period of low dependency ratios and thus demographic dividend if appropriately harnessed.

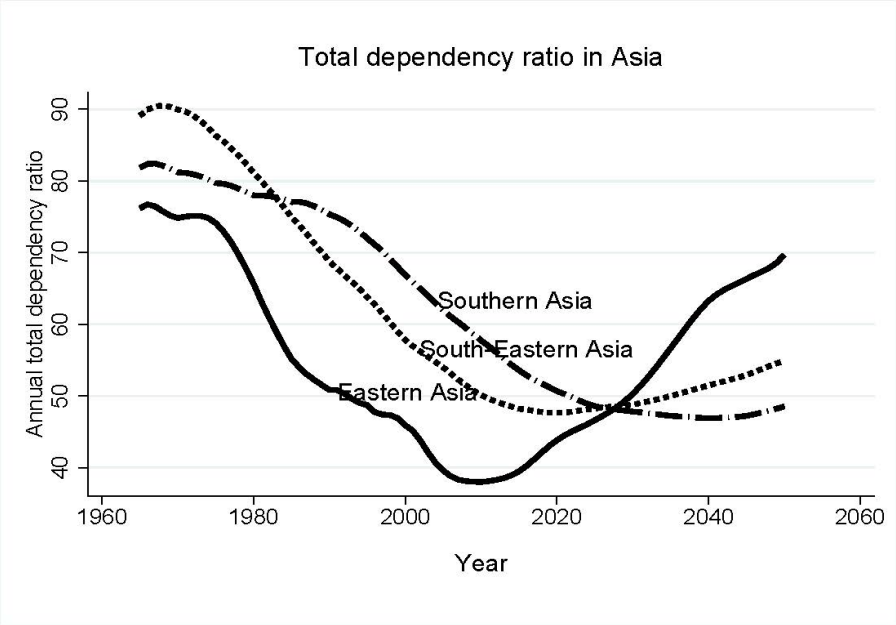

Figure 3. Total Dependency Ratio (aged 0-14 and 65+ to total population).
Source of data: United Nations, Department of Economic and Social Affairs, Population Division (2019). *World Population Prospects 2019 - Special Aggregates, Online Edition. Rev. 1*

[7] India, Pakistan, Bangladesh, Nepal, Sri Lanka
[8] Indonesia, Malaysia, Philippines, Thailand, Viet Nam
[9] China, Japan, South Korea, Singapore

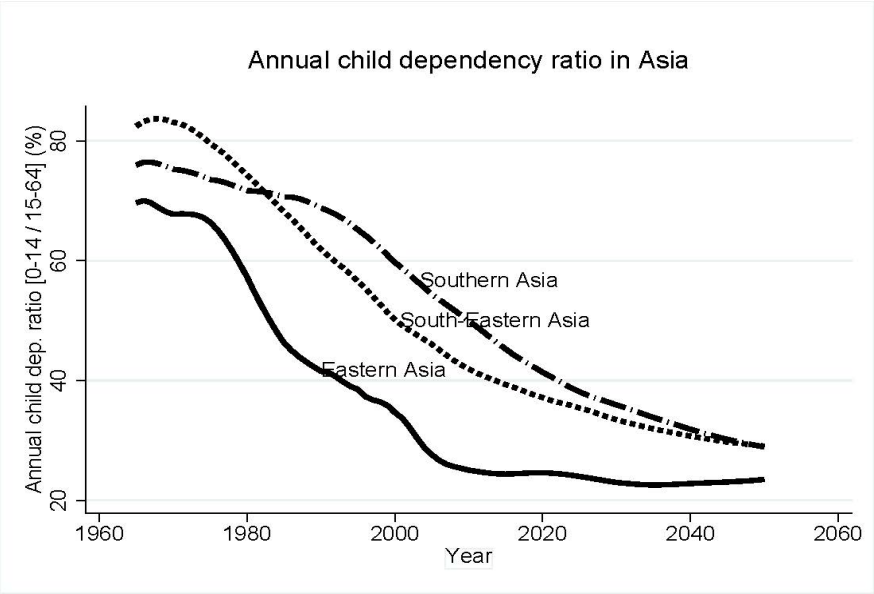

Figure 4. Annual child dependency ratio (aged 0-14 to 15-64).
Source of data: United Nations, Department of Economic and Social Affairs, Population Division (2019). *World Population Prospects 2019 - Special Aggregates, Online Edition. Rev. 1*

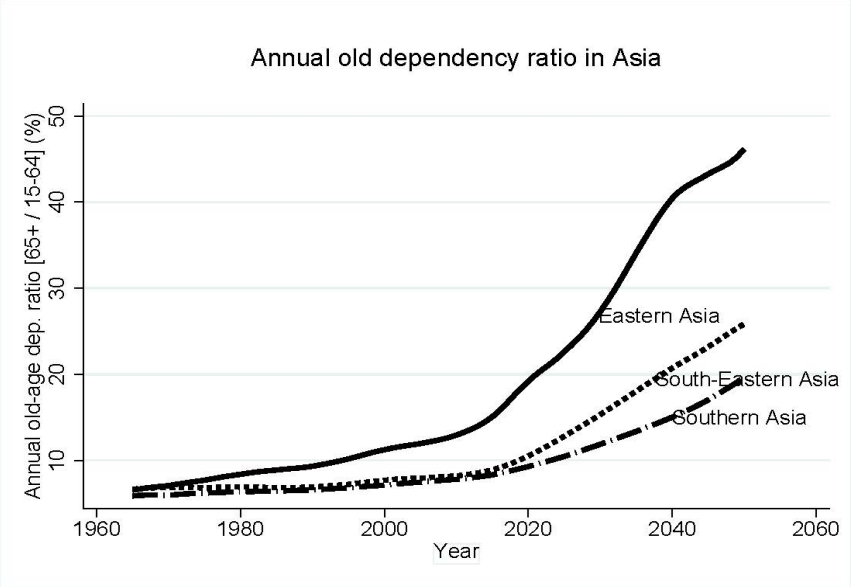

Figure 5. Annual old dependency ratio (aged 65+ to 15-64)
Source of data: United Nations, Department of Economic and Social Affairs, Population Division (2019). *World Population Prospects 2019 - Special Aggregates, Online Edition. Rev. 1*

Although in the 1950s the high birth and mortality rates were the dominant norms of the age pyramid for all regions, once the demographic transition started, the shifts from high mortality and birth rates to low mortality and birth rates occurred at varying moments throughout the whole region. Thus, heterogeneous patterns in the age-structure developed which can be traced to the present moment in their economic and social status. In East Asia, the total fertility rate (TFR) fell from 5.5 in 1965 to below the replacement level of 2 births per woman in the 1990s, in South-East Asia from 6 in 1960 to 3 in 1990, while in South Asia from 6 in 1960 to 4 in 1990 (Bloom, Finlay, 2009). While in East Asia TFR is already under the replacement level, being significantly negative, and in South-East Asia is almost at the

replacement level, in South Asia TFR is likely to converge with the replacement level in the late 2020s.[10]

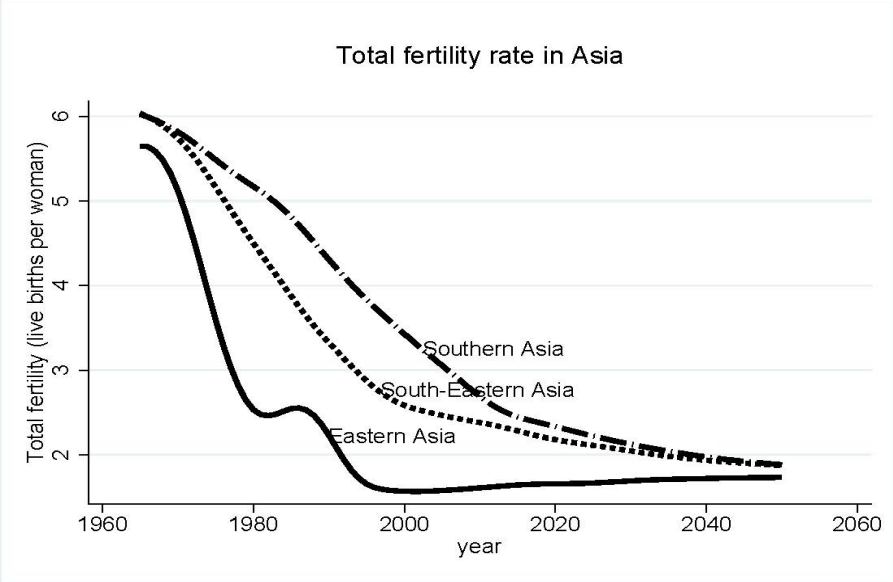

Figure 6. Total Fertility Rate.
Source of data: United Nations, Department of Economic and Social Affairs, Population Division (2019). *World Population Prospects 2019 - Special Aggregates, Online Edition. Rev. 1.*

According to Ogawa, Chawla & Matsukura (2009), the first demographic dividend started in the 70s for all countries from South and South-East Asia, just a few years later than the timing of the East Asian demographic transition from the 1960s, however yielding different outcomes for each region (Ogawa, Chawla, Matsukur, 2009). From its estimations, we can notice that the average period for the first demographic dividend to be realized in South Asia is much longer than South East Asia, with an average lag of almost 1 decade, and a difference of almost 35 years between the two extreme outliers from both regions, Bangladesh with 75 years duration and Thailand with 40 (Ogawa, Chawla, Matsukur, 2009). Whereas East Asia's figures are not crossing the limit of 50 years duration, with a total average below the 40-year figure.

Table 1: Timing of the first demographic dividend in South, South-East and East Asia

Country	First demographic dividend		
	Beginning year	Ending year	Duration years
Southern Asia			
Afghanistan[11]	1995	2057	62
Bangladesh	1974	2049	75
India	1974	2044	70
Pakistan	1995	2045	50
Nepal[12]	1995	2047	52
South-Eastern Asia			
Cambodia	1982	2043	61

[10] World Development Indicators – World Bank
[11] UNFPA (2015). Investing in Youth: How to Realize Afghanistan's Demographic Dividend
[12] Nepal, U. N. F. P. A. (2017). Population situation analysis of Nepal. *Kathmandu: UNFPA Nepal*.

Lao PDR[13]	1990	2045	55
Indonesia	1977	2028	51
Malaysia	1969	2040	71
Myanmar[14]	1983	2050	67
Philippines	1970	2049	79
Thailand	1971	2011	40
Vietnam	1980	2027	47
Eastern Asia			
China	1973	2016	43
Republic of Korea	1967	2014	47
Singapore	1967	2004	37
Japan	1960	1996	36

Source: Ogawa, N., Chawla, A., & Matsukura, R. (2009). Some New Insights into the Demographic Transition and Changing Age Structures in the ESCAP Region. Asia-Pacific Population Journal, 24(1), 87.

