

Caught in the Middle? The Economics of Middle-Income Traps*

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The Economics of Middle-Income Traps

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This paper provides an overview of the recent analytical and empirical literature on middle-income traps. The first part examines the descriptive and statistical evidence on these traps. The second discusses the various arguments that have been put forward to explain the existence, and persistence, of middle-income traps. These arguments include diminishing returns to physical capital, exhaustion of cheap labor and imitation gains, insufficient quality of human capital, inadequate contract enforcement and intellectual property protection, distorted incentives and misallocation of talent, lack of access to advanced infrastructure, and lack of access to finance, especially in the form of venture capital. The third part considers public policies aimed at avoiding, and escaping from, middle-income traps. The concluding part identifies a number of directions in which the empirical and theoretical literature could fruitfully evolve.

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1 Introduction

Since the 1950s, rapid growth has allowed a significant number of countries to achieve middle-income status. However, very few have made the additional leap needed to become high-income economies.¹ Rather, many have gotten stuck in what has been called a *middle-income trap* (a term apparently coined by Gill, Kharas, et al. (2007)), generally characterized by a sharp deceleration in growth, following a period of sustained increases in per capita income.

Much of the initial discussion on middle-income traps has focused on the experience of Latin America, the Middle East and North Africa, and especially East Asia. The recent slowdown in economic growth in China has also revived the debate on what causes middle-income traps and what type of policies can help to avoid them or escape from them once a country has fallen into one. Indeed, some observers have argued that aging population, rising dependency rates, and increasing labor costs have reduced China’s comparative advantage in a wide range of labor-intensive production activities, while the country is still improving its capacity to compete on knowledge- and technology-intensive industries. As a result, there have been heightened concerns about a sustained economic slowdown and the possibility that the country may be trapped in a middle-income stage.

This paper provides an overview of the recent analytical and empirical literature on middle-income traps. From an analytical standpoint, the perspective adopted here is that, rather than slow (or lack of) convergence to a unique equilibrium due to cross-country differences in structural parameters and public policies, as emphasized in the conventional literature on growth empirics (see Agénor (2004) and Acemoglu (2009) for instance), a middle-income trap is best viewed as a “bad” equilibrium among many—bad but nonetheless stable, in the sense of being a persistent state to which the economy gravitates unless some significant shock, structural or otherwise, occurs.²

¹“Middle income economies” and “high income economies” are usually defined in accordance with the World Bank’s classifications by income group, as described on the Bank’s website at <http://data.worldbank.org/about/country-classifications>. It is worth noting that the official World Bank threshold for “high-income economy” is substantially lower than US or OECD income averages and that the classification scheme has important operational implications—most notably in terms of access to concessional financing for those countries that are considered low income.

²Put differently, in the conventional approach to growth convergence, countries that share the same

This perspective also has important implications for understanding the role of public policy in helping to escape from a middle-income trap.

The remainder of the paper is organized as follows. Section 2 examines the descriptive and statistical evidence on these traps. Section 3 discusses the various arguments that have been offered to explain the existence, and persistence, of middle-income traps. These arguments include, in addition to diminishing returns to physical capital and unskilled labor, poor quality of human capital, distorted incentives and misallocation of talent, and lack of access to advanced infrastructure and finance. At the outset, an analytical distinction between middle-income traps and the more common notion of poverty traps—generally defined as self-reinforcing mechanisms that cause poverty to persist—is also provided. Section 4 considers a range of public policies aimed at escaping from a middle-income trap. To a significant extent, these policies are directly related to, or motivated by, the causes highlighted in the preceding section. The link between the debate on escaping from middle-income traps and the process—or lack thereof—of industrial transformation is also highlighted. The concluding section identifies a number of directions in which the empirical and theoretical literature could fruitfully evolve.

2 Caught in the Middle? The Evidence

The evidence on middle-income traps is based on both descriptive contributions and formal econometric studies. In both cases, assessing whether a country is caught in a middle-income trap requires at the outset a measure of (relative) income per capita.

The most common classification of income categories for countries is by the World Bank, which ranks countries based on their absolute level of gross national income (GNI) per capita. The latest income classification of the World Bank defines low-income countries as those with GNI per capita of \$1,045 or less in 2014; lower middle-income those with GNI per capita between \$1,046 and \$4,125; upper middle-income those with GNI per capita between \$4,126 and \$12,745; and high-income those with

characteristics eventually reach the same unique equilibrium and the same growth rate. By contrast, in models with multiple equilibria, two countries that are otherwise identical may converge to different growth rates, depending only on their initial conditions.

