Convergence Success and the Middle-Income Trap*

Jong-Wha Lee+

Economics Department and the Asiatic Research Institute,
Korea University

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Abstract

This paper investigates the economic growth experiences of middle-income economies. Middle-income economies are classified into two groups, "convergence success" and "non-success," based on their speed of transition to a high-income status over the period 1960–2014. "Convergence success" includes middle-income economies which graduated to a high-income status or have achieved rapid convergence progress. When an economy in the "non-success" experienced growth deceleration and failed to advance to a high-income status, we defined such episodes as the "middle-income trap." We observe no clear pattern that the relative frequency of growth deceleration was higher when an economy transitioned from an upper middle-income status to a high-income status, thereby refuting the "middle-income trap hypothesis". The probit regressions show that in comparison to "non-successes," "convergence successes" tend to maintain strong human capital, large working-age population ratio, effective rule-of-law, low price of investment goods, and high levels of high-technology exports and patents. Adding to unfavorable demographic, trade and technological factors, rapid investment expansion, hasty deregulation and hurried financial opening could cause the "non-successes" to fall into the "middle-income trap."

Keywords: Economic growth; convergence; middle-income trap

JEL Classifications: O11, O14, O47, O57

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+Author's address: Asiatic Research Institute, Korea University, 145 Anam-ro, Seongbuk-gu, Seoul, 02841, Korea. Tel.: +82-2-32901600. Fax: +82-2-9234661. E-mail: jongwha@korea.ac.kr

1. Introduction

There is no question that the economic influence of emerging economies in the global economy is stronger than ever. The share of the "emerging market and developing economies" (emerging economies, hereafter) in the global gross domestic product (GDP) in terms of purchasing power parity (PPP) increased steadily from 36% in 1980 to 58% in 2016, as reported in the International Monetary Fund (2017). During the global financial crisis of 2008, emerging economies were relatively resilient and maintained strong growth. A significant number of economies have shown strong long-term growth, catching up with the advanced economies in terms of their per capita income.

While there is a general optimism toward the prospects of emerging economies, the outlook remains uncertain. It is doubtful whether they can revert to sustained long-term growth paths amid uncertain global economic environments and low productivity growth. In addition, given a sustained income gap between emerging and advanced economies, there is a growing concern that many emerging economies will never match the advanced economies, in terms of their per capita income, and would be rather trapped in a middle-income status. Thus, the approach to sustaining economic growth is an important policy challenge confronting emerging economies.

The main objective of this paper is to investigate the sources of sustained long-term growth, with particular reference to experiences of middle-income emerging economies, over the past half-century. In particular, the investigation focuses on episodes of rapid transition from middle- to high-income status, and the significant growth slowdown that the middle-income economies went through. In order to elaborate, this paper will assess the factors that enable certain middle-income economies to transition to a high-income status, and those causing other middle-income economies to suffer from growth deceleration, thereby being trapped in the middle-income status.

There exists a considerable body of empirical literature studying the characteristics and sources of economic growth. Empirical literature adopts regression analysis using country-level data to identify the sources of long-term economic growth. Previous studies pioneered by Barro (1991) use cross-section data, where each country has only one observation. More recent studies use panel data involving a large number of countries over a long-term period, with years dating back to the 1960s and earlier (Barro and Sala-i-Martin, 2004; Barro 2015).

Their estimation is based on a convergence-type specification that relates per capita income growth rate to the initial level of per capita income, and other variables influencing the steady-state level of per capita income. This line of literature suggests investment rate, population growth, human capital, institutions, and trade openness as the fundamental growth factors.

Country-level growth performance did not continually persist across periods (Easterly et al. 1993). While paying attention to the episodes of economies experiencing a shift in trend growth, another line of literature focuses on exploring important factors for economic growth acceleration and slowdown (Ben-David and Papell, 1998; Hausmann et al., 2005; Aiyer et al., 2013). Recently, there was a heated debate on the meaning of "middle-income trap," that an economy, while transitioning from a middle-income status to a high-income status, is more likely to experience a sharp slowdown in its growth rate. From our observation over the past half century, there were certain emerging economies, which were able to achieve rapid convergence, graduating to a high-income status, while the others suffered from growth deceleration and failed to escape from the middle-income status.

The idea of a "middle-income trap" is rather vague.[1] Gill and Kharas (2007) introduced the term by observing that a significant number of economies were not able to take another leap from being an upper middle-income status to a high-income status after transiting successfully from the low-income status to a middle-income status. They focus on the necessary adjustment of export-oriented policies in East Asian economies to sustain export competitiveness by characterizing middle-income trap as being "squeezed between the low-wage poor country competitors that dominate in mature industries and the rich-country innovators that dominate in industries undergoing rapid technological change." A number of papers emphasize that political and institutional adjustments as well as industrial upgrading are necessary for an economy to successfully advance to the high-income status (Doner and Schneider, 2016; World Bank, 2017). Recent papers, including Eichengreen et al. (2012) and Aiyar et al. (2013) find evidence supporting the middle-income trap, where an economy experiences a sharp slowdown in the growth rate once it reaches a middle-income status. However, other studies, such as Im and Rosenblatt (2015), Barro (2016), Bulman et al.

[1] See the survey by Glawe and Wagner (2016), and Agénor (2017).

(2017), and Han and Wei (2017) do not strongly support that a transition from a middle-income status to a high-income status is more likely to lead to a low-growth trap.

This paper is built on the above lines of literature. The focus is on exploring the sources of long-term growth performance of middle-income economies by distinguishing the income convergence process and the growth deceleration episode. We first classify middle-income economies into two groups, “convergence success” and “non-success,” based on their speed of transition to a high-income status (i.e., regardless of their actual graduation to the high-income status in 2014). As evidenced that many middle-income economies achieved rapid convergence, graduating to a high-income status in a relatively short period, the convergence-success group includes all the episodes of middle-income economies in 1960 completing a transition to a high-income status over the period 1960–2014. This group also includes economies which showed outstanding growth performance (as defined by the growing average annual per-capita GDP growth rate of 3.0% or greater) over the period, even though they have not yet completed the transition to the high-income status. China and Romania are fine examples of the latter.

Further, we also note an episode of growth deceleration, in which a rapidly growing economy had a significant growth slowdown over a sustained period (as defined by a decrease of average annual per-capita GDP growth rate of at least 2 percentage points over at least 7 years). We then define the “middle-income trap” by the incident of growth deceleration that occurred in convergence non-success economies that failed to escape from the middle-income status.. Note that many convergence success economies also experienced growth deceleration, but managed to escape from the middle-income status, graduating to a high-income status during the period of 1960–2014.

This paper analyzes the convergence process of middle-income economies based on the economic growth theory and discusses the key stylized facts between convergence successes and convergence non-successes. It also identifies the episodes of growth deceleration and assesses whether the relative frequency of growth deceleration was higher when an economy transitioned from an upper middle-income status to a high-income status, as implied by the middle-income trap hypothesis. We then examine the determinants of convergence successes and middle-income traps, using probit regressions.

This paper contributes to existing literature in several ways. First, it clearly distinguishes the convergence process from growth deceleration or middle-income trap episodes. In order to elaborate, an economy in the convergence non-success follows a low-growth convergence path leading toward a low level of a steady-state per capita income. In contrast, growth deceleration can occur when an economy shifts from one convergence path to a lower one through shifts in the rate of technological progress or the steady-state per capita output that the economy converges to. Hence, convergence non-successes do not necessarily undergo the middle-income trap, although their per capita income dynamics appear similar. Other studies, such as Aiyer et al. (2013), Ito (2017), and Felipe et al. (2017), also note this distinction. We analyze this issue more clearly both in concepts and empirics. Second, based on new definitions, we assess the determinants of convergence success and the middle-income trap in a more cohesive manner. Using the probit regressions, we explain the critical factors for growth performance and convergence of the middle-income economies that have successfully advanced to the high-income status, in comparison to those observed in other economies that are trapped in middle-incomes.

The remainder of this paper is organized as follows. Section 2 provides a brief overview of the concepts of income convergence, growth deceleration, and middle-income trap in the framework of a neoclassical growth model and conditional convergence theory. Section 3 defines middle-income economies among a sample of 110 economies for which the GDP data are available for the 1960–2014 period, and identifies convergence successes and non-successes. The paper also notes episodes of growth deceleration and middle-income-trap. In Section 4, the determinants of a convergence success and middle-income-trap are examined using statistical analysis. Section 5 concludes the paper.

2. Income Convergence, Growth Deceleration, and Middle-income Trap: Concepts

Over the past half century, middle-income economies have shown diverse growth performances. Figure 1 shows the annual per capita GDP from 1960 to 2014 for selected economies. Several successful East Asian economies, such as Singapore and South Korea have rapidly caught up to the United States of America (the U.S.) in per capita income, and have reached an income level of high-income economies owing to their strong and persistent growth. China’s economy has also shown remarkable growth since 1980 by adopting a market-oriented reform and opening up to international trade. However, due to its relatively

late start, it continues to be on the path of advancing from a middle-income status to a high-income status. In contrast to the rapid income convergence of these East Asian economies, the other middle-income economies have stagnated. Certain Latin American economies, including Brazil and Mexico, could not achieve a high-income status and even the Democratic Republic of the Congo (D.R. Congo), which had twice per capita GDP of South Korea in 1960, fell behind with negative per capita income growth over the period.

[Figure 1 here]

Figure 2 plots the per capita GDP growth rates over the 1960–2014 period against the 1960 level of real per capita GDP for a sample of 110 economies.[2] Poor economies in 1960 with less than 5,000 PPP dollars of real per capita GDP showed a rather diverse performance over the period: the top 15 performers and the bottom 15 performers are indicated in different colors. The group of the top 15 economies with the highest per capita GDP growth rates from 1960 to 2014 contains nine economies of Asia (China; Hong Kong, China; Indonesia; Korea; Malaysia; Taiwan, China; Singapore; Sri Lanka; and Thailand); also included are three Middle Eastern/North African economies (Cyprus; Egypt; and Malta); and Botswana, Panama, and Romania. In contrast, the 15 slowest-growing economies over the same period include 11 African and three Latin American economies.[3] These slowest-growing economies have not been able to escape the "poverty trap."

[Figure 2 here]

The evolution of the per capita income level and growth rates over time can be explained by the "conditional convergence" theory (Barro and Sala-i-Martin, 2004; Acemoglu, 2009), where a country with a low level of initial per capita output (income) relative to its own steady-state (long-run) potential has a higher growth rate than a country with a higher level of per capita output. The basic concept is that farther a country is located from its steady-state output or income level, larger is the gap of reproducible physical and human capital stock,

[2] Underlying data are the adjusted PPP values from the Penn World Table 9.0 (Feenstra et al., 2015). Per capita GDP is the expenditure-side real GDP at chained PPPs (2011 constant prices) that compares the relative living standards across countries and over time. Real per capita GDP growth rates use national-accounts growth rates that compare (output-based) growth rates across countries.

[3] The 15 slowest-growing economies are Central African Republic, Cote d'Ivoire, D. R. Congo, Gambia, Guinea, Guinea-Bissau, Madagascar, Niger, Senegal, Togo, Zambia, Haiti, Jamaica, Nicaragua, and the Islamic Republic of Iran.

and technology (total factor productivity) from its long-run levels. This gap offers a chance for a rapid leveling through high rates of physical and human capital accumulation, which are encouraged by higher rates of return on investment. Additionally, a country with such technology gaps can enjoy benefits of adopting and imitating technology from advanced economies to expedite improvements in productivity.

The typical conditional convergence equation can be written as follows:[4] [5]

$$\frac{\mathrm{dy(t)}}{\mathrm{y(t)}} \equiv g = x - \beta \log\left(\frac{y(t)}{y^*}\right) \qquad (1)$$

where *y(t)* is an economy's per capita (or per-worker) output in period *t*, y^* is its steady-state level of per capita output, and *x* is the rate of technological progress, which is assumed to be exogenously given. In this equation, the per capita output growth rate (*g*) declines as the gap between the current level and steady-state level of per capita output narrows. Once the per capita income reaches a steady-state, the second term becomes zero and the per capita income increases at a constant rate of *x*. During transition to the steady-state, the growth rate is determined by the technological progress, which is the first term, and the convergence factor, which is the second term in equation (1).

In equation (1), β denotes the speed of convergence. Around the steady-state, the speed of convergence is as follows:

$$\beta = (1 - \alpha)(n + \delta + x) \qquad (2)$$

where α is the elasticity of output with respect to capital, and in a competitive economy, this equals the capital share of output, n is the rate of population growth, and δ is the capital depreciation rate.

Assume that the U.S. per capita income reached a steady-state and grows at a constant rate of technological progress. The conditional convergence equation can be rewritten in terms of it being relative to the U.S. as follows:

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[4] See Appendix.

[5] We assume a one-sector economy for simplicity. When we consider multiple sectors such as agriculture, industry and services, sectoral productivity and structural change have an important effect on aggregate economic growth. See Acemoglu (2009) and Lee (2017) for further discussion.

$$g = x + \beta \log\left(\frac{y^*}{y^*_{US}}\right) - \beta \log\left(\frac{y(t)}{y_{US}(t)}\right). \quad (3)$$

Hence, if the economy's steady-state per capita income (y^*) equals the U.S. level (y^*_{US}), the second term disappears. During the transition, the economy's per capita income growth rate is higher than that of the U.S. by the magnitude of the convergence factor, which is the third term. It declines as the gap between the current level of per capita output and the U.S. level narrows.