Different demographic trends exhibited different economic growth rates, specifically 6.11 point average growth of real GDP per capita in East Asia during 1965-1990, 3.80 point average growth in South-East Asia, and respectively, 1.71 point average growth in South Asia during the same period (Bloom, Williamson, 1998). These differences are in a big proportion explained by different productivity levels within sectors, the latter two regions, South Asia and South-East Asia, were still primarily agricultural (Bloom, Canning, Malaney, 1999). The productivity growth for the mentioned period was estimated in Bloom, Canning, Malaney, 1999 at 3.2 percent a year increase in East-Asia, around 2.3 percent in South-East Asia, and only 0.5 percent in South Asia, and for the latter case, the growth was mainly due to productivity increase in the agricultural sector (Bloom, Canning, Malaney, 1999). Movement of labor across sectors accounted for about a fifth for each region, indicating fast urbanization determined by the rapid migration of people from rural to urban areas. The labor force participation rate was slightly negative in South-East Asia, while South Asia reached a high figure of 35% (Bloom, Canning, Malaney, 1999). This high figure is explained by the massive shift of workers which occurred between the informal and formal sectors in South Asia. The rest of the GDP growth is explained by changes in age structure, with about 14% in East Asia, where the decline in fertility rates began earlier and was faster which raised the ratio of economically active people, 13% in South-East Asia and 11% in South Asia (Bloom, Canning, Malaney, 1999). The decomposition of growth helps us to identify where most of the growth was concentrated for each group of countries. Thus, labor reallocation, labor participation, and age structure constitute the labor effect, which accounted for most of the GDP growth in South Asia at 69%, mostly due to behavioral changes in the active population, while in South-East and East Asia productivity growth within sectors accounted for most of the growth, at 67% and respectively, 61%, indicating improvements in both, physical and human capital through savings, investments, better health infrastructure and improved education (Bloom, Canning, Malaney, 1999).

[13] Hayes, G. (2015). Population Situation Analysis: LAO PDR.
[14] Department of Population (2018). Policy Brief on Population Dynamics. The 2014 Myanmar Population and Housing Census

While South Asia appeared to be trap in a slow demographic transition coupled with modest economic growth rates for most of the last century, now is situated in the midst of this transition with higher prospects for the future. Meanwhile, South-East Asia comes from a more advanced position, having been able to reap more of the demographic dividend in the last decades, showing prospects of realizing the transition earlier than South Asia. Although South Asia has higher prospects, is still modestly reacting to this transition, economists being afraid that might fail in reaping the benefits, transforming it into a demographic burden.

Capturing the informal and marginal workforce

As I mentioned earlier, the poor absorption of the labor force into the economy coupled with the demographic growth of working-age people, encouraged the expansion of the informal sector. The size of the informal economy is showing an increasing trend in South Asia, with a share of the informal workforce above 80% of the total labor market, while in South-East Asia this trend slowed down significantly (Kucera, Roncolato, 2008). In 2006 in Indonesia 64% of the workforce was employed in the informal sector (Cuevas et al., 2009), while in India, one year earlier, in 2005, 90% of the total working population was engaged in the informal sector, which generated about 62% of GDP, 50% of national savings and 40% of national exports in 2002, with a productivity and growth rate eight times smaller than the formal sector (Harriss-White, 2010, Shonchoy, Junankar, 2014, Narayana, 2015). Besides the working-age individuals informally employed, this sector includes the elderly above 60 and child labor under 14 which participate in the wealth accumulation of the households, but which do not account in the national savings and thus national income growth.

Moving even further, Chauhan, Arokiasamy, 2018 with a focus on India, reported that the working-age ratio does not capture the entire employed population that supports the dependent population. Thus, using data from the Census of India, the workforce is separated into two groups, main workers and marginal workers. Marginal workers are those individuals who do not work permanently and thus, representing an inappropriate count in the national savings. After accounting for marginal work, the results show a substantial rise in the dependency ratio. The authors concluded that informal work, coupled with unpaid work and household services of women, which represents a considerable portion of the economic activity not only in India but for the entire South Asian region, and less but considerable in the South-East Region, lowers significantly the dependency ratio.

III. WEALTH INDICES

Within this section, asset-based indices are presented in a comparative way with other relevant socio-economic indicators. The focus is on highlighting the potential benefits and drawbacks of the asset-based indices and explain why in the current study is the most suitable proxy for household welfare. In addition, a brief explanation of the construction technique used to derive such indices is offered.

The importance of wealth indices

The immediate result of the reduction in the dependency ratio is the increase in the household savings which is best captured in the amount of assets accumulation. While the majority of studies focus their attention on the effects captured by growth in output or income per capita, in this paper we will turn our attention to wealth indices. The use of wealth indices in welfare analysis has increased, especially when data on expenditure is not available or too expensive to gather. A wealth index measures the socio-economic status (SEP) of a household and uses data on asset ownership mostly collected by Demographic and Health Surveys[15] (Filmer, Pritchett, 2001, Howe, Hargreaves, Huttly, 2008, Filmer, Scott, 2012).

Most socio-economic indicators are monetary measures such as income or consumption expenditure since material standards determine well-being (Filmer, Pritchett, 2001, Howe, Hargreaves, Huttly, 2008). However, income is not capable of capturing the consumption behavior of households such as borrowing or drawing on savings in times of low income (Filmer, Pritchett, 2001, Howe, Hargreaves, Huttly, 2008). On the other hand, consumption expenditure is a better indicator of long-term SEP and other health variables than income, especially in low- income countries, where income is obtained from various sources and may change over time (Filmer, Pritchett, 2001, Howe, Hargreaves, Huttly, 2008). However, collection of consumption expenditure requires lengthy questionnaires with accurate details on many items over different periods, which must be completed by trained interviewers and which are exposed to recall and reluctance problems in divulging information by households and hence being at risk of substantial measurement error (Filmer, Pritchett, 2001, Howe, Hargreaves, Huttly, 2008). Thus, because of reliability and cost/time issues, researchers searched for alternative measures of SEP to use in their analysis and found that an asset-based index is the best alternative to income and consumption expenditure.

An asset-based index collects information on ownership of durable assets, housing characteristics, and access to basic services, which represents the main components of expenditure (Filmer, Pritchett, 2001, Vyas, Kumaranayake, 2006, Filmer, Scott, 2012). This approach became notorious with DHS (Demographic and Health Surveys) and proved to be less costly and lengthy, and to suffer from less recall and social desirability bias since assets are all tangible, which makes easier for interviewers to observe and assess them (Vyas, Kumaranayake, 2006, Filmer, Scott, 2012). In addition, an asset index is a good measurement of long term SEP because is unlikely to change in response to economic shocks, based on the

[15] DHS (Demographic and Health Surveys) are household surveys focus on gathering data on health status and nutrition in more than 60 developing countries based on household features rather than income or consumption expenditure

assumption that during an economic shock, selling assets comes after reductions in consumption expenditure, which makes it an even better proxy for the long-term state of wealth than consumption expenditure (Filmer, Pritchett, 2001, Howe, Hargreaves, Huttly, 2008). Another significant advantage is that monetary values are not taken into consideration, making it an appropriate index in measuring the welfare differences between urban and rural areas, wherein rural areas most of the income comes from informal sources such as: subsistence agriculture and traditional barter, as for example: crops which are traded, or work in kind or in exchange of goods (Filmer, Pritchett, 2001, Howe, Hargreaves, Huttly, 2008). Moreover, income and other standard measures are unable to capture transitory employed people and seasonality influences, mostly in agriculture, a prominent sector that accounts for most of the economic growth in developing countries (Vyas, Kumaranayake, 2006).

Constructing a wealth index

When constructing a wealth index a set of assets must be chosen and weights must be assigned to each asset or group of assets (Vyas, Kumaranayake, 2006). Most of the studies suggest one reliable and efficient method of determining the weights for each component, specifically the Principal Component Analysis (PCA) (Filmer, Pritchett, 2001, Vyas, Kumaranayake, 2006, Hargreaves, Huttly, 2008, Filmer, Scott, 2012). This technique was validated by Filmer, Pritchett, 2001 in their state-level analysis on wealth and education data sets from India, Indonesia, Pakistan, and Nepal. Their study included both asset and consumption expenditure data for a comparative analysis in predicting educational outcomes. Their findings showed consistent results in predicting educational outcomes in the whole sample when the asset-based index[16] is used as a proxy for household's welfare, with less measurement error than in the consumption expenditure proxy for the long-run wealth (Filmer, Pritchett, 2001).

PCA is a statistical technique used to reduce the number of statistical variables in a data set, replacing a set of correlated variables with a set of uncorrelated principal components (Vyas, Kumaranayake, 2006). The principal components are linear weighted combinations of the initial variables[17] (Vyas, Kumaranayake, 2006). For example, for a set of variables x_1 through x_n:

$$PC_1 = a_{11}x_1 + a_{12}x_2 + \cdots + a_{1n}x_n$$

$$PC_m = a_{m1}x_1 + a_{m2}x_2 + \cdots + a_{mn}x_n \quad [18]$$

Where a_{mn} represents the weight for the m_{th} principal component and the n_{th} variable (Vyas, Kumaranayake, 2006). The weights for each principal component are derived from the correlation matrix of the data (Vyas, Kumaranayake, 2006). The components are ordered, so that the first component (PC_1) explains the largest proportion of total variance, which is taken to represent the household's wealth (Vyas, Kumaranayake, 2006). The subsequent components are uncorrelated with the previous ones and become smaller in proportion,

[16] Constructed on DHS data

[17] The principal component is a function of those variables highly correlated e.g. those assets which might constitute a group with similar separate influence on the SEP of a household and thus is no need to include all these assets, just one representative enough for the whole group

[18] Source: Vyas, Kumaranayake, 2006

explaining an additional variation in the data (Vyas, Kumaranayake, 2006. Each component takes a value subject to the constraint that the sum of the squared weights of all components is equal to one (Vyas, Kumaranayake, 2006). Then the weights for each indicator are used to generate a household score which enables us to identify the relative SEP of the household.

The importance of an index stands in the range and characteristics of the asset variables included. This requires formative research and extensive knowledge of those assets which are determinants of the living standards (Hargreaves, Huttly, 2008). Investigating the effects of using a wider or different set of assets is essential in guaranteeing strong predictors of households SEP. For instance, an asset which all households own or no household own would give no variation between households and is useless in the comparative analysis of SEP, whereas an asset which is more unequally distributed among households will give more variation and more weight to the comparative analysis of SEP (Vyas, Kumaranayake, 2006). At the same time, some variables can include some bias in the estimations, for example including infrastructure variables induce geographic bias (Vyas, Kumaranayake, 2006). In addition and perhaps even more important is the number of assets included which must be broad enough to avoid clumping and truncation, two issues that will be discussed in the next section (Vyas, Kumaranayake, 2006, Filmer, Scott, 2012).

Issues when using wealth indices

It is imperative to be aware of the various limitations when using wealth indices in econometric analysis. Firstly, wealth indices are very sensitive to measurement error if the inappropriate set of assets are used (Vyas, Kumaranayake, 2006). Secondly, wealth indices are not adjusted for different monetary values[19] of assets e.g two different households might own the same category asset but each one with a different monetary value and thus ranking both households equally (Vyas, Kumaranayake, 2006, Filmer Scott, 2012). However, this may represent an advantage in some settings, such as the poverty targeting analysis in developing countries or current analysis, where the interest is in highlighting the relative differences across households SEP in developing countries with informal and temporary economic activity prevailing (Filmer, Pritchett, 2001). Thirdly, are not adjusted for differences between rural and urban areas. For instance, some assets have different economic importance in rural areas than in urban areas, such as farmland (Vyas, Kumaranayake, 2006). Moreover, access to some assets is different and at different costs in urban areas, given the superior urban infrastructure (Filmer Scott, 2012). Forth, wealth indices are not adjusted for household size or composition and how assets are distributed across the number of members of households (Hargreaves, Huttly, 2008, Filmer Scott, 2012). However, Filmer, Scott, 2012 in their paper found little evidence of any significant change in the correlation between expenditures and asset index when controlling for household composition (Filmer, Scott, 2012). In addition, wealth indices fail to take into account short-run and temporary shocks[20] (e.g. health, weather, or economic shocks), which therefore limits the analysis for short time series (Vyas, Kumaranayake, 2006). Moreover, the asset-based estimations might vary in different settings

[19] In addition a wealth index do not account for monetary value depreciation and deflation of values across time and space (Filmer, Scott, 2012)

[20]Even in the settings of a long time-series study the existence of these outliers within the data requires further attention and explanation to avoid any potential bias in the coefficients.

and at varying stages of economic development, thus it is hardly used for cross-country analysis (Vyas, Kumaranayake, 2006).