GNI per capita of \$12,736 or more.³ These rankings are revised at regular intervals (mainly to determine the lending eligibility of each country), based on inflation and exchange rate changes. For instance, if a country graduates today to high-income status but fails to grow at the average growth rate in that group over a sufficiently long period of time, it may fall back into the middle-income group. This, in fact, has happened on a number of occasions. Fundamentally, however, the World Bank classification is in real (or absolute) terms. Using thresholds that are constant over time implies that a country's status is independent of the status of other countries. In turn, this means that there is no preset distribution that specifies the proportion of countries in each category.

An alternative approach to defining income categories is based on a relative measure. Athukorala and Woo (2011) for instance define a Catch-Up Index (CUI), in terms of each country's per capita GDP in percentage of the US level of per capita GDP. A CUI higher than 55 percent defines high-income countries, a CUI between 20 percent and 55 percent defines middle-income countries, and a CUI lower than 20 percent defines low-income economies.

Both approaches are subject to the limitation that they rely on somewhat arbitrary assumptions to define thresholds. In practice, most of the recent literature (especially descriptive studies) has followed the first metric, partly because of data availability. The key point, however, is that becoming high income is a moving target. It is not sufficient to grow at high rates, even during significant periods of time; growth must also occur at rates that are relatively higher than in those countries that are already considered as high income.

2.1 Descriptive Studies

Descriptive studies on middle-income traps include broad cross-country comparisons by the World Bank (2012) and more specific country studies such as Hill et al. (2012), Flaaen et al. (2014), Agénor and El Aynaoui (2015), and Cherif and Hasanov (2015). According to the World Bank (2012) for instance, of 101 middle-income economies in 1960, only 13 had become high income by 2008: Equatorial Guinea, Greece, Hong

³See <http://data.worldbank.org/about/country-and-lending-groups>.

Kong, Ireland, Israel, Japan, Mauritius, Portugal, Puerto Rico, Singapore, South Korea, Spain, and Taiwan. The so-called Asian tigers (Hong Kong, Singapore, South Korea, and Taiwan), in particular, moved from low-margin, labor-intensive goods such as clothing and toys to electronics assembly, then on to component manufacture and, in the case of South Korea and Taiwan, to advanced manufacturing, design and management. By contrast, most countries in Latin America, as well as in the Middle East and North Africa, reached middle-income status during the 1960s and 1970s, and have remained there ever since.

In Asia, Malaysia and Thailand provide also good examples of the growth slowdown that typically characterizes a middle-income trap. Despite the financial crisis of 1997-98, they both ended the last century with productivity levels that stood significantly closer to those recorded in advanced countries. Between 1970 and 2010, Malaysia recorded the largest improvement in educational attainment among the Asian tigers—6 years, compared to 5.4 for South Korea (Lee and Francisco (2012, Table 1)). However, the pattern of labor-intensive production and exports in these countries has remained broadly unchanged for the past two decades. At the same time, they have faced growing competition from low-cost producers, first China and India, and more recently Vietnam and Cambodia. Growth has slowed significantly as a result. After growing at an annual average rate of 5.2 percent per capita during the period 1970-79, growth in Malaysia slowed to 3.8 percent during the period 1980-99 and to 3.0 percent during 2000-10 (Hill et al. (2012, Table 2)). In Thailand, the annual growth rate per capita slowed from an average of 5.3 percent during 1970-89 to 4.1 percent during 1990-99 and 3.4 percent during 2000-10 (Hill et al., *op. cit.*). To many observers, the inability of middle-income economies such as Malaysia and Thailand to induce a shift in their industrial and export structure appears to reflect the failure in developing enough capacity to meet the needs of fast-evolving international product markets where the emphasis is on innovation and product differentiation. Middle-income countries may end up being caught between low-wage poor countries, dominant in mature industries, and innovative rich countries, dominant in technology-intensive industries. The reason is that low-income economies tend to have a comparative advantage in labor-intensive industries, whereas high-income economies have a comparative advantage in capital-

intensive and technology-intensive industries.