If the economy's steady-state level of per capita output is not the same as that of the U.S., the second term matters. When its steady-state income is smaller than the steady-state level of the U.S., the economy's per capita income growth rate is lower both in the transitional path and in the steady-state. The steady-state level of per capita output is determined by a group of external environmental and policy variables, including the investment rate, population growth rate, human capital, and institutional quality (Barro and Sala-i-Martin, 2004). When a specific policy raises the steady-state income level with the U.S. steady-state income given, the second-term shifts the convergence path upward.

An economy's technological progress rate (x) also matters for its per capita income growth rate. The neoclassical growth model regards technology as public goods that are available to all economies and the technological progress rate is determined exogenously to individual economies. However, it can be determined endogenously and can differ across economies for a certain period. According to the endogenous growth theory (Romer, 1990), the development of new technologies depends on the innovative capacity of the economy. For low- and middle-income economies, technology adaptation and imitation are also considered to be important for its convergence. An economy's speed of catch-up to the global technology frontier is inversely related to the gap between the domestic and global levels of technological sophistication (Gerschenkron, 1962). This implies that as the technological gap narrows, it becomes more challenging for emerging economies to catch up with the more advanced technologies. Hence, technological progress, or broadly productivity improvement of an economy hinges on policies that stimulate technological innovation and adaptation, and on removal of structural bottlenecks that impede productivity growth.

Figure 3 illustrates the convergence path of a hypothetical benchmark economy in which the per capita output was 10% of that of the U.S. in 1960, and converges to the steady-state per capita income, which is assumed to be 60% of the U.S. level. The exogenous technological progress rate is given by 1.9%, which is equal to the average U.S. annual per capita GDP growth rate over the 1960–2014 period. The convergence speed is assumed to be 0.02 per year (Barro, 2015). The convergence to the steady-state takes a long period of time with this assumed speed. Figure 3, Panel A shows that the economy reaches only 32% of the U.S. level in 2014.[6]

[Figure 3 here]

Figure 3, Panel B shows the change in per capita output growth rate of the economy. The average per capita income growth rate over the period 1960–2014 is 4.2%. Hence, it suggests that it would be challenging for an economy moving along the hypothetical convergence path to narrow the gap of per capita income with the U.S. income level, even over a half century.

Figure 3 also illustrates the convergence paths based on two different scenarios, assuming the same convergence speed of 0.02. Scenario A (the upper curve) assumes that the economy converges to the same level as that of the U.S. per capita output in the steady-state, and the technological progress rate is given by 0.03 annually. The hypothetical economy that had 10% of the U.S. per capita output in 1960, reaches 62% of the U.S. level (i.e., its steady-state per capita income level) in 2014 and the average per capita income growth rate over the period is 5.5%. Scenario B (the lower curve) assumes that the economy converges to only 30% of the U.S. per capita output in the steady-state and the technological progress rate is given by 0.005 annually. The economy reaches only 13% of the U.S. level in 2014 and the average per capita income growth rate over the period 1960–2014 is 2.4%. Figure 3, Panel B shows that the per capita GDP growth rates along the growth path in Scenario B are much lower than those in Scenario A, and thereby its path reaches a lower level of steady-state per capita GDP than that of Scenario A.

[6] If the hypothetical economy started the convergence with 5% of the U.S. per capita output in 1960, it would reach 25% of the U.S. level in 2014. If a faster convergence speed of 0.04 is assumed, the hypothetical economy that was 10% of the U.S. per capita output in 1960 reaches 48% of its steady-state per capita income level by 2014.

[Figure 4 here]

An economy can change its convergence path either upward or downward. If an economy shifts to a higher convergence path during the transition, it would show a much faster leveling with the U.S. income level. In contrast, an economy can shift to the lower path when its technological progress or steady-state per capita income level to which the economy converges is worsened. In literature, the idea of a middle-income trap is often associated with this pattern of economic growth, generally characterized by a sharp deceleration in growth over a sustained period, which consequently leads to the failure of a middle-income economy to advance toward a high-income status (Eichengreen et al., 2012; Aiyar et al., 2013; Ito, 2017). In this framework, the middle-income trap, which is defined by the growth deceleration, is distinguished from slow convergence along a given convergence path. Figure 4 illustrates the case of middle-income trap in which a middle-income economy is trapped in a middle-income status when it shifts downward from a convergence path (the benchmark case in Figure 3) to a low-growth convergence path (Scenario B in Figure 3). The hypothetical middle-income economy is assumed to experience a significant growth slowdown over 10 years in the 1980s and then either return to a convergence path (non-trapped) or remain in a low-growth path (trapped).[7]

3. Identification of Convergence Success, Growth Deceleration, and Middle-Income Trap

In this section, we analyze income convergence and growth performance of middle-income economies, focusing on episodes of convergence success, growth deceleration, and middle-income trap.

First, the middle-income economies are defined over the period 1960-2014. The World Bank classifies countries on their income categories based on their absolute level of gross national income (GNI) per capita (in current U.S. dollars), which is available only from 1987. According to the latest classification, low-income economies are defined as those with a GNI per capita of $1,025 or less in 2015, lower middle-income economies as those with a GNI per capita between $1,026 and $4,035, upper middle-income economies as

[7] This framework suggests that cross-country income distribution can show a tendency towards polarization depending on the nature of shocks and initial conditions, as in Quah (1997).

those with a GNI per capita between $4,036 and $12,475, and high-income economies as those with a GNI per capita of $12,476 or more.[8] Zhuang et al. (2015) use this World Bank classification and identify 24 economies which remained in the middle-income range from 1987 to 2012. Using long time-series data on GDP per capita in 1990 PPP dollars and based on Maddison (2010)'s database, Felipe et al. (2017) categorize countries into low-income below $2,000, lower-middle-income between $2,000 and $7,250, upper-middle-income between $7,250 and $11,750, and high-income above $11,750. Aiyer et al. (2013) use a range of possible middle-income categories, with a lower bound between 1,000 and 3,000 (in 2005 PPP dollars) and an upper bound between 12,000 and 16,000 (at 1,000 intervals).

Alternatively, many studies adopt the classification of income categories based on the per capita income relative to the U.S. World Bank and the Development Research Center of the State Council (2013) classifies middle-income within the range of approximately 5% to 45% of the U.S. per capita income (in 1990 PPP dollars) for the period 1960 to 2008. Woo (2012) defines middle-income countries as those with a per capita income between 20% and 55% of the U.S. per capita income (in 1990 PPP dollars) during the period 1960–2008. In Bulman et al. (2017), the middle-income range is specified between 10% and 50% of the U.S. per capita GDP for the period 1960 to 2008 (in 2005 PPP dollars), while it is between 8% and 36% relative to the U.S. per capita income (in 2005 PPP dollars) in Ye and Robertson (2016).

Both absolute and relative income-based approaches are subject to limitations as they both rely on arbitrary thresholds to set the middle-income economy. Moreover, as the existing studies use different data sources and time periods, the classifications do not always generate the same identification for middle-income countries.

This study adopts a relative income-based approach for both theoretical and practical reasons. Convergence applies to the growth path, along which an economy reduces its per capita income gap relative to advanced economies over time, given that the other factors remain unchanged. If all economies approach the same steady-state per capita GDP, convergence tends to reduce cross-sectional dispersion of per capita income. In addition, the idea of the middle-income trap is also originally associated with how an economy can

[8] According to the World Bank's classification, the middle-income range is between 1.8% and 22.3% (lower and upper, respectively) of the U.S. GNI per capita income (55,980 U.S. dollars) in 2015.

achieve a smooth transition to a high-income status by shifting its low-wage growth strategy to a new one relying more on productivity and technology (Gill and Kharas, 2007); the relative wage and productivity is significant in competitiveness in the international markets.

Practically, with the adoption of an absolute approach, any positive growth allows an economy to reach a high income status eventually, although its income gap with advanced economies widens over time. In addition, it is challenging to update the absolute income thresholds regularly so as to reflect the evolution of incomes in other economies.

We divide countries into three income groups—low, middle, and high— based on their GDP per capita relative to the U.S. The most updated version of the Penn World Tables (PWT 9.0) database is used (Feenstra et al., 2015). Low-income economies are defined as those that have a PPP GDP per capita of less than 5%, middle-income economies as those between 5% and 40%, and high-income economies are those above 40% of the U.S. PPP GDP per-capita.

Among the sample of 110 economies for which the complete GDP data are available for the 1960–2014 period, this classification identifies 12, 75, and 23 economies for the low, middle, and high-income categories respectively, in 1960, and 25, 51, and 34 economies for each corresponding category in 2014. This implies that a rather significant number of middle-income economies transit to the high-income status or low-income status over the period. In comparison to the World Bank's absolute income and other relative income-based approaches, our classification provides similar groupings in 2014: most of the sub-Saharan countries are classified into the low-income category, and Organization for Economic Co-operation and Development (OECD) countries are classified into the high-income category.

Figure 5 depicts the classification of economies by their per capita income relative to the U.S. in 1960 and 2014. Each axis is divided into three areas, representing the corresponding income groups. The economies in the top-middle quadrant are those that were in the middle-income range in 1960 and graduated to a high income over this period. These include 14 economies, which are Chile; Cyprus; Greece; Hong Kong, China; Ireland; Japan; Korea; Malaysia; Malta; Portugal; Seychelles; Singapore; Spain; and Taiwan, China.

[Figure 5 here]

Existing studies often consider only these graduates as successful episodes in terms of judging economic growth performance of middle-income economies. However, as discussed in the previous section, despite an outstanding performance, there exist several economies that could not escape from the middle-income status due to their late start. For example, in Figure 2, Romania nearly makes up to the "graduates" list (the top of the middle quadrant), but remains in the middle-income status in 2014. Its per capita GDP with 4% average per capita GDP growth rate over the 1960–2014 period increased from 8% of the U.S. in 1960 to 39.8% in 2014 (Table 1). China is another example as its average per capita GDP growth rate was initially low but accelerated since the 1980s, when China embarked on an economic opening up and a series of reforms. China's strong economic growth over the past half-century contributed to the narrowing of the per capita income gap with advanced economies. Its per capita income relative to the U.S. increased from 6.7% of that of the U.S. in 1960 to 23.9% in 2014.

[Table 1 here]

Thus, we classify middle-income economies into "convergence successes" and "non-successes," based on their speed of transition to the high-income status. This classification is based on reasonable but somewhat arbitrary criteria. In order to be a convergence success, an economy must meet either of the two following conditions. First, if an economy has ever completed a transition from a middle-income to a high-income status over the period 1960-2014, it is identified as a convergence success. As identified in Figure 5, there are 14 economies in the convergence success group. They are listed in the upper panel of Table 1. For example, Korea from 1960 to 1992 and Chile from 1960 to 2010 are included in this group.

Second, a convergence success also refers to a middle-income economy that grew at an average annual growth rate of over 3% during the period 1960-2014, even though it did not advance to the high-income status by 2014. According to the benchmark scenario in Figure 3, a middle-income economy with 10% of the U.S. per capita income in 1960 and 4.2% average per capita income growth rate over the period 1960–2014 can reach only 32% of the U.S. level in 2014. However, this economy follows a "normal" convergence path and will reach 60% of the U.S. level in the steady-state. As long as an economy is on and above

a convergence path that will reach the high-income status in the steady-state, it can be regarded as a convergence success. Calibrations show that an economy growing at 3% average growth rate over the period 1960–2014 can reach 40% of the U.S. per capita income in the steady-state. According to this definition, nine economies (China, India, Indonesia, Mauritius, Panama, Romania, Sri Lanka, Thailand, and Tunisia) are classified as convergence successes, even though they did not advance to the high-income status by 2014. Most of these economies belong to the top 15 best-performers (Figure 1). In contrast, 52 middle-income economies that were in the middle-income category in 1960 did not graduate to the high-income by growing at below 3% annually over the period 1960–2014 (Table 2). These economies are classified into convergence non-successes. In this group, 36 economies, including Brazil and Mexico remained in the middle-income category over the period, while 16 economies, such as D.R. Congo and Senegal fell to the low-income category.

[Table 2 here]

As discussed in Section 2, the concept of convergence non-success is not identical to that of the middle-income trap. Convergence non-successes are slow-growing economies that were not able to transit to the high-income category over the period 1960–2014, and would be unlikely to do so in the future if they continued their historical convergence path. In contrast, the middle-income trap is defined as the episode of growth deceleration of the convergence non-successes during the sample period. In addition to convergence non-successes, success economies could also experience a significant decline in their per capita GDP growth rate as a consequence of the deterioration in growth factors that could shift the economy toward a low-growth convergence path.