Clumping and truncation represent another two potential problems. Clumping occurs when a large proportion of households have same or similar scores at the lower (higher) end of the spectrum because they have the same low (high) access to public services or own the same assets and thus creating distinct clusters of households (Vyas, Kumaranayake, 2006, Filmer, Scott, 2012). Truncation implies discrimination at the top or bottom end of the distribution of socio-economic groups, which makes it difficult to distinguish some households from another e.g distinguish between poor and very poor (Vyas, Kumaranayake, 2006, Filmer, Scott, 2012). Both clumping and truncation are more likely to prevail at the community level where more similarities between households occur and this could be solved by adding more variables or using more relevant assets for assessing wealth (Vyas, Kumaranayake, 2006). As I mentioned earlier, this requires informative research and descriptive analysis on which and how many assets to include.

Two conditions are identified to be of major importance when assessing the correlation of an asset index with per capita expenditure, precisely: 1) the extent to which per capita expenditures are explained by observed assets and 2) the share of public goods in the expenditures at the expense of individual goods such as food (Hargreaves, Huttly, 2008, Filmer, Scott, 2012). With regard to the second condition, in very poor settings where the food component has a substantial share in total expenditure, the correlation between the asset index and per capita expenditure is very low (Filmer, Scott, 2012). However, when conducting such comparisons is it important to be aware not only on the asset index insufficiencies but also of the potential problems that expenditure data may have, such as the reliability of recall data, the share of goods consumed from home production or kind work, biases induced by poorly trained interview personnel, poorly designed surveys and price deflators (Sahn, Stifel, 2003). Therefore, the choice of including a welfare measure in an econometric analysis must be based on the informative decision and good knowledge of the research field and its objective, to avoid potential failure of the model.

Several papers used asset-based indices to assess for SEP of households in the state-level analysis. The majority of these studies found that PCA is the most reliable framework for constructing an asset index. A benchmark study is Filmer and Pritchett (2001) which uses data from India, Indonesia, Pakistan, and Nepal to assess for asset and expenditure indices performance in predicting educational outcomes, and found robust results with regard to the power of the asset index to estimate SEP of households (Filmer, Pritchett, 2001). Bollen, Glanville, and Stecklov (2002) provide robust findings in predicting fertility patterns in Ghana and Peru, Sahn, Stifel, (2003) in predicting child nutrition (as a good proxy for health and highly correlated with infant mortality), McKenzie (2005) in measuring inequality, in several developing countries. Therefore, if the interest is in studying social, wealth, or demographic outcomes, information on the household's asset ownership is the most representative.

The high proportion of the informal sector in the total work sector, unpaid work, and household services performed by women combined with lack of reliable data on income and consumption expenditure in predicting the welfare status of households hinder the empirical analysis to provide clear data on the effects of age structure transition. Because of these behavioral and economic practices, our attention in the current paper is on wealth inequality

rather than consumption or income inequality, which is better capture by an asset-based index. Thus, the rich-poor gap is larger when using asset indices than per capita expenditures or income (Filmer, Scott, 2012). Moreover, asset indices exhibit stronger correlations with health (infant mortality, nutrition) or wealth (household expenditure) predictors than other standard measures (Filmer, Scott, 2012).

Generally, welfare indices perform better in explaining variation in child mortality, nutrition, fertility, education, and other welfare and social (inequality) variables than most of the expenditure measures in low and middle-income countries (Smits, Steendijk, 2015). However, they suffer from a great disadvantage, lack of comparability across countries, and time points (Smits, Steendijk, 2015). Therefore, to overcome this issue Smits, Steendijk, 2015 computed the first asset-based index which holds the property of comparability across all low and middle-income countries (Smits, Steendijk, 2015). The International Wealth Index (IWI) is based on data from 2.1 million households, gathered from 165 household surveys, which were held between 1996-2011 in 97 low and middle-income countries and is based on a set of assets well established (Smits, Steendijk, 2015). Therefore, these characteristics make IWI a strong proxy for the household's welfare in South and South-East Asia in the current study.

IV. THEORETICAL FRAMEWORK

This section consists of two parts. The first part gives a brief overview of the technical literature devoted to studying the influence of several demographic variables on economic growth. The demographic variables emphasized herein are age structure, mortality, fertility, and population growth. The second part explains the theoretical model derived from this literature which will be used in the current econometric analysis.

1. A BRIEF REVIEW OF THE TECHNICAL LITERATURE

In the economic growth literature economists have relied on a considerable number of different approaches on cross-country data to study the determinants of economic growth and discovered that two key assumptions are at the centerpiece of their study. The first assumption supports that for each country there is an economic progress ceiling which usually denotes the steady-state level of income (Barro, 1991, Barro, Lee, 1994, Bloom, Malaney, 1999, 2000). The steady-state level of income indicates the level of economic progress that a country can attain and represents a function of several variables which influence labor productivity such as: measures of education and health which determine the quality of the labor stock or time-invariant factors like culture, geography, and climate (Barro, 1991, Barro, Lee, 1994, Bloom, Malaney, 1999, 2000). Because these factors vary across countries, so their levels of income vary too. The second key assumption refers to the speed of attaining this ceiling of income, which is the growth of income over time. This is referred in the literature as the convergence force and assumes that the higher the income ceiling of a country, given by the difference between the initial level of income[21] and steady-state level of income, the faster is likely to grow (Barro, 1991, Barro, Lee, 1994, Bloom, Malaney, 1999). For this reason, economists believe that poor countries are expected to grow at a faster growth rate.

Figure 7 illustrates the relationship between human capital at time $t+1$ on the horizontal axis as a function of the human capital amount at time t on the vertical axis in a convergence model setting. The inspection will show three different intersections points which represent three different steady-state levels U , W, and L determined by several explanatory (demographic) variables. U and L are stable, while W is not. Depending on the initial level of human capital (capital-labor ratio) the system will develop either the steady growth at U or L. The rate of return on investments in human capital rises H and demand for children falls as they become more "expensive" (Becker et al.,1990). At U the rate of return from human capital is low because is little capital, at this stage families tend to choose higher fertility rates with little investments in children, but once it starts growing, human capital increases until reaches the optimal steady-state level L. At L the growth tends to increase at a decreasing rate as it becomes difficult to absorb new knowledge (Solow, 1956, Becker et al., 1990). W is unstable and thus negative deviations from this point will lead to $H = 0$, and hence U, while positive deviations will lead to $H > H^1$ and hence H^*(Becker et al.,1990). The steady-state position on the steady-state line and the speed of attaining this position depends on several factors, such as good governance and economic capability. Note that Figure 7 does not

[21] In neoclassical growth models, a country's per capita growth rate tend to be inversely related to its starting level of income per capita. In addition, the Solow growth model assumes a constant savings rate with fixed labor participation rates and stable population growth which limits the model by rulling out important determinants (Solow, 1956, Cass, 1965, Koopmans, 1965)

incorporate physical capital, however the inclusion of physical capital does not change the illustration and its interpretation.

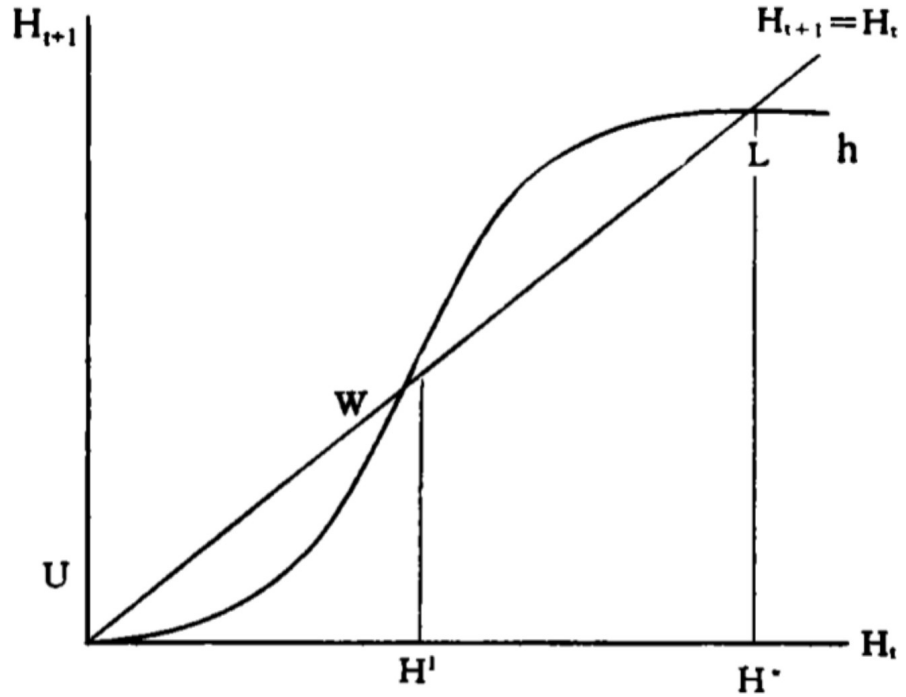

Figure 7: The Steady States with Human Capital. Source: Becker et al.(1990)

The theoretical framework in the convergence model was enriched in Barro, 1991, Barro and Lee, 1994 by adding demographic variables. Population growth, fertility, and mortality were included in the econometric analysis and yielded negative impacts on per capita output growth (Barro, 1991, Barro and Lee, 1994). Following their work, in 1994 Kelley and Schimdt, 1994 included population density and size, which revealed positive influences on output growth (Kelley, Schimdt, 1994). However, their studies revealed that the net aggregate impact of demography was negative and thus confirming a potential Malthusian demographic trap.

The convergence model[22] highlighted in Barro, 1991, Barro, Lee, 1994, and thoroughly explained in Barro, Sala-i-Martin, 1995 was adapted by several economists in the late 1990s. Bloom, Williamson, 1998 adapted the Barro setup focusing on those demographic effects due to imbalanced age-structure events that occur over the course of the demographic transition. Therefore, Bloom and Williamson, 1998 transformed the empirical model by decomposing demographic growth into two main components, specifically population growth and working-age share to the total population (Bloom, Williamson, 1998). The two components were afterward incorporated into a traditional neoclassical model of output per worker transformed into output per capita, primarily to translate changes from output per worker to output per capita (Bloom, Williamson, 1998). Such specification is nevertheless a breakthrough framework which helped in explaining much of the East-Asian miracle.

Subsequently, to isolate the pure demographic effect, the model was further enriched by decomposing economic growth into output per worker, growth of working-age individuals,

[22] This model assumes a conditional convergence force, whereby a country's economic growth is faster if it starts with a lower per capita income, determined by the initial human capital stock mainly in the forms of education and health (Barro, 1991, Barro, Lee, 1994).

and labor force ratio to the working-age individuals (Bloom, Canning, 2004). The labor force was added to the model based on the assumption that from the whole group of working-age individuals only some of them will productively be employed in the labor market (Bloom, Canning, Malaney, 2000, Bloom, Canning, 2004, Bloom, Finlay, 2009). However, labor force ratio is held constant, due to lack of reliable data, and moves inversely with population growth, which therefore assumes that growth in the labor force and in the total population have coefficients of +1 and -1 (Bloom, Finlay, 2009). This accounting framework places substantial constraints on the specification, ruling out the effects attributable to behavioral changes (Bloom, Finlay, 2009). However, the inclusion of enough variables to capture these effects minimizes the missing element, which helps in isolating the demographic effects. (Bloom, Canning, Malaney, 2000, Bloom, Finlay 2009). Regardless of its limitations in capturing the behavioral influences such as fertility reduction on female labor supply and increased longevity on savings, this model helped in explaining the accounting effects of the demographic element on economic growth (Bloom, Finlay 2009).