The inability to move up the “value chain” and resume rapid growth by breaking into fast-growing markets for knowledge and innovation-based products and services has indeed remained elusive not only for Malaysia and Thailand but also for a number of other middle-income countries, like Brazil (see OECD (2014)). From 1965 to 1980, Brazil showed stable growth at a yearly average rate of 5.6 percent per capita, fairly similar to the average annual growth rate of 6.5 percent experience by South Korea between 1965 and 1986 (Kharas and Gertz (2010)). However, while South Korea was able to continue to grow at sustained rates (at an annual rate of about 5.5 percent per capita for another twenty years) and achieve an innovation-based economy, maintaining rapid growth in per capita income in Brazil has proved difficult. With growth rates per capita averaging 0.7 percent per annum between 1980 and 2012, today per capita incomes are only slightly higher than they were thirty years ago. In fact, compared to OECD averages, in 2012 GDP per capita in Brazil was back to where it was in 1960 (OECD (2014, Table 6.9)), around 34 percent.

2.2 Econometric Evidence

More formal econometric analysis of whether a country is stuck in a middle-income trap is provided by Eichengreen et al. (2012, 2014), Felipe et al. (2012, 2014), Jimenez et al. (2012), Aiyar et al. (2013), and Im and Rosenblatt (2013).⁴ The key idea has been to identify, using either rigorous econometric techniques or simple criteria, statistically significant breaks or turning points in time-series data on levels or growth rates in per capita incomes across countries.

Using the latter approach, Eichengreen et al. (2012) defined a growth slowdown based on three conditions. The first requires that prior to the slowdown the seven-year average growth rate is 3.5 percent per annum or greater. The second identifies a growth slowdown with a decline in the seven-year average growth rate by at least 2 percentage points. The third limits slowdowns to cases in which per capita GDP

⁴Im and Rosenblatt (2013) also provide a review of some of the empirical literature. In some of these studies data on per capita income are taken from the Penn World Tables, available at <http://www.rug.nl/research/ggdc/data/pwt/?lang=en>

is greater than \$10,000 in 2005 constant international PPP prices—thereby ruling out episodes related to countries that have not yet successfully developed. Based on these criteria, they found that growth slowdowns typically occur at per capita incomes of about \$15,000 at 2005 prices. At that point, the growth rate of GDP per capita slows by an average of 3.5 percentage points.⁵ They also found, using regression and standard growth accounting techniques, that growth slowdowns are essentially *productivity* slowdowns—with a drop in total factor productivity (TFP) growth representing about 86 percent, or 3 percentage points, of the absolute reduction in the growth rate of GDP per capita—and that the peak probability of a growth slowdown occurs when manufacturing accounts for about 23 percent of total employment in the economy. Aiyar et al. (2013) also found that steep falls in TFP growth were major factors in the growth slowdown experienced by a number of countries, especially in Latin America.

In a subsequent study, Eichengreen et al. (2014) searched for structural breaks by applying a Chow test to a sample of formerly fast growing middle-income countries. Their analysis showed that the likelihood of sudden slowdowns is bimodal, having its peaks in the range of \$10,000-\$11,000 in 2005 PPP US dollars at and in the higher interval of \$15,000-\$16,000 constant prices. This evidence seems to suggest therefore that a large group of middle-income countries is at risk of being caught up a trap.

The analysis in Eichengreen et al. (2012, 2014) can be criticized on three grounds (Im and Rosenblatt (2013)). First, the threshold at which a slowdown tends to occur is at a level that would probably correspond anyway to a high-income country by World Bank standards, depending upon the PPP adjustment factor involved. Second, a slowdown by two percentage points in per capita growth from an initially high level (for instance, from 9 to 7 percent, or from 8 to 6 percent) may still allow a country to maintain rapid convergence to a high-income status. The slowdown may thus be a *temporary* phenomenon, related for instance to the existence of increasing returns in the education sector caused by human capital externalities, and the fact that individuals choose to spend more time studying and improving their skills (see Kejak (2003)). Third, if the middle-income trap were to be defined relative to a leading country (or a

⁵However, the authors also note that there is considerable dispersion in the income levels at which growth slowdowns occur.

group of leading countries), a more relevant metric would be the country's growth rate vis-à-vis that country (or group of countries). This is particularly important in view of the evidence provided by Aiyar et al. (2013), which suggests that TFP slowdowns in middle-income countries tend to be more frequent than in low- and high-income countries. At the same time, however, a growth "slowdown" may be no more than a temporary phenomenon, which may lengthen the transition time to high-income status, but it is not necessarily synonym with being "trapped" in a low-growth state.