More specifically, growth deceleration at time *t* is defined by an incident when an economy with an average per capita GDP growth rate of 3% or greater per annum over the 7 years prior to t undergoes a decrease in the average per capita GDP growth rate by 2 percentage points or more over at least 7 years after *t.* This criterion is symmetrically based on Hausmann et al. (2005)'s analysis of growth acceleration, which is defined by an increase in per capita GDP growth rate of at least two percentage points or more in an economy where the average growth rate is 3.5% or greater in the preceding period. Eichengreen et al. (2012) define the middle-income trap as a growth slowdown of at least 2 percentage points

from the 7-year average per capita GDP growth rate of 3.5% or greater in emerging market economies with per capita income greater than $10,000. We use 3% instead of 3.5% as a threshold for the average per capita GDP growth rate in the period prior to the growth deceleration, considering that the average growth rate in a normal convergence path can bes 3%. If in a number of consecutive years the criteria of a growth deceleration are met, we follow the methodology of Hausmann et al. (2005) and choose the timing of the initiation of the growth deceleration by the year, among all adjacent eligible dates, which maximizes the F-statistic of a spline regression with a break in the relevant year. We also define an independent episode of growth deceleration as long as its initiation date is more than 5 years apart from the proceeding episode. We also diagnose it as a growth deceleration when an economy experiences a decrease in the average per capita GDP growth rate by 2 percentage points or more over 6, 5, and 4 years after 2011, 2012, and 2013, respectively.[9]

Based on our definitions, we found 152 growth decelerations over the 1960–2014 period, which corresponds to 14% of the total sample.[10] We identify 89 growth decelerations for middle-income economies, among which, 32 episodes were experienced by convergence successes and 57 by convergence non-successes. Growth deceleration in the non-successes corresponds to the middle-income trap.

[Figure 6 here]

Figure 6 shows four examples of economies that experienced growth deceleration. China, an example of middle-income convergence success, underwent two growth decelerations in 1984 and 2007. Korea had four deceleration episodes, two in 1978 and 1991 as a middle-income economy and two as a high-income economy in 1996 and 2005. On the other hand, as a convergence non-success, Brazil experienced growth deceleration four times in 1960, 1975, 1980 and 2010. In Mexico, growth slowdown occurred only once in 1981, but caused a long and deep recession.

[Table 3 here]

Table 3 shows the break-down of the number and frequency of slowdown episodes by the 5-year time period and by income category. Income groups are classified based on the level

[9] The data on GDP growth rates over 2015-2017 are from the International Monetary Fund (2017).

[10] See the appendix table 1 for all growth deceleration episodes.

of relative per capita income of the initial year of each 5-year period. Frequency is measured as the ratio of deceleration episodes to the total number of observations in each income category. In our sample, the frequency of growth decelerations for the entire group of middle-income economies (17%) is not higher in comparison to high-income economies (19%), although it is higher than that of low-income economies (11%). Thus, it supports the hypothesis that middle-income economies are more likely to experience growth slowdowns than low-income economies, but the probability of experiencing growth deceleration is not particularly high in comparison to high-income economies. This finding contrasts to that of Aiyer et al. (2013), which finds that the relative frequency of growth decelerations for middle-income economies is significantly higher than that for low-income as well as high-income economies. They use the absolute income thresholds for income classification and different definitions to identify growth slowdowns. As observed in Table 3, the frequency of growth decelerations was higher for both middle-income and high-income economies over the 1970–85 and 2005–09 periods, in comparison to other periods, which must reflect the effects of adverse shocks, such as the oil and global financial crises. The frequency of growth deceleration episodes over the entire period was almost the same between middle-income successes (17%) and middle-income non-successes (18%). Note that the total number of observations for the convergence-success group (and thus for middle and high-income categories) changed over time, as convergence-successes advanced to a high-income category. Once a convergence success economy reaches a high-income category, their growth decelerations (such as Korea's slowdowns in 1996 and in 2005 in Figure 6) are classified in the high-income category.

[Figure 7 here]

Figure 7 presents the frequency of growth decelerations for the middle-income economies and all economies over a period of time by the level of per capita GDP relative to the U.S. at the beginning of each 5-year period. The sample of middle-income economies consists of economies that belong to the middle-income category by their relative income since 1960, and their initial levels of per capita GDP in each period changes, often below 5% or above 40% of the U.S. income. We do not observe a clear pattern where the relative frequency of growth deceleration is higher when the relative income approaches the upper middle-income range. Hence, the result does not support the middle-income trap hypothesis. That is, there is no evidence that the transition to a high-income status (conditional on having

achieved upper middle-income status) is more challenging than the transition from lower-income to upper-income level in other stages of development. A middle-income trap can occur in any level of middle-income, but it is not particularly prevailing when an economy transitions from an upper middle-income status to a high-income status. The figure also shows that in the sample of all economies, the frequency of growth decelerations declines with the relative income level. It indicates that a low-growth trap can occur more frequently in low-income or lower middle-income status than in upper middle-income or high-income status.

4. Determinants of Convergence Success and Middle-Income Trap

This section explores the major factors that can best explain convergence success and growth deceleration of the middle-income economies over the past half-century. The empirical strategy is to identify the factors that are statistically significantly associated with the probability of an economy being a convergence success or falling into the middle-income trap.

The regression applies to a panel set of cross-country data for 75 economies over 10 five-year periods from 1965 to 2014, corresponding to the 1965–1969, 1970–1974, 1975– 1979, 1980–1984, 1985–1989, 1990–1994, 1995–1999, 2000–2004, 2004–2009, and 2010-2014 periods. Data at 5-year intervals are used as dependent variables, because the concepts of convergence success and middle-income trap are more applicable to the criterion of average growth rates over the certain time period and there are no annual observations for all the regressors. The sample begins from 1965 as some specifications include the difference of the explanatory variable from the previous period, and use lagged values of the explanatory variable as instruments in the instrumental variable (IV) estimation. In the probit regression for convergence success, the dependent variable equals one if a middle-income economy remains in the path of convergence success over the 5-year period. For the analysis of the middle-income trap, the dependent variable equals one if an economy has experiences of falling into the middle-income trap during the specific 5-year period. Once a middle-income economy graduates to a high-income status, we exclude those country-period observations from the sample.

In the empirical specification, we control an economy's per capita GDP relative to the U.S. at the beginning of the period *t*, following the specification of conditional convergence equation

(3), and then observe if there are other factors that determine the probability of an economy experiencing convergence success or middle-income trap. In addition, the regressions include period dummies to control for the common effects of global shocks in all economies.

As the incidence of convergence success or middle-income trap is a binary-choice variable, we use a probit regression model.[11] Hausmann et al. (2005) and Aiyer et al. (2013) adopt probit regressions to identify the determinants of growth acceleration and slowdowns, respectively. We also adopt IV estimation techniques to control for the endogeneity of the explanatory variables, by using lagged values of the explanatory variables as IVs.

As found in the empirical growth literature, several external environmental and policy factors are related to the economic growth and convergence of middle-income economies. These factors include investment, human capital, demographic factors, fertility, international trade, government policies, and quality of institutions (Barro and Sala-i-Martin, 2004). Recent studies, such as Barro (2016) and Lee (2016, 2017), show that these factors contributed to the strong economic growth and convergence processes of China and Korea over the past half-century.

Any factor influencing an economy's convergence success probability positively can also affect its probability of escaping from the middle-income trap. In addition, middle-income economies could face particular challenges when they advance to the high-income status as their growth strategies that were successful until then may continue to work under new circumstances. Recent papers highlighted the critical factors that trigger or prevent the middle-income trap (Eichengreen et al., 2012; Aiyar et al., 2013; Agénor 2017; Bulman et al., 2017; World Bank, 2017). They emphasize on resource reallocation across industries to facilitate continuous product diversification and sophistication, which are important to sustain productivity growth and export competitiveness. Some studies highlight the role of human capital and institutional capacity for enabling efficient resource allocation and industrial upgrading. Eichengreen et al. (2013) show that growth slowdowns occur less frequently in economies with a large share of the population with higher secondary and tertiary education, and a large share of high technology exports. Aiyar et al. (2013) show that variables related to

[11] The main results do not significantly change qualitatively if, in order to consider the panel data structure, the specification allows for within-country correlation of the disturbance terms over the period. Fixed-effects estimation technique— either with or without IVs— is not applicable to this probit specification and data structure.

institutions, demography, infrastructure, macroeconomic environment, and economic and trade structures are important determinants for growth slowdowns. Bulman et al. (2017) find that macroeconomic management, income equality, and export-orientation are positively associated with the probability of an economy escaping from the middle-income trap.

We categorize our explanatory variables into four broad categories—demographics and human capital, institutions, macroeconomic environment and policies, and economic and industry structure. We include the explanatory variables that are commonly found in the previous literature, as shown in Tables 4 and 5.[12]

Column (1) of Table 4 reports the results of the probit estimation for the probability of an economy becoming a convergence success. The regression includes each explanatory variable while controlling for per capita GDP relative to the U.S. and the period dummies. The specification includes only the level term as the difference term is always statistically insignificant in all the regressions, when it is considered together with the level term. We find that the probability of convergence success is strongly associated with demographic and human capital variables, including average years of schooling, fertility, life expectancy, and dependency ratio. Convergence successes also tend to better maintain the rule-of-law, low inflation, free international trade, a high investment rate, low price of investment goods, and low public debt in comparison to non-successes. In addition, higher levels of financial opening, foreign direct investment (FDI) inflows, manufacturing exports, high-technological exports, and patents are also presented as important in being a convergence success.

[Table 4 here]

Column (2) of Table 4 shows that the results in Column (1) change very little in IV estimation. Thus, the close bivariate relationship does not appear to come from reverse causality or omitted variables.

[Table 5 here]

Column (1) of Table 5 reports the results of probit estimation for the probability of an economy falling into a middle-income trap. The specifications for the investment rate,

[12] Appendix Table 2 presents data sources and summary statistics of the variables.

regulation,[13]FDI inflows and financial openness include the difference terms, in addition to the level, of the explanatory variables, as they are statistically significant. The results show that higher levels of fertility and dependency ratio tend to increase the probability of the economy being trapped in the middle-income status. Manufacturing export and high-technology exports are negatively associated with the probability of a middle-income trap. Thus, these demographics, human capital, and export variables are important factors for achieving convergence success and escaping from a middle-income trap.

In contrast to the regression for convergence success, the investment rate is identified to be statistically insignificant for the probability of the middle-income trap, while the price of investment goods appears significantly positive. Interestingly, the change of investment rate, with its level fixed, is positively associated with the probability of a middle-income trap.

Similarly, changes in the level of regulatory restraints, FDI inflows and financial opening are also statistically significant and positive, while their levels have insignificant effects. Hence, rapid increases in the levels of investment, deregulation, FDI inflows and financial opening can increase the probability of falling into a middle-income trap. This may reflect that middle-income countries have often suffered financial crises following investment boom, hasty deregulation, and rapid financial opening.

Column (2) of Table 5 presents the results of the IV estimation.[14] It shows that most of the binary relationships in column (1) remain unchanged after controlling for the endogeneity of explanatory variables. Two notable exceptions are terms-of-trade and FDI inflow variables. The estimated coefficient of terms-of-trade is positive and statistically significant in column (1), but becomes negative and statistically significant with the IV estimation in column (2). It may indicate that when controlled for the endogeneity, the improvement in terms-of-trade is more likely to reduce the probability of falling into a middle-income trap. With the IV estimation, the level of FDI inflow variable becomes positive and statistically significant, while its difference term is still positive but statistically insignificant. Since both level and difference terms are jointly statistically significant, the rapid increase of FDI inflow to an

[13] The index of regulation, sourced from Gwartney et al. (2016), focuses on regulatory restraints that limit the freedom of exchange in credit, labor, and product markets. The higher value indicates lesser degree of restraints.

[14] For the probit IV regressions of regulation, investment share and financial openness, in which both the average level and change of the variable over the previous period are included, we use lagged values of the average level and own values of the changes over the previous period as IVs.

undesirable level seems to raise the probability of falling into a middle-income trap.

The probit results in Tables 4 and 5 indicate that some explanatory variables have statistically significant relationships with the probability of convergence success or middle-income trap, when we include only the initial relative income, period dummies, and one other explanatory variable at a time as regressors. We also examine whether the bivariate relationship holds when the explanatory variables are included jointly.

[Table 6 here]

The results of the probit regressions for convergence success are presented in Table 6. Column (1) of Table 6 shows the probit regressions without IVs. The explanatory variables include the initial relative income, average years of schooling, rule-of-law, international trade openness, investment rate, price level of investment and patent. Unfortunately, the inclusion of several variables reduces the sample size significantly. Nonetheless, the major results hold robust in this specification. The result supports the positive effects of average years of schooling, better maintenance of rule-of-law, low price of investment goods, and higher levels of international trade openness and patent.

Column (2) of Table 6 shows the probit regression with IVs for the probability of convergence success. Note that the number of observations shrinks as lagged values are used as IVs. They show that the major results in column (1) are similar in the IV estimation that controls the possible endogeneity of the explanatory variables. The Wald test statistic shows that we cannot reject the null hypothesis of no endogeneity of the instrumented variables.

[Table 7 here]

We also execute probit regressions for the probability of middle-income trap when the major explanatory variables are included jointly. Column (1) of Table 7 presents the probit results without IVs and column (2) presents the IV estimation results. The result in column (1) shows that a high investment rate, high investment goods price, low trade openness, and a low level of high-technology exports are significantly and positively associated with the probability of an economy falling into a middle-income trap. In this specification, average

years of schooling, dependency rate and rule-of-law are included, and these variables are statistically insignificant.

The results of the probit regression with IVs are presented in column (2) of Table 7. Here, investment rate and investment goods price become statistically insignificant. But, the estimated coefficient on change in investment rate is positive and statistically significant, indicating that a rapid expansion in investments can cause an economy to fall in the "middle-income trap."