Bloom, Canning, Malaney, 1999, 2000 in a panel data set with countries from South, South-East and East Asia, included productivity within sectors and sectoral composition, namely labor force reallocation from low-productivity agriculture to high-productivity industries and service sectors, to test for the effect of sectoral movements, and thus account for labor productivity effects (Bloom, Canning, Malaney, 1999, 2000). The results suggested strong effects on economic growth explaining almost a fifth of the growth in GDP in South and South-East Asian countries (Bloom, Canning, Malaney, 1999, 2000). Bloom, Canning, Hu, et al, 2010 in a cross-country study using micro panel data to study in a comparative analysis the growth takeoffs in China and India, decomposed growth in income per worker into a portion attributable to the growth of the labor productivity within sectors and another portion attributable to the shift of labor force from low to high productive sectors (Bloom, Canning, Hu, et al, 2010). The results were robust and significant in explaining economic growth. Although these results suggested a strong association between growth and sectoral shift, this was not enough in explaining the complete potential effect, which forces us to conclude that poor labor absorption in the labor-intensive sectors as well as capital intensive, still seizes some of the potential effects of labor reallocation and productivity.

Several papers accounted for mortality using life expectancy, as a proxy for population health (Bloom, canning, Malaney, 1999, 2000, Bloom, Canning, 2004, James, 2008, Bloom, Finlay, 2009, Bloom et al, 2010). It is presumed that mortality affects labor productivity and savings. Some papers focused their attention on the effects on savings, confirming the life cycle hypothesis (Bloom, Canning, Graham, 2003, Bloom, Canning, Mansfield, Moore, 2007). Bloom, Canning, Sevilla, 2004 found that life expectancy has a real labor productivity effect when controlling for work experience. Contrary to these findings, Acemoglu, Johnson, 2007 found no evidence to support the hypothesis that a large increase in life expectancy raises income, in fact, when using predicted mortality as an instrument, 1 percent increase in life expectancy leads to almost 2 percent increase in population, enforcing the strong negative effect of population growth (Acemoglu, Johnson, 2007). Cervellati, Sunde, 2011 considered the data and instrumentation of Acemoglu, Johnson, 2007 to test the causal effect of life expectancy on income per capita, and found that the effect is negative before the demographic transition, but becomes positive once the transition onsets, which confirms the non-linearities in the pattern of life expectancy and growth (Cervellati, Sunde, 2011, Kunze, 2014).

Lorentzen, McMillan, Wacziarg, (2008) regressed adult mortality during the prime productive years (as a proxy for population health), once controlling for endogeneity issues

and age patterns of mortality. They found that higher death rates are associated with higher fertility rates and lower investments in physical and human capital, even when controlling for infant mortality, which explained most of Africa's economic catastrophe (Lorentzen, McMillan, Wacziarg, 2008). Kunze, 2014 discovered interesting results, in which increased life expectancy lowers investments in children's education, through reducing inter-generational transfers in the form of bequests, as old age consumption becomes more important (Kunze, 2014). However, Kunze, 2014 confirms the positive significant effects of increased longevity on savings rates and public education expenditures which offsets the negative effect of reduced bequests (Kunze, 2014).

Fertility captures some important effects on women's labor supply and education. Bloom, Canning, Sevilla, 2003 explains the economic gains that a country might gain if fertility decline occurs. These benefits relate to increases in income per capita, due to increases in the ratio of working-age people to total population, physical and human capital in form of schooling, health, and female labor force participation (Bloom, Canning, Sevilla, 2003). Bloom, Bloom, Canning, Fink, Finlay, 2009 in their empirical work on a data set from 1960 to 2000 for 97 countries, considered only the effect of fertility on female labor supply and found that a birth reduces a women's labor supply by almost 2 years during her reproductive life accompanied by higher economic returns to women's schooling, increased savings for old age retirement and greater investments in child health and education (Bloom, Bloom, Canning, Fink, Finlay, 2009).

Other studies accounted for population growth and density effect, which assume that a higher density will depress economic growth, since the distribution of natural resources among a higher number of individuals decreases their share (Kelley, Schimdt, 1995, 2005, Bloom, Canning, Malaney, 1999, 2000, Bloom, Finlay, 2009). The results show that population density in inland areas has a negative effect, while along the coast the impact is strong and positive (Bloom, Canning, Malaney, 1999, 2000, Bloom, Canning, Fink, Finlay, 2007). Population growth which is included in most of the studies, representing a staple in the demographic literature, exhibits a significant negative impact on income growth once enough demographic explanatory variables are included in the model, such as working-age population growth, working-age to total population ratio, labor force to working-age population ratio and population density (Kelley, Schimdt, 1995, Bloom, Williamson, 1998, Bloom, Canning, Malaney, 2000, Bloom, Finlay, 2009).

In growth models, causality represents a serious problem since all explanatory variables are determined to some extent by changes in income levels (Bloom, Canning, Malaney, 1999, 2000, Bloom, Canning, 2004, Bloom et al, 2010). To correct for these feedback loops, economists used instruments for the variables that are measured during the growth period and econometric techniques, such as Two-Stage Least Squares (Aiyar, Mody, 2011) to test the robustness of these results. Therefore, instrumenting them with lagged values (e.g. **lagged** income from a previous time period, lagged fertility) and controlling for the initial conditions (e.g. initial income per capita, base year total fertility and mortality rate)(Bloom, Canning, Malaney, 2000, Bloom, Canning, 2004, Bloom, Finlay, 2009, Bloom et al, 2010, Aiyar, Mody, 2011). Acemoglu, Johnson, 2007, Cervellati, Sunde, 2011 discussed the contemporaneous effect of life expectancy on economic growth, in other words, the exogenous effect of health status at the beginning of the growth interval. Acemoglu, Johnson, 2007 used disease prevalence before the growth period occurs as an instrument. Moreover, there is a strong feedback effect from higher income levels to population change via lower fertility (Bloom, Canning and Malaney, 1999, 2000). This effect is highlighted in a fixed-

effects framework in Bloom, Canning and Malaney, 1999, 2000, indicating that a 10 percent rise in income produces a 2.2 percent fall in fertility.

Numerous papers have explored the relationship between demographic development and economic growth in South and South-East Asia using the specifications and econometric tools mentioned in this section. Most notable Bloom, Williamson, 1998, Bloom, Canning, Malaney, 1999, 2000, Bloom, Canning, Rosenberg, 2011, Bloom, Finlay, 2009 which confirm that South Asia seems to remain caught in a low-level demographic and economic trap, while South-East Asia is already on the way of finishing its transition. Other interesting papers focused on a particular country, such as India (Chandrasekhar, Ghosh, Roychowdhury, 2006, James, 2008, Aiyar, Mody, 2011, Kumar, 2014) or on small groups such as China, India, Pakistan (Choudry, Elhorst, 2010), China, India (Bloom et al., 2009). However, most of the studies include South and South-East Asian states in cross country comparisons together with other low or middle-income countries.

One interesting study which sought to explain how the demographic transition impacts economic performance using an asset-based index is Van der Ven, R., & Smits, J. (2011). To my best knowledge is the only sub-national level study in the growth literature which uses an asset-based index as a proxy for economic growth. The composite index was derived from multiple surveys and includes the following assets: tv, car, availability of running water, flush toilet (Van der Ven, Smits, 2011). The comparative analysis was performed across 367 districts within 39 countries using a multilevel convergence growth model. The study reports significant positive effects from the growth in the working-age ratio on the asset index.

2. MODEL SPECIFICATION

In most empirical models of economic growth income per capita is the major focus because it represents a convenient approach to the level of economic development and standard of living. In the following analysis the income growth theoretical model is used, whereas the proxy for income per capita is replaced by a wealth index, which we support is a better proxy for the standard of living at the household level in low and middle and income countries where questionable reliability of data prevails[23].

Following the theoretical outline in Bloom, Williamson, 1998 and Bloom, Canning, Malaney, 1999, the convergence model discussed in Barro and Sala-I Martin, 1995 is adapted to derive the relationship between the demographic factors, in particular working-age share and income. Therefore, we consider the Cobb-Douglas production function:

$$Y_{it}=AK_{it}^{\alpha}L_{it}^{1-\alpha} \quad (1)$$

Where Y is aggregate income, A is total factor productivity, K is capital stock and L is the labor force. The subscripts i and t denote country and time and suggest that income, capital, and labor varies across countries i and over time t. Thus, output per worker is formulated as:

$$\frac{Y_{it}}{L_{it}} = A\left(\frac{K_{it}}{L_{it}}\right)^{\alpha} \quad (2)$$

[23] An asset-based index carry less bias and error in measurement of households welfare, since is based on observable items and better accounts for inequality across poor and rich.

Considering $z = log(Y/L)$, then the growth of income per worker is written as:

$$g_z = \lambda(z^* - z_0) \tag{3}$$

Where z^* represents the steady-state level of income per worker, z_0 is the initial value of log income per worker and λ is the speed of convergence. The steady-state level of income z^* is assumed to be determined by a set of factors[24], denoted by a vector X, which determine the total factor productivity:

$$z^* = X\beta \tag{4}$$

Substituting (4) in (3) and adding a random error the new expression is:

$$g_z = \lambda(X\beta - z_0) + \varepsilon \tag{5}$$

As in Bloom, Williamson, 1998 and Bloom, Canning, 2004, the age structure effects are included in the empirical model using a modification that changes the unit of analysis from output per worker to per capita as follows:

$$\frac{Y_{it}}{P_{it}} = \frac{Y_{it}}{L_{it}} \frac{L_{it}}{W_{it}} \frac{W_{it}}{P_{it}} \tag{6}$$

Where Y is income, P is population, L is labor force, W is the working-age to total population in country i in year t. The identity expresses that income per capita is a product of income per worker, times participation rate, times working-age share to the total population. Taking natural logs of both sides of the equation, the following is obtained:

$$\log\left(\frac{Y}{P}\right) = \log\left(\frac{Y}{L}\right) + \log\left(\frac{L}{W}\right) + \log\left(\frac{W}{P}\right) \tag{7}$$

Letting lower case letters to represent the log of these ratios,

$$y = \log\left(\frac{Y}{P}\right); z = \log\left(\frac{Y}{L}\right); p = \log\left(\frac{L}{W}\right); w = \log\left(\frac{W}{P}\right)$$

It follows that:

$$y = z + p + w$$

$$z = y - p - w \tag{8}$$

Which can be rewritten as:

$$z = y - \log\left(\frac{L}{W}\right) - \log\left(\frac{W}{P}\right) \tag{9}$$

Combining (5) and (9), the new equation of growth of income per worker is obtained:

$$g_z = \lambda\left(X\beta - y_0 + \log\left(\frac{L}{W}\right)_0 + \log\left(\frac{W}{P}\right)_0\right) + \varepsilon \tag{10}$$

Given identity (6) and notation (8), assuming that the participation rate is constant, in growth terms we can derive:

$$g_y = g_z + g_w \tag{11}$$

[24] Generally includes factors which influence human capital, economic and institutional policy, geography and natural resource abundance.