Felipe et al. (2012) followed an altogether different approach. They begin their analysis by defining four income groups of absolute levels of GDP per capita during the period 1950-2010: 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). They argue that if a country is stuck in the lower middle-income category for more than 28 years, or in the upper-middle income for more than 14 years, then the country is caught in a middle-income trap. These thresholds represent the median number of years that the sample countries spent in their income categories. Thus, avoiding the middle-income trap is a question of how to grow fast enough in order to cross the lower middle-income segment in at most 28 years, and the upper middle-income segment in at most 14 years. Based on these numbers, they found that, out of 124 countries in their sample, there were 52 middle-income countries in 2010; and out of that group, 35 countries (of which 13 in Latin America, 11 in the Middle East and North Africa, and 3 in Asia) were caught in a middle-income trap. Moreover, using disaggregate trade data, they found that countries caught in that trap were all characterized by lower sophistication and diversification of their exports.

There are two major limitations to this study, both of them related to the thresholds that they set. First, taking the median of a limited set of countries is a somewhat arbitrary approach. For instance, if the authors had taken the mean instead of the median, the threshold for the lower middle income would have been 33 years instead of 28 years. Second, the sample has only a limited number of countries making the transition from one income level into another. The thresholds (which are kept constant in real terms over time) could differ therefore significantly for other sets of countries.⁶ Nevertheless,

⁶In a subsequent study, Felipe et al. (2014) extend their data to 2013, revise the income classi-

the evidence that suggests that improved diversification and sophistication of production and exports—which itself points to the key roles of human capital, structural change and innovation as the main drivers of total factor productivity growth—are important; it is consistent with the key message of the descriptive studies referred to earlier and is further discussed next.

A broader criticism of the econometric evidence, echoing an important contribution by Quah (1993) in the context of the convergence debate, was put forward by Pritchett and Summers (2014). If changes in growth rates are randomly but identically distributed across countries, then there would be, by virtue of Galton’s regression to the mean, a correlation between higher growth rates and lower subsequent income. This is because those countries that had experienced high (low) growth in the past would inevitably tend to grow slower (faster) in the future. However, for the concept of regression to the mean to be valid, the premise must indeed be that growth outcomes are random. This assumption is not consistent with the statistical regularities that the literature on growth empirics has uncovered with respect to the role of geography, institutions, openness to trade, and so on (see Agénor (2004) and Acemoglu (2009)). There is also no clear rationale for assuming *a priori* that growth rates are identically distributed across countries facing vastly different economic conditions.

A fair assessment would nevertheless recognize that, in addition to difficulties in identifying slowdowns, the econometric literature on middle-income traps remains vulnerable to a range of problems that have plagued cross-country growth regressions—including sample selection bias, measurement and specification errors, inadequate tests for pooling, and simultaneity bias (see Agénor (2004) and Acemoglu (2009)). There is also significant room to improve, as will become clear later, the identification of nonlinearities associated with interactions between causes of middle-income traps. The crucial point, however, is that even though the identification of precise turning points

fication of economies to smooth out fluctuations in the various income categories that they define, and revise the criteria used in their earlier paper to determine whether an economy is trapped or not. A key finding of their paper is that over a longer period of time, the relatively fast transitions to high-income status observed since 1950 (especially in East Asia) do not appear to be the norm. In fact, The median number of years spent in the lower middle-income group is now estimated at 55 years, rather than 28 years. But because the methodology used remains the same, the limitations of their previous contribution continue to hold.

and other empirical regularities (such as the *magnitude* of growth slowdowns when they do occur) using cross-country data remains a matter for debate, this does not invalidate the fact that the concept of a middle-income trap is useful to understand the experience of *individual* countries and the policy challenges that productivity slowdowns, and the transition to high-income status, present to them. A sensible approach from that perspective, and one that will be followed in the remainder of this paper, is to attempt to identify some of the key structural features that are consistent with the various causes of middle-income traps.

3 Causes of Middle-Income Traps

Various explanations have been put forward to explain the existence of middle-income traps. In line with the descriptive and statistical evidence discussed earlier, these explanations include diminishing returns to physical capital, exhaustion of cheap labor and imitation gains, insufficient quality of human capital, inadequate contract enforcement and intellectual property protection, distorted incentives and misallocation of talent, lack of access to advanced infrastructure, and lack of access to finance. Before they are considered in more detail, it is important to note that many of these arguments are fundamentally consistent with the evidence that views productivity slowdowns as the main source of middle-income traps; they differ from each other mainly in terms of the *reasons* why these slowdowns occur—and, by implication, what type of public policies can be implemented to promote productivity growth. As such, they may well be complementary in nature rather than substitutes.