5. Concluding Remarks

This paper investigated the economic growth experiences of middle-income economies over the past half-century, by focusing on episodes of convergence successes and middle-income trap. Among the sample of 110 economies for which GDP data are available for the 1960–2014 period, we identified 14 middle-income economies that graduated to the high-income status, 9 middle-income economies showed strong growth as convergence successes, and 52 middle-income economies were diagnosed as convergence non-successes. Furthermore, a middle-income trap was defined as an episode of growth deceleration that occurred only to convergence non-successes over a certain period of time. This analysis found no clear pattern that the relative frequency of growth deceleration was higher when the relative income approached the upper middle-income range, thereby refuting the middle-income trap hypothesis.

Further, this paper explored the causes of differences in growth experiences among the middle-income economies. Convergence successes in comparison to non-successes, tend to maintain sound policy factors, including strong human capital, effective rule-of-law, a high investment rate, low investment good price, high trade openness, and also achieve industrial upgrading, as indicated by higher levels of high-technology manufacturing exports and patent. In contrast, non-successes in the middle-income trap tend to have weak demographic factors, high investment goods price, low trade openness, lower level of manufacturing exports and high- technology exports, rapid investment expansion, hasty deregulation and hurried financial opening.

As observed from historical experiences, many middle-income economies underwent growth slowdowns following rapid economic growth. They grew fast at the early stage of

economic development, but their further economic growth was increasingly hindered by slower pace of convergence, structural problems and stagnant productivity growth. Thus, a smooth transition to a high-income status of an economy hinges critically on whether it continues to maintain strong convergence by adopting sound policies and institutions, and successfully improves productivity, while carefully managing macroeconomic and financial vulnerabilities.

REFERENCES

Abbas, S.M., Belhocine, N., ElGanainy, A.A., Horton, M., 2010. A historical public debt database. IMF Working Paper No.10/245.

Abiad, A., Detragiache, E., Tressel, T., 2010. A new database of financial reforms. IMF Staff Papers, 57(2), 281–302.

Acemoglu, D., 2009. Introduction to Modern Economic Growth. Princeton University Press.

Agénor, P.R., 2017. Caught in the middle? The economics of middle-income traps. Journal of Economic Survey. 31(3), 771–791

Aiyar, S., Duval, R., Puy, D., Wu, Y., Zhang, L., 2013. Growth slowdowns and the middle-income trap. IMF Working Paper 13/71. Washington, D. C.: IMF.

Barro, R.J., 1991. Economic growth in a cross section of countries, The Quarterly Journal of Economics, 106(2), 407–443.

Barro, R. J., 2015. Convergence and modernization, Economic Journal, 122(585), 911–942.

Barro, R.J., 2016. Economic growth and convergence, applied especially to China. China & World Economy, 24(5), 5–19.

Barro, R.J., Lee, J.W., 2013. A new data set of educational attainment in the world, 1950–2010. Journal of Development Economics, 104, 184–198.

Barro, R.J., Sala-i-Martin, X., 2004. Economic Growth, 2nd eds. Cambridge, MA: MIT Press.

Ben-David, D., Papell, D., 1998. Slowdowns and meltdowns: postwar growth evidence from 74 countries. Review of Economics and Statistics, 80(4), 561–571.

Bulman, D., Eden, M., Nguyen, H., 2017. Transitioning from low-income growth to high-income growth: is there a middle-income trap?. Journal of the Asia Pacific Economy, 22(1), 5–28.

Chinn, M., Ito, H., 2006. What matters for financial development? capital controls, institutions, and interactions. Journal of Development Economics, 81(1), 163–92.

Doner, R.F., Schneider, B.R., 2016. The middle-Income trap: more politics than economics. World Politics, 68(4), 608–644.

Easterly, W., Kremer, M., Pritchett, L., Summers, L.H., 1993. Good policy or good luck?. Journal of Monetary Economics 32(3), 459-483.

Eichengreen, B., Park, D., Shin, K., 2012. When fast-growing economies slow down: International evidence and implications for China. Asian Economic Papers. 11(1), 42–87.

Feenstra, R.C., Inklaar, R., Timmer, M., 2015. The next generation of the Penn World Table. American Economic Review, 105(10), 3150–3182.

Felipe, J., Kumar, U., Galope, R., 2017. Middle-income transitions: trap or myth?. Journal of the Asia Pacific Economy, 22, 1–25.

Freedom House, 2016. Freedom in the World. Washington D.C.: Freedom House.

Gerschenkron, A., 1962. Economic Backwardness in Historical Perspective: a Book of Essays. Cambridge, MA: Belknap Press of Harvard University Press.

Gill, I., Kharas, H., 2007. An East Asian Renaissance–Ideas for Economic Growth. Washington, DC: World Bank.

Glawe, L., Wagner, H., 2016. The middle-income trap: definitions, theories and countries concerned—a literature survey. Comparative Economic Studies, 58(4), 507–538.

Gwartney, J., Lawson, R., Norton, S., 2016. Economic Freedom of the World 2016 Annual Report. The Fraser Institute.

Han, X., Wei, S.J., 2017. Re-examining the middle-income trap hypothesis (MITH): What to reject and what to revive?. Journal of International Money and Finance, 73, 41–61.

Hausmann, R., Prichett, L., Rodrik, D., 2005. Growth accelerations. Journal of Economic Growth 10, 303–329

Im, F.G., Rosenblatt, D., 2015. Middle-income traps: a conceptual and empirical survey. Journal of International Commerce, Economics and Policy, 6(3), 1–39.

International Monetary Fund, 2017. The World Economic Outlook (WEO) database. Washington D.C.: IMF. http://www.imf.org/external/pubs/ft/weo/2017/01/weodata/index.aspx (accessed 18 August 2017).

Ito, T., 2017. Growth convergence and the middle-income trap. Asian Development Review, 34(1), 1–27.

Laeven, L., Valencia, F., 2013. Systemic banking crises database. IMF Economic Review, 61(2), 225–270.

Lee, J.-W., 2016, Korea’s economic growth and catch-up: implications for China. China & World Economy, 24(5), 71-97.

Lee, J.-W., 2017. China's economic growth and convergence. World Economy, 40(11), 2455-2474.

Maddison, A., 2010. Historical statistics of the world economy: 1-2008 AD. http://www.ggdc.net/maddison/oriindex.htm.

Quah, Danny, 1997. Empirics for growth and distribution: stratification, polarization, and convergence, Journal of Economic Growth, 2(1), 27-59..

Romer, P.M., 1990. Endogenous technological change. Journal of Political Economy, 95(5), S71–S102.

United Nations, Department of Economic and Social Affairs, Population Division, 2017. World population prospects: The 2017 revision, key findings and advance tables, Working Paper ESA/P/WP.248. New York: United Nations.

Woo, W.T., 2012. The major types of middle-income trap that threaten China. In Woo, W.T., Lu, M., Sachs, J.D., Chen, Z. (Eds.), A New Economic Growth Engine for China: Escaping the Middle-income Trap by Not Doing More of the Same. Singapore: World Scientific Publishing Company and London: Imperial College Press.

World Bank, 2016. World Development Indicators. Washington D.C.: World Bank. http://data.worldbank.org/data-catalog/world-development-indicators (accessed 17 May 2017).

World Bank, 2017. World Development Report. Washington D.C.: World Bank.

World Bank and the Development Research Center of the State Council, P.R. China (DRC), 2013. China 2030: Building a modern, harmonious, and creative society. Washington, D.C.: World Bank.

World Intellectual Property Organization, 2016. World Intellectual Property Indicators 2016. Geneva: World Intellectual Property Organization.

Ye, L., Robertson, P.E., 2016. On the existence of a middle-income trap. Economic Record, 92(297), 173–189.

Zhuang, J., Vandenberg, P., Huang, Y., 2015. The middle-income transition challenge: an introduction. In Zhuang, J., Vandenberg, P., Huang, Y. (Eds.), Managing the Middle-income Transition—Challenges Facing the People's Republic of China (3–24). Cheltenham, UK: Edward Elgar and Asian Development Bank.

Appendix: Convergence Equation

Let us consider the basic Solow model with constant population (labor force) growth *n*, saving rate *s*, depreciation δ, and labor-augmenting technological growth *x* in continuous time. The changes in output and capital stock over time are given by the following equations:[15]

$$\mathrm{y(t)} = \mathrm{A(t)k(t)}, \qquad \text{(A.1)}$$

and

$$\frac{\mathrm{dk(t)}}{\mathrm{k(t)}} = \frac{\mathrm{sf(k(t))}}{\mathrm{k(t)}} - (n + \delta + x), \qquad \text{(A.2)}$$

where $\mathrm{y(t)} \equiv \mathrm{Y(t)/L(t)}$ is per-worker output, $\mathrm{A(t)}$ is labor-augmenting technological term and its growth rate is given by x, and $\mathrm{k(t)} \equiv \mathrm{K(t)/A(t)L(t)}$ is the capital stock per effective labor.

Further, applying a first-order Taylor expansion (A.3) with respect to $\mathrm{k(t)}$ around the steady-state value k^*, the steady-state value k^* satisfies

$$\mathrm{sf(k^*)} = (s + \delta + x)k^*. \qquad \text{(A.4)}$$

Using that approximation and (A.1), we derive a convergence equation for $\mathrm{y(t)}$ as follows:

$$\begin{aligned}\frac{\mathrm{dy(t)}}{\mathrm{y(t)}} &= x - \big(1 - \alpha(k^*)\big)(n + \delta + x)(\log y(t) - \log y^*) \\ &= x - \beta \log\left(\frac{y(t)}{y^*}\right), \qquad \text{(A.5)}\end{aligned}$$

where $\alpha(k^*)$ is the elasticity of output with respect to capital around the steady-state value k^* and $\beta \equiv \big(1 - \alpha(k^*)\big)(n + \delta + x)$ is the speed of convergence measuring how fast the economy reduces the gap in per worker output between the current and the steady-state levels.

We can rewrite the convergence equation in terms of it being relative to that of the U.S. as follows:

$$\frac{\mathrm{dy(t)}}{\mathrm{y(t)}} = x + \beta \log\left(\frac{y^*}{y_{US}(t)}\right) - \beta \log\left(\frac{y(t)}{y_{US}(t)}\right). \qquad \text{(A.6)}$$

[15] See Barro and Xala-i-Martin (2004, chapter 1) and Acemoglu (2009, chapter 3).

Appendix Table 1: Episodes of Growth Deceleration and Magnitude of Deceleration

Country	Year	Real per capita GDP relative to the U.S.	Real per capita GDP (2011 PPP$)	Growth rate before	Growth rate after	Difference in growth rates
Middle-Income Success						
Chile	1981	0.250	7311	0.0403	0.0068	-0.0335
	1997	0.274	11577	0.0641	0.0184	-0.0458
China	1984	0.065	2051	0.0562	0.0280	-0.0282
	2007	0.152	7858	0.0903	0.0686	-0.0216
Cyprus	1972	0.327	8262	0.0699	0.0485	-0.0214
Indonesia	1996	0.115	4708	0.0593	-0.0022	-0.0615
Korea	1978	0.183	5298	0.0853	0.0590	-0.0263
	1991	0.371	13361	0.0857	0.0570	-0.0286
Malaysia	1974	0.196	5059	0.0766	0.0503	-0.0263
	1981	0.236	6894	0.0503	0.0136	-0.0367
	1997	0.309	13049	0.0640	0.0198	-0.0442
Malta	1980	0.355	10194	0.1156	0.0089	-0.1067
Mauritius	1975	0.186	4741	0.0427	0.0178	-0.0249
	1989	0.239	8644	0.0591	0.0364	-0.0227
Panama	1971	0.228	5505	0.0664	0.0041	-0.0623
	1981	0.219	6399	0.0335	-0.0050	-0.0385
Portugal	1973	0.373	9891	0.0707	0.0205	-0.0502
Romania	1975	0.175	4445	0.0896	0.0478	-0.0419
	1980	0.216	6186	0.0736	0.0268	-0.0469
	1985	0.215	7032	0.0323	-0.0488	-0.0811
	2008	0.315	15874	0.0723	0.0176	-0.0548
Singapore	1973	0.295	7835	0.1048	0.0607	-0.0442
Spain	1966	0.396	8781	0.0790	0.0502	-0.0289
Sri Lanka	1970	0.127	2987	0.0386	0.0141	-0.0246
	1983	0.073	2169	0.0414	0.0204	-0.0209
Thailand	1970	0.096	2257	0.0743	0.0371	-0.0371
	1975	0.099	2520	0.0681	0.0478	-0.0203
	1995	0.202	7988	0.0779	0.0013	-0.0766
Tunisia	1972	0.123	3102	0.0777	0.0347	-0.0429
	1980	0.149	4284	0.0392	0.0063	-0.0329
	2008	0.196	9907	0.0402	0.0079	-0.0323
Middle-Income Non-Success						
Algeria	1979	0.348	10266	0.0379	0.0105	-0.0274
	2005	0.230	11604	0.0338	0.0098	-0.0240
Argentina	1971	0.170	4100	0.0307	0.0051	-0.0256
	1995	0.302	11978	0.0313	-0.0130	-0.0443
	2011	0.405	20225	0.0476	0.0001	-0.0475
Bolivia	1967	0.084	1878	0.0318	0.0009	-0.0309
	1977	0.077	2134	0.0322	-0.0354	-0.0676
Brazil	1960	0.140	2463	0.0470	0.0110	-0.0361
	1975	0.192	4871	0.0760	0.0226	-0.0534
	1980	0.189	5410	0.0419	0.0069	-0.0350