Substituting (10) into (11) yields:

$$g_y = \lambda X\beta - \lambda y_0 + \lambda \log\left(\frac{L}{W}\right)_0 + \lambda \log\left(\frac{W}{P}\right)_0 + g_w + \varepsilon \qquad (12)$$

Equation (12) is the basis of the current empirical estimation. It relates growth in income per capita to a range of variables X, growth in the working-age people g_w relative to total population growth $\left(\frac{W}{P}\right)$ and initial income per capita y_0. The identity assumes that the participation rate $\left(\frac{L}{W}\right)$ is captured in the constant term of the regression. In addition, the identity places testable parameter restrictions on the coefficients for the working-age growth and working-age ratio. However, these restrictions will become invalid once behavior changes occur in response to the changes in working-age ratio, such as female labor supply to fertility declines and savings to longevity increases (Bloom, Canning, 2004, Bloom, Finlay, 2009). Rather than imposing accounting restrictions on the estimation, the data is allowed to freely display any evidence of these effects.

Introducing a wealth index (IWI-International Wealth Index) into the model will not change the specification, since is acting as a proxy for income (The data is extensively explained in the next section). Therefore, the following specification is estimated:

$$IWI_{i,t} = -\lambda y_{0_{i,t1}} + \beta_1 young_{i,t1} + \beta_2 old_{i,t1} + \beta_3 gw_{i,t} + \gamma X_{i,t1} + \mu Dum_j + \varepsilon_{i,t} \qquad (13)$$

Our specification yields that growth in the dependent variable IWI is explained by the following regressors: initial IWI y_0, the initial young ratio and initial old ratio, the annual average growth rate of the working-age ratio over the growth period gw, X[25] a vector of all explanatory variables that might influence the steady-state labor productivity level, μ a country dummy which captures time-invariant country effects and the random error term ε for the i^{th} region. The error term is assumed to have zero mean and constant variance. Subscript i refers to districts and subscript j to countries. Two interval variables are added to the model, one to control for different length of time periods between the surveys and another for period fixed effects. In addition, the participation rate $\frac{L}{W}$ is excluded from the equation since is considered to be constant.

$$IWI_{i,t} = -\lambda y_{0_{i,t1}} + \beta_1 young_{i,t1} + \beta_2 old_{i,t1} + \beta_3 gw_{i,t} + \gamma X_{i,t1} + \alpha Z_{i,t} x + \mu Dum_j + \varepsilon_{i,t} \qquad (14)$$

The model is adjusted to include interaction terms between our main demographic variables and country-level variables. The interaction terms show the dependence of the demographic variables effects on the country-level variables. Thus, it helps us to make inferences about how the institutional, economic, cultural, and geographic national setting impacts the effects of age structure's variables on economic growth. Model 14 includes the interaction term between the demographic variable of interest, denoted by the vector Z, and the country level variable, denoted by the vector x. A standard application of the Least Square Dummy Variable (LSDV1) estimator will be employed to estimate the parameters of the equation. The country fixed effects estimator and endogeneity correction are taken up at some length in the next section.

[25] Note that vector X also includes time invariant effects besides other explanatory variables

Because of the spotty nature and lack of available data on the labor force at the subnational level we implicitly assume that the participation and productivity rate of workers (those aged 15 to 64) is constant over time. However, this will not affect our results very much since we are studying the changes in household welfare, proxied by an asset-based index, caused by decreases or increases in the number of dependents across households. Whereas, an asset-based index is more capable of capturing those effects which are difficult to measure, such as unpaid work, through measuring those observable and easy to evaluate assets that a household owns, making it a reasonable measure. Whereas, income per capita or other standard measure suffers from serious error measurement in capturing the variation of wealth accumulation of households, in particular in low and middle-income countries where informal and marginal work prevail.

V. DATA AND METHODOLOGY

1. METHOD

The LSDV 1[26] model is employed to study the conditional convergence model presented in the previous section. LSDV 1 is simply estimated by Ordinary Least Squares (OLS) regression with a set of dummies for each country. The country dummies capture the fixed or random effect specific to each country, which is not included in the regression. The individual effect or heterogeneity is allowed to be correlated with other regressors (Wooldridge, 2006). Thus, a fixed country effect model examines individual differences in the intercepts, since each country exhibits a different starting point influenced by several variables such as quality of governance, the abundance of resources, or geographical characteristics. This model produces different intercepts but assumes the same slopes and constant variance across countries (Wooldridge, 2006).

The LSDV 1 model is preferred over the main estimating techniques used so far in the literature, the pooled OLS, the Within estimator, or Multilevel Regression for various reasons. The pooled OLS reports an overall intercept, which is not suitable for the current dataset which contains regions nested within countries, ruling out individual differences between groups. However, the LSDV 1 model loses some degrees of freedom due to the inclusion of the country dummies, which is equal to the number of dummies included in the regression (except the baseline dummy which is dropped out). Although some degrees of freedom are lost, this is not problematic since the number of dummy variables in the current analysis is not big (12 countries).

One solution to the loss of degrees of freedom issue, also named the "incidental parameter problem" is to use the "within" estimation technique (Baltagi, 2005). Unlike LSDV, the "within" estimation does not require dummies, because it uses deviations from group means. However, the data transformation removes all time-invariant variables (variables which do not vary within a group) and hence not allowing correlation with other variables included in the model (Baltagi, 2005). In addition, the "within" estimation produces incorrect statistics, because of the large number of degrees of freedom for errors, since no dummy is included (Baltagi, 2005). Therefore, the standard errors must be adjusted with a special formula. Moreover, because the intercept term is suppressed the R^2 is incorrect (Baltagi, 2005). And lastly, no dummy coefficients are produced for a comparative analysis between countries. Since we have regions nested within groups, one will say that the multilevel approach is the most suitable, however the small number of groups produces biased second level standard errors (Maas, Hox, 2005).

[26] LSDV is estimated through 3 different approaches: LSDV 1 which drops a dummy variable, LDSV 2 which suppresses the intercept and LSDV 3 which imposes a restriction. LSDV 1 with a dummy variable dropped out from the entire set of dummies is used because of is relatively easy estimation and interpretation. The dummy is excluded to avoid perfect multicollinearity. This dummy represents the baseline which is set to zero and all deviations from the baseline dummy represents the intercepts for the other countries (Baltagi, 2005).

2. DATA

The comparative analysis will be run on a district-level dataset for 173 districts within 12 South and South-East Asian countries, namely India, Pakistan, Afghanistan, Bangladesh, Nepal, Cambodia, Laos, Myanmar, Indonesia, Thailand, Vietnam, and the Philippines. The IWI and demographic indicators are measured at the district level and are obtained from the GDL Area Database[27]. GDL contains indicators at the national and subnational level for low and middle-income countries (LMICs) that were created by aggregating data from household survey datasets (Demographic and Health Surveys DHS with data on population, health, and nutrition and UNICEF Multiple Indicator Cluster Surveys (MICS)). The national-level data used for the interaction terms are obtained from the World Bank (World Bank Development Indicators).

The number of surveys for each country ranges from two, which means one growth period and thus one observation, to five or four growth periods with four observations. The time difference between two surveys, which form an observation, varies across countries, from 3 years for Bangladesh to 16 years for Myanmar. Therefore, an interval variable is included in the analysis to control for the different length of time periods between surveys. The interval variable ranges from 3 years to 16 years with an average of 6 years across all countries. The 6 year period is small enough to exclude any feedback effect from income. The surveys were conducted between 1991 and 2018. In addition, we include a period fixed effect variable to control for worldwide shocks to the period studied. The period fixed effect variable takes a value equal to the difference between the starting year for each survey period studied and the first year of all years, precisely the 1991 survey in Pakistan. The first year of all survey years is subtracted from the starting year of each growth period to prevent a high constant without having any impact on the model's coefficients. Appendix, Table 8 shows a complete list of the countries and their corresponding surveys.

Missing data is a common problem and might have a substantial effect on the inferences which can be drawn from the data. In the dataset used there are few missing values for some observations in a few controlled variables, but not in the variables of interest. However, the number of missing values is very small to induce any biased results and the exclusion of these values will reduce the number of observations which might leave some of the effects unexplored. Hence, the data was manipulated to obtain values for these missing observations e.g. taking the mean for the previous and subsequent year values for the governance indicator. Appendix, Table 10 reports data manipulation for the missing values.

3. DESCRIPTION OF VARIABLES

The dependent variable **International Wealth Index (IWI)** is an asset-based wealth index that measures the economic welfare of households, derived from 165 household surveys in 97 low and middle-income countries. This index runs from 0 (no assets) to 100 (all assets) and is comparable across place and time. Moreover, this index exhibits a strong correlation

[27] Access to Global Data Lab at: http://globaldatalab.org/.

with human development, life expectancy, and education, and less but significant with income growth (Smits, Steendijk, 2015). The asset index is regarded to be very robust to short-term economic shocks and a very good measure for district development (Smits, Steendijk, 2015).

The assets used to compute the index were carefully selected to make comparative analysis possible across all countries, while avoiding potential problems, such as clumping and truncation. Thus, IWI includes eight two-category items (yes or no) and four-three category items (low, middle, and high) with a total of over 20.000 possible combinations and covering 165 national surveys (Smits, Steendijk, 2015). The high number of possible combinations make clumping unlikely to occur (Smits, Steendijk, 2015). Although truncation is almost impossible to be completely prevented, the authors tried to minimize it through including several assets at both ends to discriminate between households (Smits, Steendijk, 2015). The descriptive statistics table below shows the complete list of assets with their mean, standard deviations, and weights.

Table 2: International Wealth Index.

	Mean	SD	Raw indicator weight	IWI formula weight
Consumer durables				
Television	54.25	49.82	0.798552	8.612657
Refrigerator	36.99	48.28	0.781531	8.429076
Phone	38.74	48.72	0.660869	7.127699
Car	11.68	32.12	0.431269	4.651382
Bicycle	29.12	45.43	0.171238	1.846860
Cheap utensils	74.48	43.60	0.381851	4.118394
Expensive utensils	28.16	44.98	0.603345	6.507283
Housing characteristics				
Floor material				
Low quality	34.97	47.69	−0.700809	−7.558471
Medium quality	36.08	48.02	0.113815	1.227531
High quality	28.95	45.35	0.566271	6.107428
Toilet facility				
Low quality	40.13	49.02	−0.689810	−7.439841
Medium quality	17.57	38.06	−0.101100	−1.090393
High quality	42.29	49.40	0.754787	8.140637
Number of rooms				
Zero or one	38.44	48.65	−0.343028	−3.699681
Two	32.64	46.89	0.035609	0.384050
Three or more	28.92	45.34	0.319416	3.445009
Public utilities				
Access to electricity	62.30	48.46	0.747001	8.056664
Water source				
Low quality	32.13	46.70	−0.584726	−6.306477
Medium quality	23.85	42.62	−0.213440	−2.302023
High quality	44.02	49.64	0.737338	7.952443
Constant				25.004470

Minimum value	−2.318374	0
Maximum value	6.953466	100

Source: Smits, J., & Steendijk, R. (2015). The International Wealth Index (IWI). *Social Indicators Research : An International and Interdisciplinary Journal for Quality-Of-Life Measurement, 122*(1), 65-85

The consumer durables are measured with two-category variables (yes or no) and include 7 different items: TV, refrigerator, phone, bicycle, car, cheap utensils (<50 USD), and expensive utensils (>250 USD) (Smits, Steendijk, 2015). Cheap utensils (radio, fan, table etc.) and Expensive utensils (for example: computer, washer, motorbike etc.) are constructed indices with the purpose of creating more discriminatory power at the lower and upper end of the distribution (Smits, Steendijk, 2015). The housing characteristics are measured with three-category variables (low quality, middle quality, high quality) and include three different items: number of sleeping rooms[28], floor material[29], toilet facility[30] (Smits, Steendijk, 2015). The basic services assets include: water supply[31] and electricity (two-category variable: yes or no). The method used in constructing the weights of these assets is principal component analysis (PCA) which is extensively covered in Chapter III.

This analysis includes several predictors for measuring the demographic effects on economic growth. The demographic variables are Youth ratio, Old ratio, Working-age ratio, Population growth, and Population density. The total dependent population is decomposed into its two components young (under 15 years) and old (65 years and over) individuals, hence allowing capturing the separate effects. The Youth ratio and Old ratio to total population are both measured at the initial level of the growth period. The working-age ratio to total population is measured as the average growth for the time period analyzed. All three variables are provided by Global Data Lab. The Youth and Old ratios decrease or increase relative to the Working-age ratio during the demographic transition (Bloom, Williamson, 1998). Coale and Hoover were the first to introduce the dependency hypothesis in their landmark paper *"Population growth and economic development in low income countries (1958)".* In addition, population growth and population density are introduced in the analysis as control variables to account for potential confounding effects (Bloom, Canning, Malaney, 2000). Population growth and growth in the Working-age ratio are contemporaneous with growth in IWI. All variables are measured at the district level.

Several variables at the district level are included to explain labor productivity differences across districts. Human capital is measured by the average total years of schooling of adults aged 20 years and over. Education is the major determinant of labor quality and economic performance. The health status is measured by infant mortality rate, which can be interpreted as the number of deaths of children under one year of age per 1000 live births. The infant mortality rate is strongly correlated with life expectancy and a good measure of health in low and middle-income countries where death rates are more prominent due to the low quality of

[28] Include three categories: 1st: Zero or One sleeping rooms; 2nd: Two sleeping rooms; 3rd: Three or more sleeping rooms

[29] **High quality** is finished floor with parquet, carpet, tiles, ceramic etc. **Middle quality** is cement, concrete, raw wood, etc. **Low quality** is none, earth, dung etc (Smits, Steendijk, 2015).

[30] **High quality** is any kind of private flush toilet. **Middle quality** is public toilet, improved pit latrine, etc. **Low quality** is traditional pit latrine, hanging toilet, or no toilet facility (Smits, Steendijk, 2015).

[31] **High quality** is bottled water or water piped into dwelling or premises. **Middle quality** is public tap, protected well, tanker truck, etc. **Low quality** is unprotected well, spring, surface water, etc (Smits, Steendijk, 2015).

the health care system. The district development stage is measured by the ratio of the total population living in urban areas. Thus, districts with larger proportions of people living in urban areas are considered more urbanized with better infrastructure, improved access to public services, and more possibilities to acquire essential assets.

Four interaction terms are included in the analysis independently or simultaneously. Each of the interaction terms consists of one demographic variable, namely growth in working-age ratio, and one national-level variable. The first interaction term is with the average inflation index during the growth period (Van der Ven, Smits, 2011). The inflation index is measured at the country level and it can be included in our model only as interaction with one of our main predictors. The index is measured as the annual percentage change in the Consumer Price Index and is collected from the World Bank Development Indicators[32] database. This index is an indicator of economic performance, which ultimately determines the power of households to acquire assets. The purpose of this interaction is to highlight to what extent the effects of changes in the age structure on having access to basic facilities and acquiring essential assets are amplified by their costs. The second interaction term includes trade openness with each of the demographic variables to determine the effect of good economic policy on the age structure (Bloom, Williamson, 1998). The variable trade openness is from the Penn World Table and is measured at a higher level, as the sum of exports and imports divided by GDP.

The third interaction term contains an index which measures the degree of political freedom at the national level (Bloom, Finlay, 2009). The Freedom House Polity index has two main components, namely Political Rights and Civil Liberties, and is measured on a one-to-seven scale, with one representing the highest degree of freedom and seven the lowest (Puddington, A., Dunham, J., *Freedom House (2018)*). Högström John. (2013) in a cross-national analysis between two of the most widely used measures of democracy, specifically Freedom House and Polity IV, and other four independent variables, namely GDP per capita, education, population, and area size, found that the two indices deliver different results and hence different inferences. The empirical results show that the Freedom House index is more statistically related to the independent variables and tends to rate countries with a slightly higher level of democracy than Polity IV (Högström, 2013).

The last interaction term is with a composite governance index which measures the quality of the institutional settings (Bloom, Williamson, 1998). This index aggregates six dimensions of governance: Government Effectiveness, Control of Corruption, Rule of Law, Political Stability and Absence of Violence/Terrorism, Voice and Accountability, Regulatory Quality (Kaufmann et al., 2009). All six indicators range from -2.5 to 2.5, with the lowest score for the worst institutional quality and highest score for the best institutional quality. The governance index is very likely to correlate with the Freedom Index since political rights and civil liberties rely on the quality of the institutional settings. Therefore, we must use the interaction terms of these two variables separately.

Several other interactions between the main demographic variables and other national-level variables are added into the model but deliver insignificant results. The interaction effects between either growth of working-age ratio or initial youth ratio with ethnolinguistic fractionalization are insignificant. The same insignificant results are delivered by the

[32] Access to WDI at: https://databank.worldbank.org/source/world-development-indicators

interaction with the property of being landlocked. The insignificant results hold either when added independently or simultaneously to the model with other interactions. However, national-level variables included in the interaction terms might fail in capturing some of the effects at the district level, but since district-level data is scarce, the inclusion of these variables helps in explaining some of the remained variations. Note that all national variables included in the interaction terms were centered with their grand mean for interpretation purposes. Descriptive statistics are reported in Table 3 and the description of variables in Appendix, Table 9.

Table 3: Descriptive Statistics

Variable	Obs	Mean	Std.Dev.	Min	Max
International Wealth Index	599	48.325	17.105	11	90.1
Growth in IWI	426	7.591	6.136	-18.7	30.5
Youth ratio	599	34.588	5.967	13.7	51.8
Old age ratio	599	5.022	1.766	1.29	13.3
% Population aged 15-65	599	60.399	4.948	46.1	76.9
Growth in working-age ratio	426	1.638	2.363	-10.8	9.6
Population density	599	686.408	1869.52	4.98	17991.17
Total area population	599	12.897	25.109	.09	208
Mean years of education adults aged 20 and over	599	5.942	2.129	1.03	12.2
Infant mortality rate	599	49.845	25.330	3.22	170
% Population in urban areas	599	29.386	20.031	0	100
Interval variable (length of time between two surveys)	426	6.025	2.744	3	16
Interval variable (period fixed effects)	599	16.183	7.099	0	27
Inflation	599	5.585	3.1	-.791	11.791
Trade openness	599	.6232	.3454	.1447	2.048
Governance Index	569	-.6440	.3766	-1.742	.0399
Freedom House Polity Index	599	4.09	1.92	2	7

Because the analysis is at the district level and includes more than one country, many variables of interest are not available for comparative analysis. However, the inclusion of dummy variables for each country accounts for much of the variation which is explained at the national (group) level. The variation captures differences in some country-specific variables which may determine the long-run level of total factor productivity, such as institutional quality, openness to trade, geography, culture, and ethnicity. In addition, districts within the same country are more homogenous than districts from different countries, because usually share the same institutional principles and cultural beliefs.

VI. ESTIMATION AND REGRESSION RESULTS

Table 4 shows the regression results of the relationship between growth in IWI and the initial value of IWI while controlling for each country's fixed effects and different time lengths of the growth periods. The empirical results indicate a catch-up to the steady-state level, as implied by the neoclassical growth theory. The significant negative coefficient of the initial value of IWI is consistent with the hypothesis of conditional convergence that these states will experience substantial growth rates before attaining their respective income ceilings.

Table 4: Convergence model

Growth IWI	Coefficient	Standard Error	t-value
Initial value IWI	-0.1485***	0.0235	-6.30
Constant	-21.309***	3.346	-6.37
Country dummy	yes		
Interval variable (length of time)	yes		
Interval variable (Period fixed effects)	yes		
Number of observations		426	
R-squared		0.385	
Adjusted R-squared		0.364	
F-test		18.41	

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 5 shows the relationship between growth in IWI and the main demographic variables. The results are in line with theoretical predictions. The coefficient of the initial value of IWI is strong at a high t-value which indicates a pronounced convergence between districts. The coefficient of the initial Young ratio is significant and has the expected sign which indicates that a larger youth dependency impedes economic growth in the form of having improved access to basic facilities and acquiring assets. In contrast, the Old ratio is not significant with a very weak coefficient and a positive sign opposed to the theoretical underpinnings. The insignificant coefficient of the Old ratio is because the age structure is still in its prime stage with a low proportion of old people. Growth in the Working-Age ratio is strong and highly significant indicating that a larger share of working-age people will have a positive effect on household welfare since a household with less dependent members has less consumption and better prospects of investments in improving its wellbeing.

The interval variable which measures the length of time between two adjacent surveys is displayed for interpretation. The significant positive coefficient implies that larger growth periods (time lengths between two surveys) give more time and thus opportunities for households to acquire more assets. The inclusion of dummy variables for each country accounts for country fixed effects and can be used as an indication of how much of the total variation is explained by our variables included in the model. Therefore, it seems that some of the dummy variables exhibit highly significant coefficients which means that there is

variation captured by these dummies which are not explained by our demographic variables. Hence, other controlled variables need to be added to the model.

Table 5: Growth IWI and the demographic variables

Growth IWI	Coefficient	Standard Error	t-value
Initial value IWI	-0.223***	0.031	-7.17
Initial Young Ratio	-0.373***	0.098	-3.79
Initial Old Ratio	0.025	0.218	0.12
Growth in Working-age Ratio	0.705***	0.117	6.02
Interval variable (length of time)	1.374***	0.167	8.22
Country dummy	yes		
Interval variable (Period fixed effects)	yes		
Constant	-0.772	6.084	-0.13
Number of observations		426	
R-squared		0.454	
Adjusted R-squared		0.431	
F-test		20.00	

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 6 reports the regression results with control variables in two columns. Column 2 contains all variables from Column 1 plus growth in the average years of education. In both columns, the initial value of the asset index is negatively correlated with the change in the asset index and highly significant, which once again confirms the economic convergence theory. The coefficient of the initial value of IWI is stronger with control factors, which suggest a higher economic growth and hence stronger convergence towards the steady-state income level. The initial Young ratio is significant at 1% level and strongly negatively correlated with growth in the asset index in both columns, which confirms the life cycle savings hypothesis that the young consume more than they produce, which lowers savings and economic development (Lee, Mason, Miller, 2000, Bloom, Canning, Graham, 2003). The coefficient of the initial Old ratio is insignificant and has the opposite sign which indicates that the low proportion of old people in these countries has no meaningful impact on economic growth. The opposite positive sign might suggest that those districts which recorded a higher rate of old people have attained a higher development stage with better health care and social systems which permit individuals to reach their old ages. In addition, old age individuals might contribute through savings, work, and perhaps by tending the young, being a less heavy burden than the young age individuals (Bloom, Williamson, 1998).

Growth in Working-age Ratio is strong and highly significant at 1% level. Hence, a larger proportion of working-age people promotes economic performance across households. Theoretically, education must be added at the beginning of the studied period because is endogenous to economic growth. However, after adding both growth in average years of education and the initial average years of education to the equation (see Column 2), the effect of the working-age ratio becomes weak because its effect is captured by the growth in education. If both terms, initial and growth in average years of education are added separately to the equation, their effects become weaker. This suggests that the wealth index is more

strongly correlated with improvements in education than other demographic or economic variables especially in low and middle-income countries where the level of education determines the power of acquiring assets. Therefore, if a household has access to education, then it is more likely for that household to have access to basic facilities and essential assets. In addition, education is the primary channel through which the changes in the working-age ratio influence growth, since a lower dependency ratio, encourage families to invest more in education, and therefore is very likely that some of the demographic effects would be captured by schooling. This problem is overcome by introducing just the initial level of education (see Column 1) as according to the literature (Bloom, Canning, Malaney, 2000, Bloom, Canning, 2004, Van der Ven, Smits, 2011) to control for the starting level of schooling and let the demographic effects to be emphasized.