Country	Year	Real per capita GDP relative to the U.S.	Real per capita GDP (2011 PPP$)	Growth rate before	Growth rate after	Difference in growth rates
	2010	0.272	13514	0.0305	-0.0100	-0.0404
Cabo Verde	1971	0.060	1461	0.0779	-0.0248	-0.1027
	1987	0.057	1968	0.0380	0.0151	-0.0228
	2008	0.109	5490	0.0537	0.0042	-0.0495
Cameroon	1979	0.072	2138	0.0555	0.0192	-0.0363
	1984	0.095	3016	0.0360	-0.0633	-0.0993
Chad	1987	0.039	1330	0.0324	-0.0044	-0.0367
	2007	0.033	1704	0.0880	0.0339	-0.0541
	2013	0.039	1981	0.0372	-0.0209	-0.0581
Comoros	1967	0.083	1876	0.0649	0.0034	-0.0616
Costa Rica	1974	0.240	6192	0.0421	0.0179	-0.0241
	1979	0.268	7893	0.0303	-0.0181	-0.0484
Cote d'Ivoire	1979	0.107	3166	0.0318	-0.0491	-0.0809
Dominican Republic	1963	0.153	2918	0.0369	0.0086	-0.0283
	1976	0.158	4229	0.0652	0.0200	-0.0452
	1998	0.166	7269	0.0437	0.0206	-0.0231
Ecuador	1975	0.171	4355	0.0726	0.0265	-0.0461
	1980	0.201	5767	0.0368	-0.0106	-0.0473
Fiji	1973	0.163	4314	0.0569	0.0175	-0.0394
	1994	0.156	6069	0.0333	0.0126	-0.0207
Gabon	1976	0.378	10100	0.1498	-0.0603	-0.2101
Ghana	2013	0.072	3716	0.0559	0.0179	-0.0380
Guatemala	1978	0.131	3793	0.0302	-0.0274	-0.0576
Honduras	1979	0.099	2926	0.0318	-0.0167	-0.0485
	2008	0.078	3952	0.0362	0.0146	-0.0215
Jamaica	1960	0.270	4760	0.0596	0.0206	-0.0391
	1972	0.263	6654	0.0308	-0.0358	-0.0666
	1993	0.139	5250	0.0430	-0.0082	-0.0512
Jordan	1965	0.190	3992	0.0506	-0.0498	-0.1004
	1982	0.153	4354	0.0998	-0.0311	-0.1310
	2009	0.197	9605	0.0378	-0.0042	-0.0420
Mauritania	1970	0.104	2448	0.0921	0.0120	-0.0801
	2007	0.054	2801	0.0365	0.0142	-0.0224
Mexico	1981	0.439	12826	0.0396	-0.0195	-0.0592
Morocco	1964	0.111	2212	0.0759	0.0171	-0.0589
	1977	0.092	2556	0.0363	0.0057	-0.0306
Namibia	1967	0.232	5216	0.0462	0.0248	-0.0214
Nicaragua	1967	0.285	6398	0.0613	0.0121	-0.0492
Nigeria	1963	0.207	3960	0.0372	-0.0356	-0.0729
	1977	0.256	7068	0.0427	-0.0458	-0.0885
	2008	0.088	4452	0.0584	0.0264	-0.0320
	2013	0.105	5388	0.0324	-0.0096	-0.0420
Pakistan	1970	0.076	1798	0.0413	0.0113	-0.0300
	2007	0.069	3583	0.0333	0.0091	-0.0242

Country	Year	Real per capita GDP relative to the U.S.	Real per capita GDP (2011 PPP$)	Growth rate before	Growth rate after	Difference in growth rates
Paraguay	1981	0.126	3690	0.0703	-0.0097	-0.0800
Peru	1966	0.148	3283	0.0373	0.0116	-0.0257
	1997	0.120	5084	0.0358	0.0137	-0.0221
	2013	0.213	10914	0.0479	0.0216	-0.0264
Philippines	1979	0.100	2959	0.0315	-0.0300	-0.0615
Rep. of Congo	1973	0.056	1487	0.0702	-0.0022	-0.0724
	1984	0.121	3822	0.1002	-0.0281	-0.1284
Rep. of Iran	1964	0.132	2639	0.0561	0.0000	-0.0560
	1969	0.147	3503	0.0756	0.0104	-0.0652
	1977	0.262	7244	0.0462	-0.0766	-0.1228
	2006	0.293	15068	0.0431	0.0080	-0.0351
	2011	0.366	18264	0.0334	-0.0030	-0.0364
Rwanda	1981	0.044	1275	0.0504	-0.0217	-0.0721
South Africa	1969	0.321	7675	0.0309	0.0102	-0.0208
	2008	0.227	11436	0.0305	0.0081	-0.0223
Syria	1976	0.158	4211	0.0651	0.0247	-0.0405
	1981	0.088	2563	0.0396	-0.0219	-0.0615
	1998	0.027	1206	0.0445	0.0137	-0.0309
Tanzania	1968	0.071	1664	0.0502	0.0070	-0.0432
Togo	1971	0.064	1553	0.0378	-0.0053	-0.0431
Turkey	1976	0.331	8824	0.0349	-0.0063	-0.0412
	2007	0.282	14568	0.0440	0.0213	-0.0227
Zambia	1968	0.168	3934	0.0658	-0.0137	-0.0795
	2013	0.071	3643	0.0477	0.0049	-0.0428
Zimbabwe	1972	0.110	2780	0.0550	-0.0384	-0.0934
	2013	0.035	1813	0.1096	-0.0097	-0.1194
High-Income						
Australia	1970	0.812	19162	0.0344	0.0134	-0.0210
Austria	1960	0.531	9348	0.0591	0.0345	-0.0246
	1974	0.637	16441	0.0511	0.0268	-0.0243
Barbados	1971	0.609	14718	0.0818	0.0016	-0.0802
Belgium	1974	0.756	19512	0.0495	0.0216	-0.0278
Cyprus	1980	0.434	12459	0.0640	0.0436	-0.0204
	1990	0.572	20808	0.0519	0.0256	-0.0263
Denmark	1969	0.802	19139	0.0417	0.0162	-0.0255
	1987	0.753	25756	0.0314	0.0112	-0.0202
Finland	1974	0.687	17729	0.0561	0.0257	-0.0305
	1989	0.704	25509	0.0320	-0.0045	-0.0364
	2004	0.707	34936	0.0319	0.0047	-0.0271
France	1974	0.759	19572	0.0457	0.0239	-0.0218
Germany	1960	0.583	10265	0.0659	0.0323	-0.0336
Greece	1973	0.490	12987	0.0799	0.0266	-0.0533
	1978	0.484	14013	0.0320	-0.0058	-0.0378
	2007	0.600	31023	0.0376	-0.0507	-0.0883

Country	Year	Real per capita GDP relative to the U.S.	Real per capita GDP (2011 PPP$)	Growth rate before	Growth rate after	Difference in growth rates
Hong Kong SAR	1988	0.641	22627	0.0599	0.0382	-0.0217
	1994	0.800	31170	0.0399	0.0020	-0.0379
	2007	0.927	47974	0.0505	0.0211	-0.0294
Iceland	1981	0.992	29022	0.0456	0.0232	-0.0224
	2007	0.859	44442	0.0357	-0.0091	-0.0448
Ireland	2002	0.840	39590	0.0755	0.0134	-0.0621
	2007	0.961	49726	0.0330	-0.0067	-0.0397
Israel	1960	0.495	8710	0.0617	0.0356	-0.0260
	1974	0.647	16700	0.0673	0.0095	-0.0578
Italy	1974	0.576	14865	0.0525	0.0306	-0.0219
Japan	1968	0.457	10672	0.0800	0.0486	-0.0314
	1973	0.589	15608	0.0775	0.0277	-0.0498
	1990	0.744	27081	0.0451	0.0110	-0.0342
Korea	1996	0.491	20005	0.0723	0.0463	-0.0260
	2005	0.557	28119	0.0518	0.0305	-0.0213
Luxembourg	1974	1.258	32464	0.0453	0.0077	-0.0377
	1991	1.316	47357	0.0614	0.0190	-0.0424
	2002	1.492	70297	0.0445	0.0149	-0.0295
Malta	2000	0.522	24406	0.0425	0.0170	-0.0256
Netherlands	1974	0.836	21569	0.0410	0.0134	-0.0275
	2000	0.864	40395	0.0335	0.0129	-0.0206
New Zealand	1966	0.775	17176	0.0380	0.0155	-0.0224
Portugal	1991	0.424	15252	0.0536	0.0197	-0.0340
	2000	0.481	22466	0.0340	0.0063	-0.0277
Seychelles	1979	0.431	12727	0.0576	0.0000	-0.0577
	1990	0.419	15242	0.0573	0.0188	-0.0385
	1999	0.444	20210	0.0346	-0.0146	-0.0492
Singapore	1983	0.527	15585	0.0701	0.0468	-0.0233
	1994	0.668	26032	0.0621	0.0239	-0.0382
	2013	1.418	72744	0.0323	0.0084	-0.0239
Spain	1974	0.508	13102	0.0519	0.0063	-0.0457
	1990	0.486	17690	0.0367	0.0147	-0.0219
	2002	0.611	28800	0.0335	0.0117	-0.0218
Switzerland	1973	1.127	29888	0.0335	0.0011	-0.0324
Taiwan	1995	0.654	25898	0.0617	0.0390	-0.0227
Trinidad and Tobago	1961	0.471	8371	0.0835	0.0252	-0.0583
	1982	0.732	20771	0.0540	-0.0575	-0.1115
	2003	0.350	16771	0.0705	0.0406	-0.0298
	2008	0.684	34511	0.0776	-0.0009	-0.0785
United Kingdom	1989	0.672	24346	0.0379	0.0144	-0.0235
United States	1968	1.000	23352	0.0397	0.0180	-0.0217
Uruguay	1980	0.332	9518	0.0376	-0.0107	-0.0483
	1998	0.285	12491	0.0338	-0.0135	-0.0473
	2013	0.386	19806	0.0514	0.0136	-0.0378

Country	Year	Real per capita GDP relative to the U.S.	Real per capita GDP (2011 PPP$)	Growth rate before	Growth rate after	Difference in growth rates
Venezuela	1978	0.318	9223	0.0312	-0.0398	-0.0709
Low-Income						
Botswana	1974	0.057	1459	0.1248	0.0716	-0.0532
	1989	0.170	6174	0.0792	0.0191	-0.0601
	1994	0.169	6603	0.0590	0.0290	-0.0299
Burundi	1970	0.031	740	0.0359	0.0124	-0.0235
	2013	0.014	743	0.1056	-0.0315	-0.1371
Egypt	1985	0.056	1836	0.0662	0.0299	-0.0363
	2008	0.144	7253	0.0321	0.0072	-0.0250
El Salvador	1966	0.040	882	0.0316	0.0099	-0.0216
	1978	0.040	1159	0.0306	-0.0499	-0.0806
	1996	0.043	1760	0.0428	0.0207	-0.0221
Lesotho	1978	0.048	1382	0.0840	-0.0170	-0.1010
Malawi	1971	0.051	1231	0.0778	0.0286	-0.0493
	1976	0.048	1282	0.0525	-0.0055	-0.0581
	2011	0.022	1087	0.0341	0.0056	-0.0285
Mali	1977	0.021	584	0.0303	-0.0028	-0.0331
Mozambique	1999	0.013	606	0.0736	0.0498	-0.0238
Uganda	1969	0.037	894	0.0306	-0.0248	-0.0554
	2011	0.036	1787	0.0469	0.0133	-0.0336

Appendix Table 2: Summary Statistics of Variables in the Regression

Descriptions	Sources	Start year	Mean	Standard deviation.	No. of countries
Initial income relative to the U.S.	Feenstra et al. (2015), PWT 9.0	1965	0.13	0.09	75
Demographics and human capital					
Average years of schooling, total	Barro and Lee (2013)	1960	5.10	2.49	67
Total years of schooling, female	Barro and Lee (2013)	1960	4.59	2.70	67
Total years of schooling, male	Barro and Lee (2013)	1960	5.62	2.35	67
Fertility rate, total	United Nations (2017)	1960	5.03	1.74	75
Life expectancy	United Nations (2017)	1960	60.60	10.03	75
Dependency ratio (%)	United Nations (2017)	1960	81.05	16.75	75
Institutions and politics					
Rule of law (index)	Gwartney et al. (2016)	1970	4.48	1.40	69
Regulation (index)	Gwartney et al. (2016)	1970	5.64	1.24	70
Freedom to trade internationally (index)	Gwartney et al. (2016)	1970	5.19	2.02	70
Democracy indicator	Freedom House (2016)	1960	0.46	0.30	73
Macroeconomic environment and policies					
Investment share at current PPPs	PWT 9.0	1960	0.19	0.10	75
Price level of investment	PWT 9.0	1960	0.39	0.27	75
Government consumption share in GDP	PWT 9.0	1960	0.19	0.11	75
CPI inflation	World Bank, WDI	1960	2.22	1.05	73
Public debt to GDP ratio (%)	Abbas et al. (2010)	1960	58.07	55.11	70
External debt stocks (% of GNI)	World Bank, WDI	1970	61.41	64.00	61
Foreign direct investment inflows (% of GDP)	World Bank, WDI	1970	0.02	0.06	70
Banking crisis dummy	Laeven and Valencia (2013)	1960	0.40	0.27	75
Financial liberalization index	Abiad et al. (2010)	1970	0.19	0.10	44
Terms of trade change	World Bank, WDI	1960	-0.001	0.03	73
Economic and industry structure					
Agriculture share (% of GDP)	World Bank, WDI	1960	20.81	12.69	67
Industry share (% of GDP)	World Bank, WDI	1960	30.10	10.72	67
Services share (% of GDP)	World Bank, WDI	1960	49.13	10.67	67
Trade openness	PWT 9.0	1960	0.34	0.27	75
Financial openness	Chinn and Ito (2006)	1970	0.32	0.28	69
Manufacturing exports/total exports (%)	World Bank, WDI	1960	30.75	27.45	74
High technology exports (% of manufacturing exports)	World Bank, WDI	1985	7.91	11.97	63
High-technology exports (% of GDP)	World Bank, WDI	1985	1.57	5.12	63
Patent (thousands)	World Intellectual Property Organization (2016)	1980	2.62	27.44	63