Table 6: Regression results with control variables

	(1) Growth IWI	(2) Growth IWI
Initial value IWI	-0.263***	-0.310***
	(0.042)	(0.037)
Initial Young Ratio	-0.332***	-0.243***
	(0.103)	(0.090)
Initial Old Ratio	0.137	0.053
	(0.233)	(0.204)
Growth in Working-age Ratio	0.654***	0.186*
	(0.117)	(0.111)
Ln Initial Population density	-0.128	-0.251
	(0.249)	(0.218)
Ln Population growth	2.764***	2.610***
	(0.803)	(0.702)
Initial average years of education adults aged 20+	-0.369	0.703**
	(0.347)	(0.318)
Initial Urbanization	0.033	0.035*
	(0.023)	(0.020)
Initial Infant mortality rate	-0.056***	-0.052***
	(0.016)	(0.014)
Interval variable (length of time)	1.387***	1.027***
	(0.163)	(0.146)
Growth in average years of education		4.999***
		(0.447)
Interval variable (Period fixed effects)	Yes	Yes
Country dummy	Yes	Yes
Constant	3.755	2.563
	(6.384)	(5.583)
Number of observations	426	426
R-squared	0.489	0.610
Adjusted R-squared	0.461	0.588

Standard errors are in parenthesis
**** p<0.01, ** p<0.05, * p<0.1*

Growth of the total population also appears to have a relatively strong and significant effect on economic growth, whereas population density has a negative effect but insignificant. The positive coefficient sign of total population growth holds only when the demographic variables which account for the age structure of population growth are added to the model.

Therefore, once the working-age ratio is relatively higher than the dependency ratio (composed from youth and old ratio), then the growth in the total population becomes positive, indicating that some of the effects of the working-age ratio are captured by the total population growth. The population density variable is negative as per our expectations but not significant. In addition, since data on inland and coastal density at the district level is not available, it is not possible to explore the true effect of population density, which according to the literature has a positive effect in developed coastal region which are more urbanized and open to the world trade (Bloom, Canning, Malaney 2000). Overall, our demographic variables exhibit a strong effect on our asset-based index which clearly suggests the essential role of the demographic structure on economic growth in South and South-East Asia.

Average years of education for adults aged over 20 years in the initial year is introduced in both regressions as a proxy for human capital at the district level. Education represents a measure of the quality of human capital and it is highly correlated with economic growth (Bloom, Canning, Malaney 2000, Bloom, Canning 2004, Cuaresma, Lutz, Sanderson, 2014). In Column 1 education has a statistically insignificant negative effect which indicates that districts with low starting levels of education perform worse. However, once the initial level of the asset index is added to the equation, the effect becomes insignificant. Hence, the effect of the initial level of education is entirely captured by the initial value of the asset index, since both variables are highly correlated and the ownership of essential assets determines the access of families to a good education. In addition, another cause for the insignificant coefficient for education is the inclusion of dummy variables in the model, which means that a potential correlation between education and the unobserved variable, denoted by the initial efficiency, could be present in the current model (Temple, 1998).

In contrast, Column 2 shows different results when we add growth in the average years of education to the regression, together with the initial level of education. Consequently, the effect of the initial level of education becomes positive and significant at 5% level, while the effect of growth in education shows a relatively high strong effect with the positive sign. The explanation is that both terms are moving in the same direction with the asset index and are able to capture most of the effects coming from the other variables. In addition, the initial level of education is no longer insignificant and negative, indicating that the starting level of education is important and stimulates households to economically perform better, especially when followed by strong growth in the number of years of schooling. Hence, Column 2 suggests that improvements in education explain much of the productivity and income growth and that a substantial portion of the demographic dividend is channeled through it.

The remaining variables included in the two regressions exhibit different effects that potentially explain the economic performance of households. The infant mortality rate has a relatively weak but significant negative effect on asset accumulation as per our expectations. Since life expectancy data is not available at the district level for these years, the infant mortality rate is used as a proxy for health. The infant mortality rate is highly correlated with life expectancy especially in low and middle-income countries where low rates of deaths among infants are an indication of improved sanitation and better health care services. The initial level of urbanization is positive and insignificant in the first Column and significant at 10% level in the second Column. Urbanization implies that regions with improved infrastructure and facilities provide better access to various facilities and acquisition of assets. The interval variable which measures the length of time of a growth period is significant and

strongly positive, indicating that a longer period of time gives more possibilities for households to acquire assets and hence economically improve.

Table 7 reports the regression results with interaction terms between the main demographic variable, namely growth in the working-age ratio and several other variables measured at the national level, which might determine the effects of changes in the age-structure on economic growth. The coefficients of our main demographic and control variables were almost not affected by the introduction of the interaction terms, which suggests that even when controlling for national characteristics and their interaction with some other variables the significant effects hold. In Column 1 the interaction with the average inflation for the studied period appears to be negative and significant at 5%, however with a relatively weak effect on the asset index. The negative coefficient denotes that the accumulation of assets is impeded by their costs and hence the efficiency of the economic policy (Barro, 1995). Thus, a high inflation figure is an indication of higher costs of living and uncertainty which ultimately do not encourage individuals to acquire goods or services (Barro, 1995). Column 2 includes an interaction with the Governance index to test whether the growth in the working-aged ratio is conditional or not on the institutional settings. The coefficient appears to be highly significant and strong, indicating that countries with better institutional and economic policies perform better in reaping the benefits of the demographic transition. A stable macroeconomic environment promotes investments, for instance, sound institutions with a good rule of law make contracts enforceable which in turn delivers incentives for various entities and individuals to conduct businesses and invest (Bloom, Canning, 2004).

Table 7: Regression results with interaction terms

	(1) Growth IWI	(2) Growth IWI	(3) Growth IWI	(4) Growth IWI	(5) Growth IWI
Initial value IWI	-0.253***	-0.293***	-0.282***	-0.261***	-0.265***
	(0.042)	(0.042)	(0.041)	(0.043)	(0.042)
Initial Young Ratio	-0.368***	-0.404***	-0.333***	-0.333***	-0.345***
	(0.104)	(0.102)	(0.101)	(0.103)	(0.101)
Initial Old Ratio	0.082	-0.001	0.121	0.133	0.081
	(0.233)	(0.226)	(0.229)	(0.234)	(0.228)
Growth in Working-age Ratio	0.689***	0.568***	0.665***	0.653***	0.655***
	(0.117)	(0.114)	(0.115)	(0.117)	(0.114)
Ln Initial Population density	-0.127	-0.146	-0.132	-0.125	-0.107
	(0.247)	(0.244)	(0.243)	(0.249)	(0.243)
Ln Population growth	2.589***	2.548***	2.160***	2.761***	1.987**
	(0.802)	(0.776)	(0.800)	(0.804)	(0.799)
Initial average years of education adults aged 20+	-0.426	-0.274	-0.230	-0.379	-0.292
	(0.346)	(0.340)	(0.341)	(0.349)	(0.341)
Initial Urbanization	0.027	0.029	0.036	0.032	0.030
	(0.023)	(0.022)	(0.022)	(0.023)	(0.022)
Initial Infant mortality rate	-0.056***	-0.068***	-0.051***	-0.056***	-0.050***
	(0.016)	(0.016)	(0.015)	(0.016)	(0.015)
Interval variable (length of time)	1.412***	1.243***	1.264***	1.394***	1.300***
	(0.163)	(0.203)	(0.162)	(0.166)	(0.162)
Growth in Working-age Ratio times Average Inflation Index	-0.052**				
	(0.022)				

Growth in Working-age Ratio times Governance Index		0.922*** (0.206)			
Growth in Working-age Ratio times Freedom House Index			-0.214*** (0.051)		-0.265*** (0.055)
Growth in Working-age Ratio times Trade Openness Index				0.110 (0.427)	1.017** (0.457)
Constant	21.670*** (6.013)	29.033*** (6.038)	22.889*** (5.926)	20.266*** (6.023)	23.696*** (5.908)
Number of observations	426	396	426	426	426
R-squared	0.496	0.550	0.511	0.489	0.517
Adjusted R-squared	0.467	0.521	0.483	0.460	0.488

Standard errors are in parenthesis
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Freedom house index is included in the empirical specification to test whether growth in the working-age ratio is conditioned or not by the degree of democracy a country is experiencing. Freedom house index runs from 1 to 7, with 1 representing the highest degree of freedom. Acemoglu, Gallego, Robinson, 2014 provide strong evidence that the impact of good policies and institutions on economic performance is pronounced and robust, especially in the long term. The coefficient in Column 3 suggests that the effect of growth in the working-age ratio is determined by certain political institutions. The negative coefficient denotes that an increase in the working-age proportion of individuals becomes a burden under the improper political and institutional circumstances. One prominent example would be the inability of the labor market to absorb those individuals who reached the prime working ages due to the inadequate policies which govern it (Acemoglu, Gallego, Robinson, 2014).

Column 4 shows the results from the interaction with the degree of openness to trade. This allows us to explore if the effect of an increased working-age ratio is conditional on the flexibility of the economy. The coefficient is positive but insignificant which suggests that after controlling for a range of other variables the effect of open economies is not considerable enough. However, the coefficient becomes strong and significant at 5% level when is added to the analysis simultaneously with the interaction between growth in working-age and the Freedom House index. One possible explanation would be that once the appropriate policies and institutions are in place, an open economy will experience the gains from the demographic transition.

Some control variables which delivered insignificant coefficients were omitted from the regression analysis. Among these omitted variables are ethnolinguistic fractionalization and landlocked, which proved to be insignificant when added to the equation through the interaction terms. Theoretically, these variables would exhibit a negative effect on economic growth. Moreover, data is not available for some of these variables, such as for ethnolinguistic fractionalization after 2013, which causes a large number of observations to be dropped out from the analysis. In order to avoid this problem, the last available data is used for the years after 2013. However, the results remained statistically insignificant.

The coefficients of the country fixed effects dummy variables and period fixed effects variable are not reported in the tables because are not of main interest since the focus is on the effects of the demographic variables. The coefficients of the country fixed effects dummy variables are not statistically significant which implies that the variables included in the model succeeded in explaining much of the variation in the asset index growth caused by several other variables. However, the coefficient of the dummy variable for Myanmar is statistically significant which is due to the large time gap between the two studied surveys, representing an outlier in our regressions. Thus, Myanmar holds some variation which is not explained by the model. To test for the influence of Myanmar to the overall results I ran the regression with and without it and the results still hold, which shows that is not an influential case in the model.

In addition, the period fixed effects variable which accounts for the starting year of each growth period is statistically significant and positive in all models which means that the period in which the surveys were held is important for economic growth. In addition, it is clear that over time the availability of assets and services improved, and hence households who were surveyed after some years later were in better circumstances. This variable has also a role in capturing external shocks that these countries might suffer.

The tables report high standard errors for the constant term. The variation in the constant term found in each table suggests that the initial levels of efficiency differ systematically across districts (Temple, 1998). The variation in technical and technological efficiency, given by the quality of physical and human capital, is due to the different access to economic infrastructure and various institutional, geographic, cultural, or demographic factors. Therefore, it is realistic to say that districts are unlikely to fall on a common surface. However, the model shows strong explanatory power that these districts follow the same pattern of economic convergence which confirms the underlying theory.

VII. DISCUSSION AND CONCLUSION

1. DISCUSSION

Influential cases and measurement error biases

In this section, we will discuss some serious difficulties which might arise in panel data applications within the growth literature, which might affect our results. In addition, the reverse causality problem is taken up at some length in the current section. Temple, 1998 recognizes two major problems in the growth literature applications for which recommended some useful robustness tests which might be applied for future work on the current study or other similar studies. The two problems identified are influential cases and measurement error biases.