Table 1. Convergence Success Stories

Sample: 75 Middle-Income Economies in 1960

Economy	Real per capita GDP relative to the U.S. in 1960	Real per capita GDP relative to the U.S. in 2014	Year the economy graduated to high-income	Average per capita GDP growth rate, during middle-income	Average per capita GDP growth rate, 1960–2014
		Graduated to High-Income			
Chile	0.290	0.413	2011	0.0243	0.0244
Cyprus	0.216	0.547	1979	0.0585	0.0343
Greece	0.275	0.497	1970	0.0760	0.0235
Hong Kong, China	0.213	0.991	1976	0.0564	0.0440
Ireland	0.368	0.933	1971	0.0381	0.0321
Japan	0.304	0.676	1967	0.0819	0.0327
Korea	0.067	0.671	1993	0.0665	0.0568
Malaysia	0.147	0.443	2011	0.0399	0.0398
Malta	0.128	0.605	1991	0.0558	0.0434
Portugal	0.238	0.545	1990	0.0423	0.0280
Seychelles	0.363	0.494	1979	0.0466	0.0323
Singapore	0.151	1.388	1980	0.0678	0.0499
Spain	0.326	0.648	1967	0.0693	0.0265
Taiwan	0.137	0.848	1986	0.0644	0.0555
		Not Graduated to High-Income			
China (PRC)	0.066	0.239	--	--	0.0451
India	0.059	0.100	--	--	0.0322
Indonesia	0.054	0.186	--	--	0.0336
Mauritius	0.205	0.343	--	--	0.0315
Panama	0.155	0.377	--	--	0.0338
Romania	0.080	0.398	--	--	0.0397
Sri Lanka	0.157	0.198	--	--	0.0374
Thailand	0.064	0.267	--	--	0.0470
Tunisia	0.090	0.198	--	--	0.0308

-- Not available

Notes: A convergence success refers to an economy that advanced from a middle-income status to a high-income status during the period 1960–2014, or an economy whose per capita GDP increased at an average annual growth rate over 3.0% over the period, even though it has not graduated to a high-income status.

Table 2. Convergence Non-Success Stories

Sample: 75 Middle-Income Economies in 1960

Economy	Real per capita GDP relative to the U.S. in 1960	Real per capita GDP relative to the U.S. in 2014	Average per capita GDP growth rate, 1960-2014	Economy	Real per capita GDP relative to the U.S. in 1960	Real per capita GDP relative to the U.S. in 2014	Average per capita GDP growth rate, 1960-2014
Stayed in the Middle-Income Category Until 2014							
Algeria	0.289	0.245	0.0102	Pakistan	0.068	0.089	0.0239
Argentina	0.182	0.387	0.0126	Paraguay	0.090	0.158	0.0214
Bangladesh	0.084	0.055	0.0150	Peru	0.146	0.210	0.0143
Bolivia	0.081	0.115	0.0098	Philippines	0.108	0.127	0.0163
Brazil	0.140	0.284	0.0228	Republic of Congo	0.057	0.085	0.0182
Cabo Verde	0.058	0.120	0.0272	South Africa	0.335	0.232	0.0094
Cameroon	0.071	0.051	0.0056	Syria	0.111	0.080	0.0103
Colombia	0.196	0.241	0.0216	Turkey	0.263	0.368	0.0247
Costa Rica	0.266	0.271	0.0222	Zambia	0.150	0.071	0.0050
Cote d'Ivoire	0.104	0.064	0.0045	*Fell from the Middle-Income Category to a Low-Income Category*			
Dominican Republic	0.141	0.239	0.0289	Benin	0.090	0.037	0.0117
Ecuador	0.149	0.210	0.0202	Central African Rep.	0.076	0.011	-0.0171
Fiji	0.160	0.151	0.0172	Chad	0.113	0.038	0.0087
Gabon	0.153	0.271	0.0200	Comoros	0.066	0.028	0.0080
Ghana	0.160	0.068	0.0096	D.R. Congo	0.138	0.023	-0.0196
Guatemala	0.137	0.131	0.0133	Gambia	0.097	0.030	-0.0013
Honduras	0.118	0.085	0.0108	Guinea	0.113	0.027	0.0009
Islamic Rep. of Iran	0.146	0.297	0.0022	Guinea-Bissau	0.052	0.024	-0.0036
Jamaica	0.270	0.142	0.0047	Haiti	0.071	0.030	-0.0066
Jordan	0.173	0.200	0.0095	Madagascar	0.073	0.024	-0.0086
Kenya	0.099	0.053	0.0074	Niger	0.078	0.016	-0.0081
Mauritania	0.065	0.065	0.0174	Rwanda	0.055	0.030	0.0116
Mexico	0.326	0.303	0.0169	Senegal	0.125	0.043	-0.0009
Morocco	0.079	0.137	0.0276	Tanzania	0.071	0.042	0.0156
Namibia	0.231	0.209	0.0134	Togo	0.055	0.026	0.0034
Nicaragua	0.254	0.085	0.0032	Zimbabwe	0.117	0.036	0.0079
Nigeria	0.226	0.105	0.0137				

Table 3. Distribution of Slowdown Episodes by Time Period

	1960 –64	1965 –69	1970 –74	1975 –79	1980 –84	1985 –89	1990 –94	1995 –99	2000 –04	2005 –09	2010 –14	Total
Middle-Income	6/75	11/73	18/70	21/65	16/60	3/58	3/49	7/44	0/38	13/40	7/44	105/616
Success	0/23	1/23	8/20	4/19	8/15	2/15	1/13	4/11	0/11	3/11	0/11	31/172
Non-Success	6/52	10/50	10/50	17/46	8/45	1/43	2/36	3/33	0/27	10/29	7/33	74/444
High-Income	4/23	4/23	14/26	3/27	5/31	4/31	8/33	4/35	8/35	7/35	2/35	63/334
Low-Income	0/12	2/14	3/14	4/18	1/19	3/21	1/28	3/31	0/37	2/35	5/31	24/260
Total	10	17	35	28	22	10	12	14	8	22	14	192
Slowdown Frequency (%)												
Middle-Income	8	15	26	32	27	5	6	16	0	33	16	17
Success	0	4	40	21	53	13	8	36	0	27	0	18
Non-Success	12	20	20	37	18	2	6	9	0	34	21	17
High-Income	17	17	54	11	16	13	24	11	23	20	6	19
Low-Income	0	14	21	22	5	14	4	10	0	6	16	9
Total	9	15	32	25	20	9	11	13	7	20	13	16

Note: The figures are the number and frequency of growth slowdown episodes, as defined in the text, based on 5-year time periods and income categories for the sample of 110 economies.

Table 4. Probit Regression for Convergence Success

	(1)			(2)		
	Probit			Probit IV		
Variable	Coefficien	S.E.	N.	Coefficien	S.E.	N
Demographics and human capital						
Average years of schooling	0.3397***	0.0407	596	0.3305***	0.0413	596
Fertility rate, total	-1.0917***	0.0945	669	-1.0876***	0.0954	669
Life expectancy	0.1306***	0.0104	669	0.1304***	0.0135	669
Dependency ratio	-0.0878***	0.0075	669	-0.0842***	0.0078	669
Institutions and politics						
Rule of law	0.3901***	0.0612	459	0.5908***	0.0986	390
Regulation	0.0700	0.0634	468	0.0332	0.0889	397
Freedom to trade internationally	0.1839***	0.0458	508	0.2233***	0.0781	431
Democracy indicator	0.1618	0.2063	633	0.0647	0.2660	605
Macroeconomic environment and policies						
Investment share	3.0849***	0.6532	669	2.9791***	0.7792	669
Price level of investment	-2.3144***	0.4926	669	-2.4684***	0.5712	669
Government consumption/GDP	-0.1536	0.6137	669	0.4874	0.7103	669
Log (1+CPI inflation)	-0.2736***	0.0738	584	-0.3786***	0.1598	554
Public debt/ GDP	-0.0061***	0.0023	565	-0.0077***	0.0031	519
FDI inflows/GDP	0.0538**	0.0272	538	0.1026	0.0671	468
Banking crisis dummy	-0.8056	1.0085	669	3.6107	8.1437	669
Financial liberalization index	0.0997	0.5378	316	-0.5321	0.7079	272
Terms of trade change	0.0014	1,8917	608	0.2957	21.131	545
Economic and industry structure						
Agriculture share in the GDP	-0.0133	0.0084	502	-0.0078	0.0093	456
Industry share in the GDP	0.0213***	0.0067	502	0.0226***	0.0081	456
Services share in the GDP	-0.0114*	0.0067	502	-0.0197**	0.0086	456
Trade openness	0.3941*	0.2198	669	0.5991*	0.3124	669
Financial openness index	0.6546***	0.2274	563	0.7888***	0.2862	494
Manufacturing exports/total exports	0.0222***	0.0027	565	0.0211***	0.0030	521
High technology exports/manu exports	0.0140**	0.0071	290	0.0132	0.0087	225
High technology exports/GDP	0.0720***	0.0228	288	0.0652***	0.0262	223
Patent	0.0720***	0.0228	348	0.2501***	0.0674	273

Notes: The dependent variable is a binary variable for being a convergence success. The regression applies to a panel set for 75 economies over 10 five-year periods from 1965 to 2014. The speciation includes each explanatory variable, while controlling for initial income relative to the U.S. and period dummies. The IV probit estimation technique uses the lagged values of the explanatory variable as IVs. ***, **, and * indicate statistical significance at 1 %, 5 %, and 10%, respectively.

Table 5. Probit Regression for Middle-Income Trap

	(1)			(2)		
	Probit			Probit IV		
Variable	Coefficien	S.E.	N.	Coefficien	S.E.	N
Demographics and human capital						
Average years of schooling	0.0114	0.0463	596	0.0269	0.0469	596
Fertility rate, total	0.1313**	0.0582	669	0.1330**	0.0656	669
Life expectancy	-0.0068	0.0097	669	-0.0082	0.0098	669
Dependency ratio	0.0151***	0.0056	669	0.0152**	0.0059	669
Institutions and politics						
Rule of law	-0.0671	0.0736	459	-0.1652	0.1287	390
Regulation (level, t)	-0.0243	0.0931	397	-0.0448	0.0971	397
Change of regulation (t-1)	0.2557**	0.1336		0.2685**	0.1338	
Freedom to trade internationally	-0.0371	0.0497	508	-0.0990	0.0742	431
Democracy indicator	-0.0369	0.2758	633	-0.6406	0.3528	605
Macroeconomic environment and policies						
Investment share (level, t)	0.4101	0.8196	669	0.0140	0.9687	669
Change of investment share (t-1)	3.8894***	1.3192		4.2587***	1.4110	
Price level of investment	0.8765***	0.2961	669	0.6452***	0.4071	669
Government consumption/GDP	0.1875	0.6624	669	-0.4070*	0.8761	669
Log (1+CPI inflation)	0.0425	0.0850	584	0.2006*	0.1193	554
Public debt/ GDP	-0.0052*	0.0029	565	-0.0035	0.0029	519
FDI inflows/ GDP	0.0200	0.0360	434	0.1106**	0.0560	434
	0.0426*	0.0246		0.0326	0.0269	
Banking crisis dummy	-0.4069	1,4035	669	7.1922	11.771	669
Financial liberalization index	-0.0117	0.8030	316	0.6133	0.9829	272
Terms of trade change	4.8166**	2.3451	608	-20.574***	7.1740	545
Economic and industry structure						
Agriculture share in the GDP	-0.0060	0.0090	502	0.0068	0.0100	456
Industry share in the GDP	-0.0012	0.0084	502	-0.0042	0.1060	455
Services share in the GDP	0.0063	0.0084	502	-0.0053	0.1060	456
Trade openness	0.0877	0.2608	669	-0.6819	0.7076	669
Financial openness index (level, t)	-0.5763	0.3606	481	-0.5024	0.4021	481
Change of financial openness (t-1)	1.1971*	0.4863		1.1778**	0.4879	
Manufacturing exports/total exports	-0.0087**	0.0036	565	-0.0067*	0.0038	521
High technology exports/manu exports	-0.0603**	0.0335	290	-0.0621*	0.0033	225
High technology exports/GDP	-1.3692**	0.7020	288	-0.6749	0.6791	223
Patent	-0.0086	0.0228	348	-0.0330	0.0909	273

Notes: The dependent variable is a binary variable falling into a middle-income trap. The regression applies to a panel set for 75 economies over 10 five-year periods from 1965 to 2014. The speciation includes each explanatory variable, while controlling for initial income relative to the U.S. and period dummies, except for regulation, investment share, FDI inflows and financial openness in which both the average level and change of the variable over the previous period are included. The IV probit estimation uses the lagged values of the explanatory variable as IVs. ***, **, and * indicate statistical significance at 1 %, 5 %, and 10%, respectively.

Table 6. Probit Regressions with Multiple Regressors for Convergence Success

	(1)		(2)	
	Probit		Probit IV	
Variable	Coefficient.	S.E.	Coefficient	S.E.
Income relative to the U.S.	-0.4092	1.3230	0.8883	1.8403
Average years of schooling	0.2623***	0.0636	0.2303***	0.0795
Rule of law	0.3619***	0.0892	0.4725***	0.1741
Investment share	1.4336	1.9346	-3.0040	3.5664
Price level of investment	-3.6001***	1.0003	-6.6853***	1.8824
Trade openness	1.1614*	0.6203	2.0144**	0.9284
Patent	0.1607**	0.0696	0.2352**	0.1129
Pseudo R2	*0.361*		---	
Wald test of exogeneity (P-value)	---		*0.1998*	
N	*317*		*251*	
No. of countries	*57*		*56*	

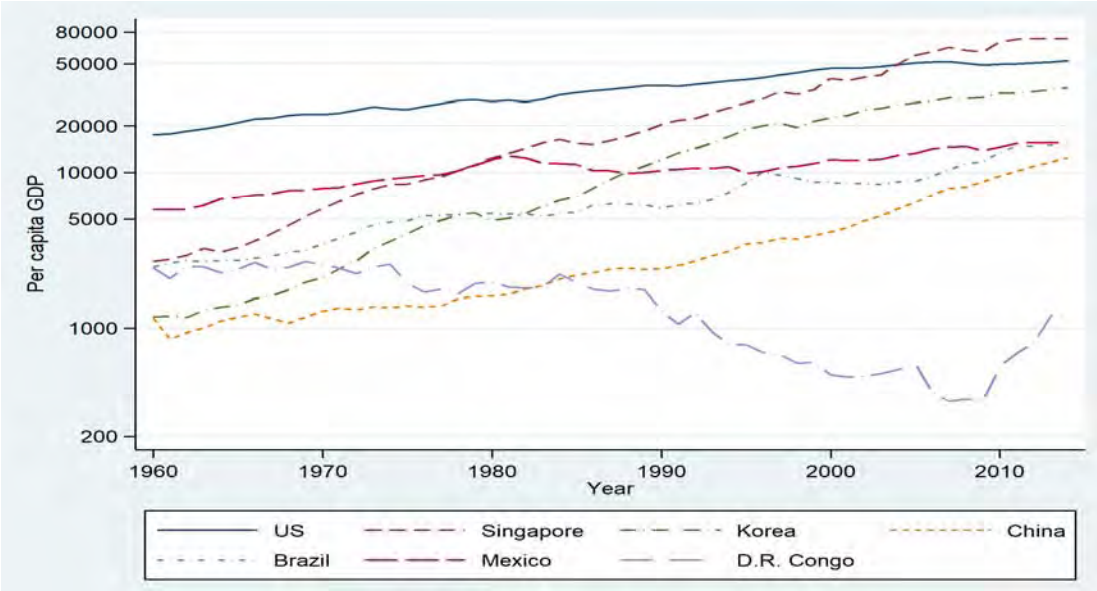
Notes: The dependent variable is a binary variable for being a convergence success. The probit regression applies to an unbalanced panel data set of 5 economies over 10 five-year periods from 1965 to 2014. The speciation includes all the listed regressors and period dummies. The IV probit estimation technique uses lagged values of the explanatory variables as IVs. The variables, such as relative income and average years of schooling that are measured as values at the initial year of each period are used as own IVs. The speciation includes all the listed regressors and period dummies. Standard errors are shown in parentheses. ***, **, and * indicate statistical significance at 1 %, 5 %, and 10%, respectively.

Table 7. Probit Regressions with Multiple Regressors for Middle Income Trap

	(1)		(2)	
	Probit		Probit IV	
Variable	Coefficient.	S.E.	Coefficient	S.E.
Income relative to the U.S.	2.7433	2.4165	6.9516*	4,0682
Average years of schooling	0.1567	0.1160	0.2440	0.1783
Dependency rate	0.0167	0.0158	0.0203	0.0243
Rule of law	-0.1925	0.1728	-0.6239	0.4103
Investment share	7.8997**	3.4959	4.4727	5.9655
Investment share (change, t-1)	2.6647	3.4051	11.176*	6.7797
Price level of investment	2.9725**	1.1697	0.8099	2.9754
Trade openness	-1.9042*	1.0124	-4.2727*	2.2328
Regulation (change, t-1)	0.3012	0.1903	0.2182	0.2676
High technology exports / manufacturing exports	-0.0929**	0.0446	-0.1549**	0.0772
Pseudo R2	*0.233*		---	
Wald test of exogeneity (P-value)	---		*0.122*	
N	*257*		*191*	
No. of countries	*56*		*53*	

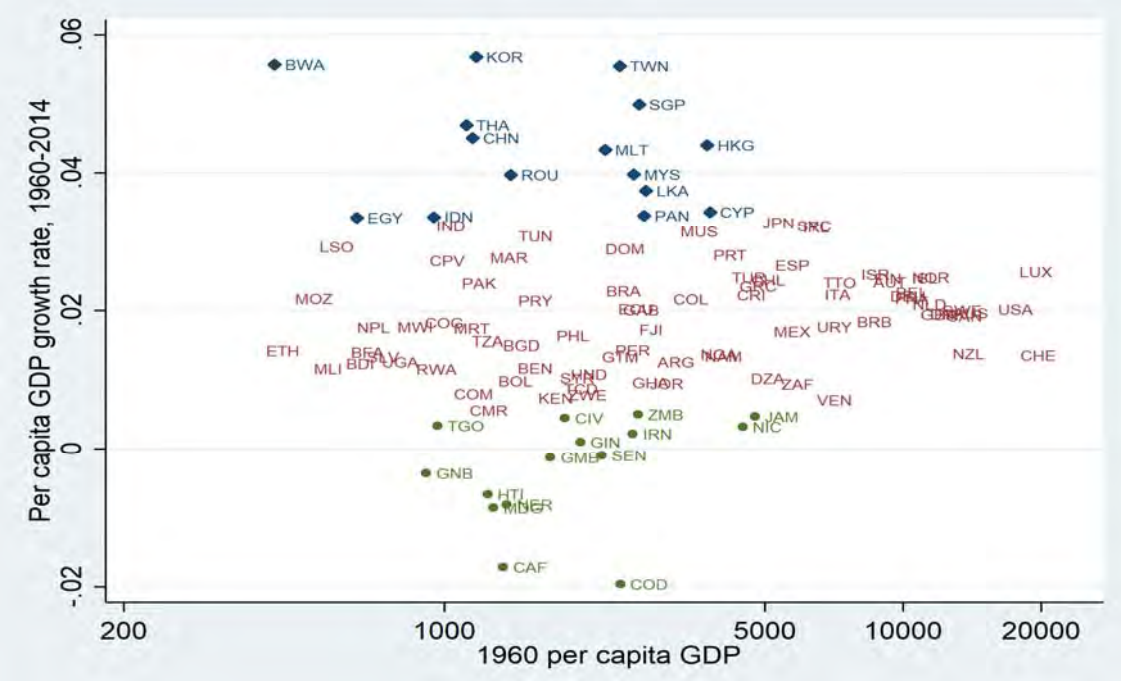
Notes: The dependent variable is a binary variable for falling into a middle-income trap. The probit regression applies to an unbalanced panel data set of 62 economies over 10 five-year periods from 1965 to 2014. The speciation includes all the listed regressors and period dummies. The IV probit estimation technique uses lagged values of the explanatory variables as IVs. Those variables measured as initial values at each five-year period or over the previous five-year period are used as own IVs. The speciation includes all the listed regressors and period dummies. Standard errors are shown in parentheses. ***, **, and * indicate statistical significance at 1 %, 5 %, and 10%, respectively.

Figure 1. Trends in Per Capita Gross Domestic Product in Selected Economies



Note: Data are per capita GDP in PPP international dollars (2011 constant prices) from the Penn World Table 9.0 (Feenstra et al., 2015).

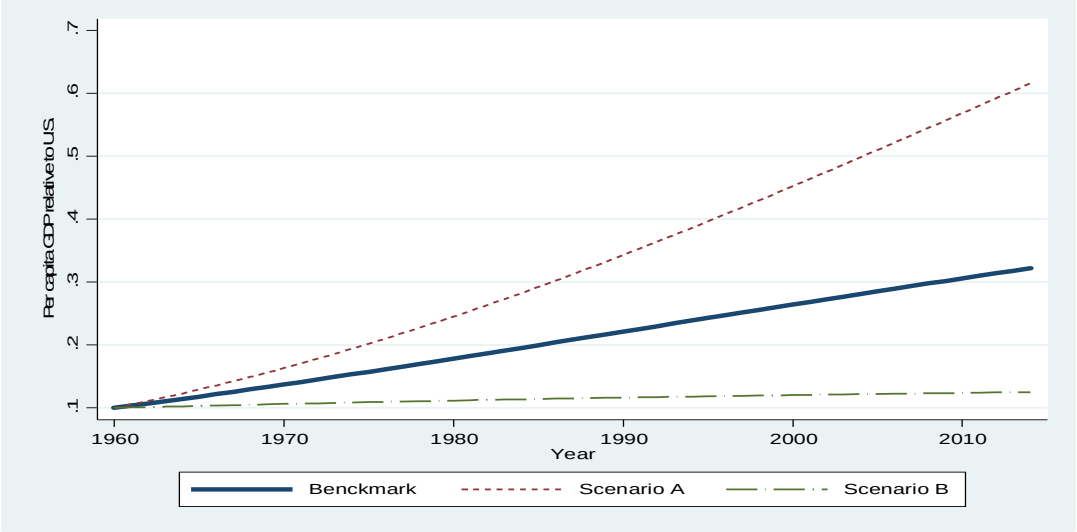
Figure 2. Growth Rate versus Initial GDP, 1960–2014



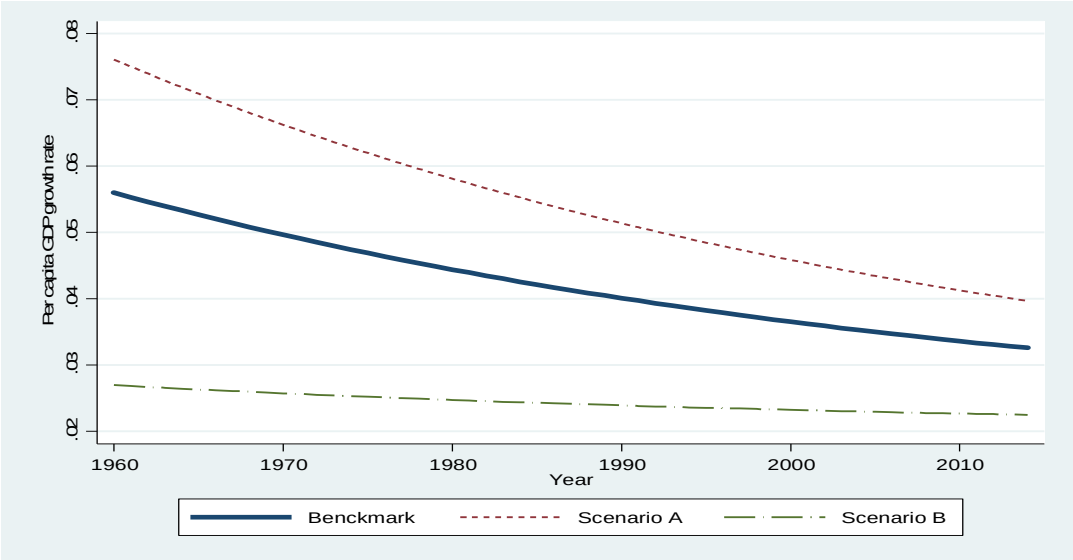
Note: Author's calculations based on data on per capita GDP in PPP international dollars (2011 constant prices) from the Penn World Table 9.0 (Feenstra et al., 2015).