Outliers arise through measurement error, omitted variables, or parameter heterogeneity (Temple, 1998). The latter receives more attention, indicating that different districts are unlikely to follow the same patterns. The traditional diagnostics to address this issue are plotting the data, using scatter plots or box plots, the Cook's distance, Studentized residuals, DFITS or Least Trimmed Squares (Temple, 1998, Wooldridge, 2006). However, in some cases, these techniques fail in picking up the influential cases which are unrepresentative to the whole sample. In the current analysis presence of outliers is not a prominent problem. As I discussed in the previous section, the model performs almost similar when Myanmar, the single most salient outlier identified in the current analysis, is excluded from the analysis. The results hold even when the most developed districts in the dataset, which might have some influential power, are removed.

Measurement errors appear when multiple variables are measured with error which influence coefficients estimate to be biased away from zero or towards it (Temple, 1998). Data quality in growth regressions is often poor. Some variables are being highlighted in the literature, which is more likely to be badly measured. Such variables are any proxy for human capital, for instance, the schooling variable or data on labor force participation rates which makes the GDP per worker an inappropriate measure (Temple, 1998). Therefore, to obtain information about the sensitivity to measurement error, besides the traditional diagnostics of plotting and inspecting the data, one can use the multivariate reverse regression and the classical method of moments estimators (Temple, 1998).

In the current analysis, one would say that the lack of good data prevails even more at the subnational level. However, the use of an asset-based index for income growth is a better proxy where data is at risk of error or unavailable since assets are tangible objects which do not require sophisticated techniques or extraordinarily trained examiners. In addition, for the remaining variables, various other proxies available at the subnational level were used to test for potential coefficient biases. For instance, the expected years of schooling or average years of female education are used instead of average years of education for adults, as for the demographic variables the dependency ratios, which represent the ratio of each dependent subgroup to the working-aged population, were used as an alternative. Although different proxies were used, the results do not change much, especially for our variables of main interest.

Reverse causality

Economic growth is caused by several factors which are endogenous to growth itself. Human capital, culture, institutional and economic factors cause economic growth and are determined by economic growth (Bloom, Canning, Malaney, 2000). Thus, it is crucial to account for endogeneity concerns and the introduction of a range of control variables. The current literature overcomes this issue by introducing a set of control variables at the beginning of the studied period or prior to it (Bloom, Canning, Malaney, 2000, Bloom, Canning, 2004, Kelley, Schimdt, 2005, Bloom, Finlay, 2009, Bloom et al., 2010, Van der Ven, Smits, 2011, Aiyar, Mody, 2011, Joe, Kumar, Rajpal, 2018).

This study attempts to control for potential reverse causality between the growth rates of the asset index IWI and growth rates of the working-age ratio by introducing several variables measured at the beginning of the survey period before the growth has occurred. The effects captured by the demographic variables are potentially endogenous and hence are included in the model through the initial value of the young ratio and old ratio (Van der Ven, Smits, 2011). Endogeneity between the demographic variables and economic growth occurs mostly through one channel, specifically through reductions in fertility rates (Bloom, Canning, Malaney, 2000). Population density and urbanization, measured by the proportion of people living in urban areas, are determined by economic development and therefore are introduced at the beginning of the sample period (Bloom, Finlay, 2009, Van der Ven, Smits, 2011). Furthermore, Bloom, Canning, Malaney, 2000 found no evidence of feedback loops from income to changes in the age-structure when analyzing 5 year time periods, which implies that is unlikely to have income effects in our model with an average time intervals of 6 years. These variables account for the initial conditions at the beginning of the sample period which might influence the pace of economic growth during the sample period.

However, the inclusion of variables measured at the starting year for each growth period studied hardly controls for potential feedback loops between the independent and dependent variables. Because some countries in our dataset have only one time period do not allow us to instrument variables with previous values, since prior surveys were not held to provide us with data at the district level. Hence, using instrumental variables with prior values causes many observations for these countries to be dropped from our dataset which will significantly affect our results. For future research, it would be recommended to test for potential causality using various methods suggested by the literature, such as the Two-stage least squares method with instrumental variables, if additional data will become available to permit instrumenting with previous values the corresponding variables.

In addition, the reverse causality issue may be induced by external phenomena which are hard to capture due to the unavailability of data. One such external factor is the migration of people between districts and countries mostly caused by the desire for searching better economic prospects. Migration is more likely to occur between districts due to the absence of cultural barriers and relatively lower transportation and settlement costs (Walmsley et al., 2011). The working-age component of the age structure is the most affected by migration since working-age people are the ones who search for such economic benefits. However, in some countries, internal migration was found to respond very weak to changes in real per capita incomes (Cashin, Sahay, 1996), and yet these studies cast doubts on the economic effects of internal migration due to the unreliability of data.

2. CONCLUSION

This study establishes the existence of a strong correlation between some key demographic factors and economic growth, proxied by an asset index, using a subnational panel dataset across multiple countries. The demographic factors became key explanatory variables for economic growth once the East Asian state's demographic transition started in the early 60' and 70'. East Asian states reaped huge economic benefits aroused from the age-structure transition, entering in a new demographic stage, while those (lagged) South and South-East Asian states missed harnessing those benefits at an early stage. In the midst of a demographic transition, the dependent population in South and South-East Asian countries reached the lowest levels and will continue to stagnate in the following two decades which provides a huge opportunity for these states to catch up with their fellow neighbors (Choudhry, Elhorst, 2010). Within these circumstances, households hold tremendous opportunities to invest and save more in order to increase their wealth, since smaller family sizes make investments and savings easier and more attractive.

The contribution of this study to the growth literature is that the traditional proxy for economic growth, income per capita is replaced by a wealth index. Hence, using an asset-based wealth index gives us the capacity to better capture the demographic effects on the living standards of households in economies operated mostly by an informal unorganized sector and unpaid household work. Hence, the current analysis reports a strong correlation with the expected sign between the asset index and the main demographic variables which indicates that the demographic transition must be carefully managed by the South and South-East Asian states in order to reap its gains.

The results suggest that the demographic effects are strong and significant. A relatively higher working-age ratio has strong positive effects on asset accumulation and thus economic performance. Thus, a relatively lower youth and old ratio encourage savings and investments in human capital, as well as empowerment and increased participation rates for women. The overall population growth plays a significant and positive role in the economy when the ratio of dependent people is significantly lower. The population density is negative and insignificant. In addition, the findings suggest that the working-age ratio effects, induced by the changes in the age structure, are conditional on various factors measured at the national level. Such factors are the institutional quality, inflation index, the degree of openness of an economy, and of political freedom.

Other variables exhibit different coefficients when added to the model. The infant mortality rate is highly significant with the expected sign, which confirms the importance of health status to economic growth. The initial level of education is negative and insignificant, which means that much of the effect is captured by other variables included in the model, potentially by the fixed effects dummy variables. However, when the growth of education is added to the model together with the initial level of education, both variables become significantly positive, while the working-age ratio losses much of its effect, which is an indication of the high correlation between increased educational years and accumulation of assets. It is no doubt that those families who have access to better education are more likely to own essential assets. In addition, the initial level of urbanization is positive and insignificant.

The empirical analysis implies that the demographic dividend is conditional on good policies. The key determinants of whether a district will realize the demographic dividend are the flexibility and quality of the economic policies at the national level. The quality of governmental institutions determines the ability of a country to engage in world trade and absorb the rapidly increasing labor force. Failing in capitalizing the demographic dividend might result in a demographic burden manifested through unemployment or underemployment, political instability, and deterioration of social capital (Bloom, Canning 2004). Thus, investments in education, health care services and better family planning schemes are necessary for exploiting the economic and social gains of the demographic dividend.

Future research is required to test for the two-way causality between demographic change and economic growth, in order to obtain the precise effects of the variables, when additional data will be available. In addition, further work is necessary to explore potential problems which might arouse from measurement errors. Therefore, we have to understand the biases induced by the limitations caused by the lack of data availability on various indicators at the subnational level. The analysis and selection of variables were determined by the availability of data. However, the most important is the empirical evidence of the significant coefficient signs of the variables of interest, according to the literature, which became the foundation of the current study.

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APPENDIX

Table 8: Countries and survey years

Countries	Number of districts	Survey years	
Afghanistan	8	2010, 2015	MICS, DHS
Bangladesh	23	2004, 2011, 2014	DHS, DHS, DHS
Cambodia	17	2000, 2005, 2010, 2014	DHS, DHS, DHS, DHS
India	26	1992, 1999, 2006, 2016	DHS, DHS, DHS, DHS
Indonesia	29	1997, 2003, 2007, 2012	DHS, DHS, DHS, DHS
Laos	17	2012, 2017	MICS, MICS
Myanmar	14	2000, 2016	MICS, DHS
Nepal	5	1996, 2006, 2011, 2016	DHS, DHS, DHS, DHS
Pakistan	6	1991, 2007, 2012, 2018	DHS, DHS, DHS, DHS
Philippines	17	1998, 2003, 2008, 2013, 2017	DHS, DHS, DHS, DHS, DHS
Thailand	5	2006, 2012, 2017	MICS, MICS, MICS
Vietnam	6	1997, 2002, 2006, 2010, 2014	DHS, DHS, MICS, MICS, MICS

Note: MICS - UNICEF Multiple Indicator Cluster Surveys. DHS - Demographic and Health Surveys (DHS)

Table 9: Variables description and sources

Variable	Source	Description
International Wealth Index	GDL	Asset-based wealth index that runs from 0 (no assets) to 100 (all assets) comparable across place and time
Youth dependency ratio	GDL	Percentage of population in the region under age 15
Old-age dependency ratio	GDL	Percentage of population in the region over 65
% Population aged 15-65	GDL	Percentage of population in the region aged 15 to 65
Population density	Statoids Website	People per square kilometer
Total area population	Statoids Website	Total area population
Mean years of education adults aged 20 and over	GDL	Mean years education of adults aged 20+ in region
Infant mortality rate	GDL	Number of deaths of children less than one year of age, per 1000 live births in a given year
% Population in urban areas	GDL	% of the population living in urban areas in the region
Interval variable		Number of years between two surveys
Interval variable (period fixed effects)		Difference between the starting year for each survey period studied and the first year of all years
Inflation	WDI	Inflation as measured by the annual percentage change in the consumer price index
Trade openness	Penn World Table version 9.1	The Sum of exports and imports divided by GDP, measured at the national level.
Governance Indicator	Worldwide	Composite Index aggregating 6 institutional

	Governance Indicators	dimensions, which ranges from -2.5 low governance quality to 2.5 high governance quality
Freedom House Polity index	Freedom House	Measured on a one-to-seven scale, with one representing the highest degree of freedom and seven the lowest.

Note: Access to GDL at: https://globaldatalab.org/
Access to WDI at: https://databank.worldbank.org/source/world-development-indicators
Access to Penn World Table at: https://www.rug.nl/ggdc/productivity/pwt/?lang=en
Access to Statoids Website at: http://www.statoids.com/statoids.html
Access to Freedom House website at: https://freedomhouse.org/

Table 10: Data manipulation for missing values

Variable	Level	Country	Year	Manipulation
Governance indicator	National	Indonesia	1997	Mean of the years 1996 and 1998
Governance indicator	National	Vietnam	1997	Mean of the years 1996 and 1998
Governance indicator	National	India	1999	Mean of the years 1998 and 2000
Infant Mortality rate	District	Pakistan	2018	National level values from WDI
Infant Mortality rate	District	Myanmar	2000	National level values from WDI
Trade openness	National	Pakistan	2018	Values from the closest year