Figure 3. Convergence Paths of a Hypothetical Middle-Income Economy, 1960–2014

A. Relative Level of Per Capita GDP

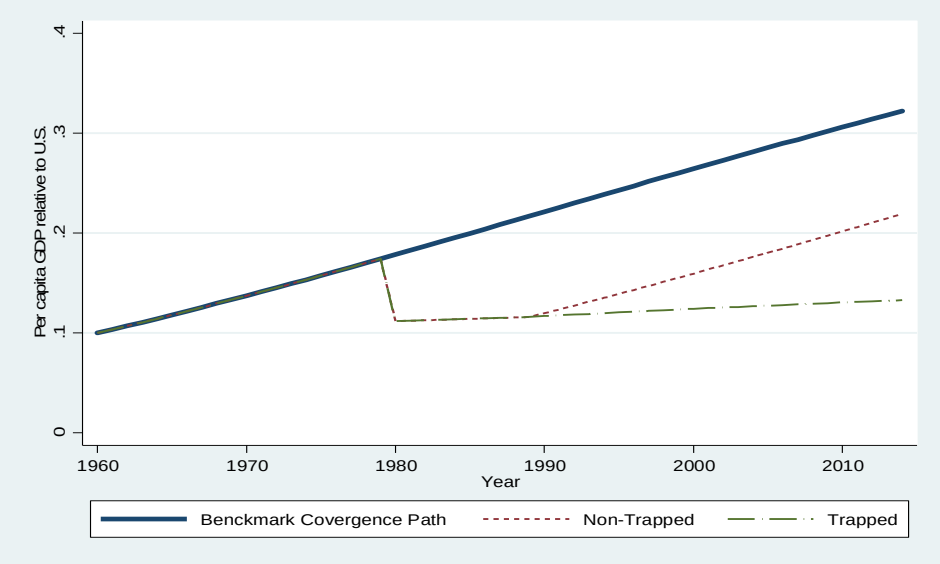


B. Per Capita GDP Growth Rates



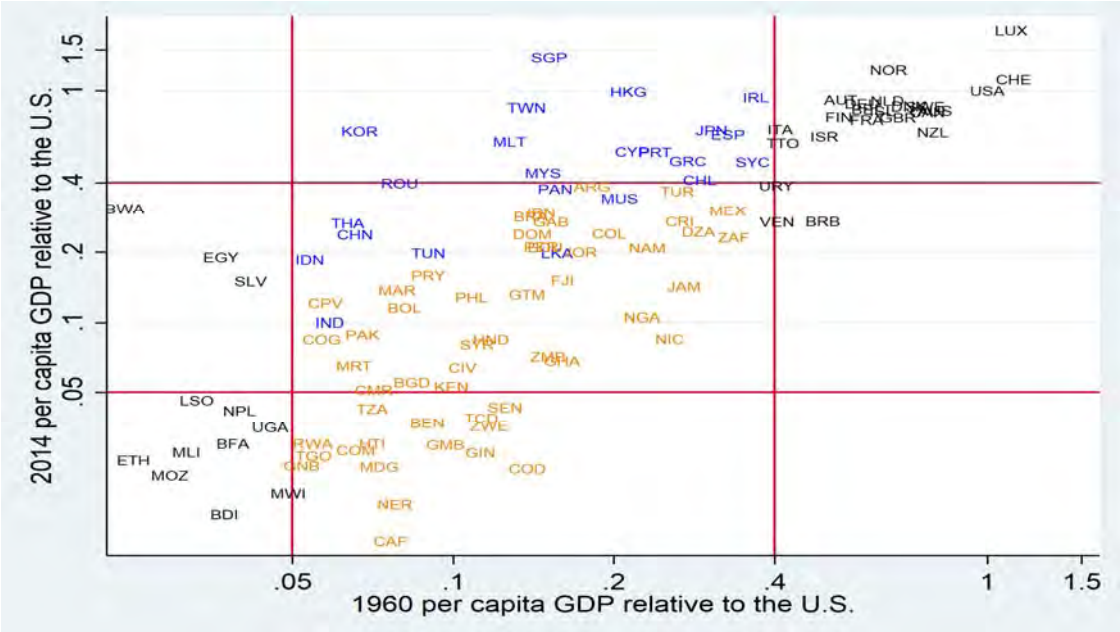
Notes: In the benchmark scenario, a hypothetical economy is assumed to have 10% of the U.S. per capita GDP in 1960, and converges to 60% of the U.S. per capita GDP in the steady-state. It has an exogenous technological progress rate of 1.9%, which equals the average U.S. annual per capita GDP growth rate over the 1960-2014 period. The convergence speed is assumed to be 0.02. Scenario A assumes that the economy converges to the same level as that of the U.S. per capita output in the steady-state and the technological progress rate is given by 3% annually. Scenario B assumes that the economy converges to only 30% of the U.S. per capita output in the steady-state and the technological progress rate is given by 0.5%.

Figure 4. Growth Deceleration and the Middle-Income Trap of a Hypothetical Economy, 1960–2014



Note: A hypothetical middle-income economy following a benchmark convergence path as in Figure 3 is assumed to experience a significant growth slowdown over 10 years in the 1980s and then either return to the same convergence path (non-trapped) or stay in a low-growth path (trapped).

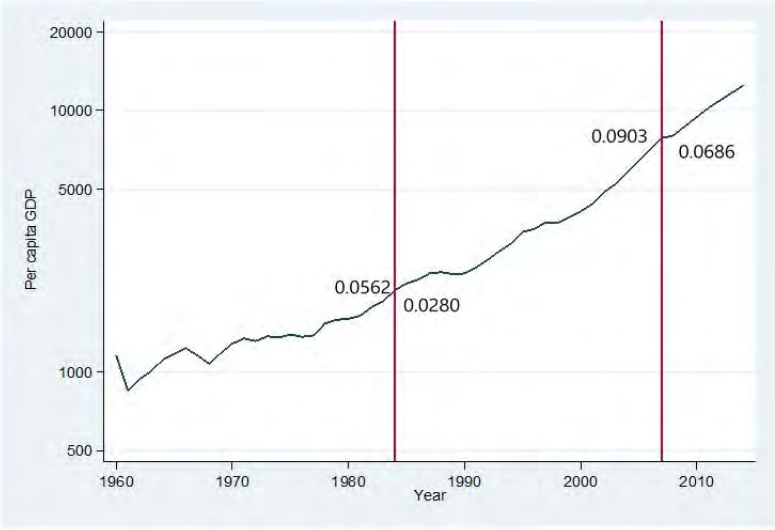
Figure 5. Relative Per Capita Income Changes, 1960–2014



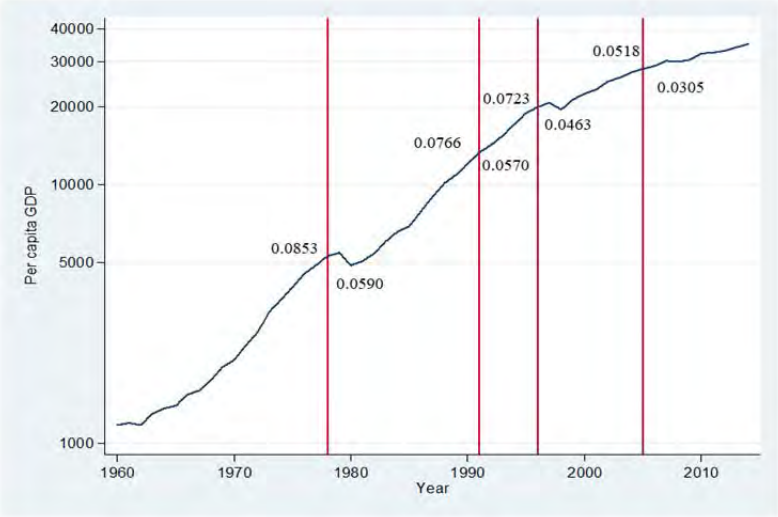
Note: Data are per capita GDP in PPP international dollars (2011 constant prices) from the Penn World Table 9.0 (Feenstra et al., 2015).

Figure 6. Examples of Growth Deceleration Episodes

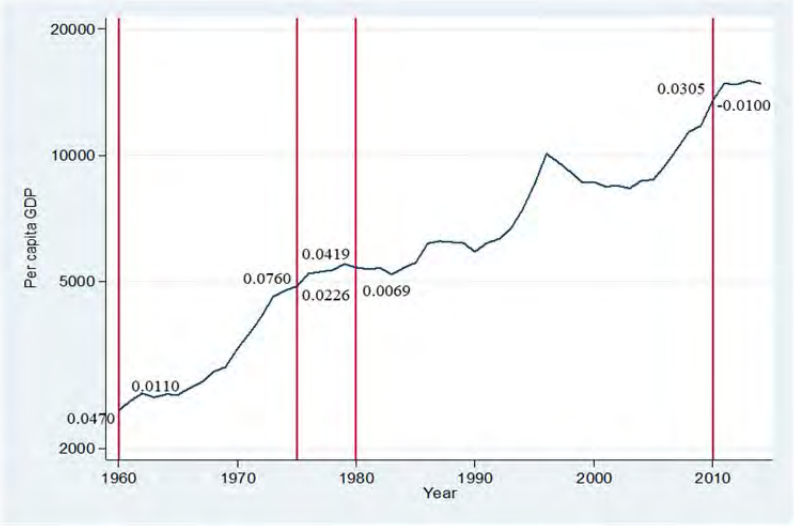
A. China



B. Korea



C. Brazil



D. Mexico

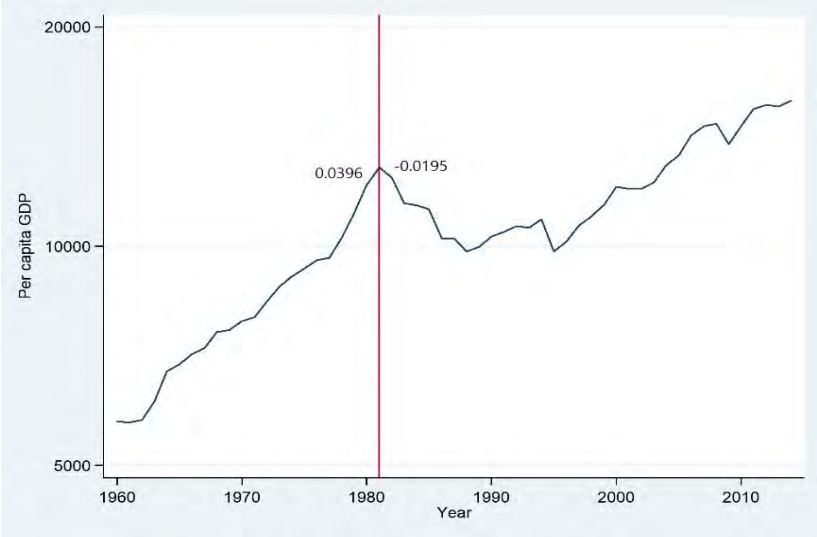
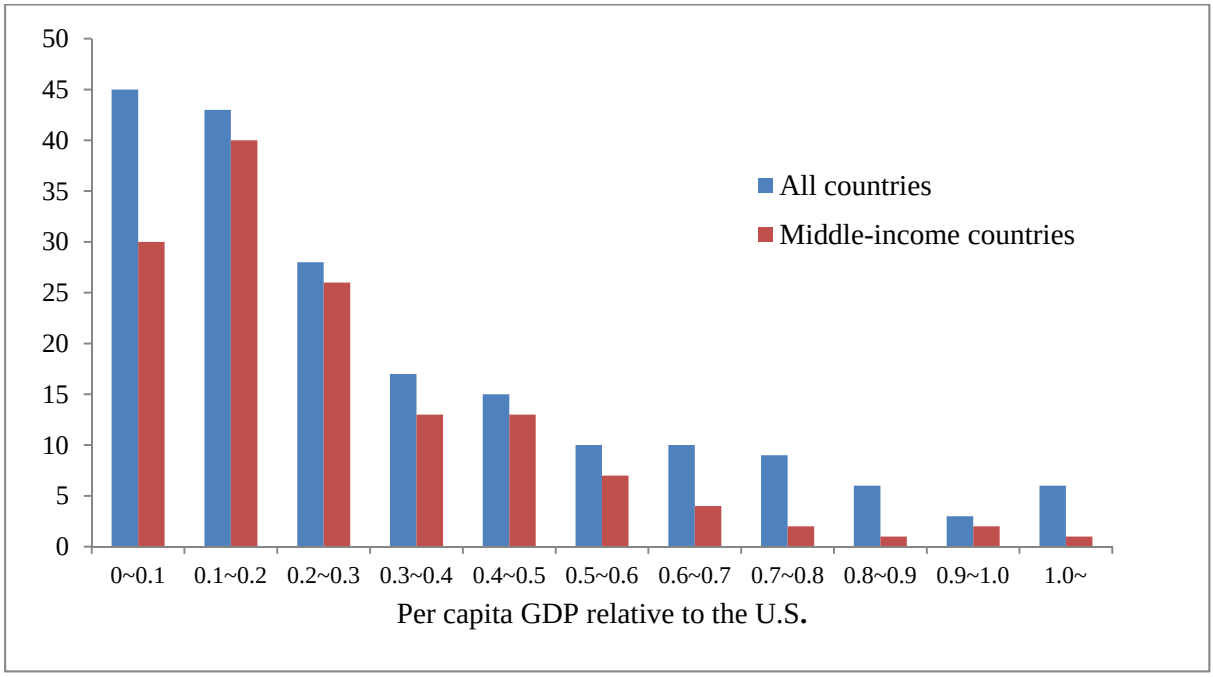


Figure 7. Frequency of Growth Deceleration by the Relative Per Capita Income Level



Notes: The figure refers to the frequency of growth decelerations for the economies that belong to the middle-income category in 1960 by the level of per capita GDP relative to the U.S. at the beginning of each 5-year period of 1960-2014.