It is also useful to make, at the outset, an analytical distinction between middle-income traps and the more common notion (at least among economists) of poverty traps. In general, a poverty trap is defined as a self-reinforcing mechanism that causes poverty to persist, that is, a “locked-in” equilibrium associated with stagnation (zero growth) or very low growth in income over time. A typical poverty trap is often due to a lack or limited availability of a key production input or public good—insufficient supply of private capital due to low savings and low income to begin with, coordination failures, inadequate public infrastructure, insufficiently developed credit and capital markets,

poor access to public health or education services, weak institutions, and so on—in an environment where income per capita is initially low.⁷ By contrast, a middle-income trap typically occurs *after* a country has been growing rapidly for a sustained period of time and has improved substantially the standards of living of its population—so that the question is more about explaining a slowdown in growth, rather than why it is low in the first place—and for reasons that are not generally related to those that explain why a poor country may be stuck in a bad, path-dependent equilibrium. It is often not the *quantity* of production inputs (public or private) that matters, but rather their *quality*. For instance, access to electricity may be available to most in urban areas, but it can be highly unreliable; roads may cover most of the country but they are of poor quality; human capital (in terms of tertiary education) may be high on paper, but the quality of training is poor; and so on. Indeed, the fundamental source of multiple equilibria in a middle-income trap is often related to the *lack of innovation activity*—itself related to poor quality of human capital, which may prevent a country from escaping a low- or moderate-growth equilibrium—rather than, say, low savings, poor nutrition, lack of basic infrastructure, etc., as typically observed in low-income countries. However, as discussed later, the main insights that the theory of poverty traps provides are important to understand the role of public policy in helping to escape from a middle-income trap.

3.1 Diminishing Returns to Physical Capital

A first argument to explain a middle-income trap (particularly with respect to the experiences in East Asia, and the Middle-East and North Africa) relates to diminishing marginal returns to physical capital. In the initial stages of economic development, high rates of investment (especially by the public sector) generate strong benefits in terms of economic growth—in the case of public investment either directly through its impact on the productivity of private inputs or indirectly by fostering private invest-

⁷Poverty traps can occur in models with either a single (stagnation) equilibrium or multiple equilibria. See Iwaisako (2002), Azariadis (2006), Azariadis and Stachurski (2005), Kuwahara (2007, 2013), Guillaumont (2009), Agénor and Aizenman (2010), Bénassy and Brezis (2013)), Wang and Wang (2013), Agénor (2015), and Ghatak (2015) for recent contributions to, and discussion of, the literature on poverty traps.

ment through a complementarity effect (see Agénor (2012)). Sustained rates of capital accumulation have indeed been a key feature of the experience of East Asian countries in the aftermath of the Second World War (see for instance Commission on Growth and Development (2008) and Lee and Hong (2010)). But as economies develop, capital accumulation (both private and public) becomes subject to diminishing marginal effects. The growth benefits of that strategy—which occur during a stage of *extensive growth*, as characterized by Kejak (2003)—therefore get eroded over time. Unless other policies are adopted to promote economic growth, a country may be unable to continue its transition from middle-income to high-income stage.

A related but different argument is that, over time, the *efficiency* of investment (especially public) gets eroded; because of corruption or mismanagement, a smaller fraction of (investment) flows turn into (capital) stocks. At the same time, due to the same factors the *quality* of (public) capital may weaken, thereby diminishing its marginal benefits for the economy. Thus, the issue is not that the marginal return to capital falls because there is too much of it—if anything, less efficient investment means lower stocks—but rather that its quality deteriorates, and that in turn eventually has an adverse effect on growth. If empirical measures of capital stocks do not capture this deterioration, they may overestimate the growth in the capital stock and its contribution in growth accounting exercises.

The cross-country econometric literature points out that the growth slowdowns that are associated with a middle-income trap are essentially *productivity* slowdowns rather than simply the consequence of decreasing returns in physical capital accumulation. For instance, in the study by Eichengreen et al. (2012) discussed earlier, 86 percent of the growth slowdown is estimated to result from a slackening in TFP growth, compared to only 15 percent to capital accumulation. In the same vein, Daude (2010) found that TFP plays a key role in explaining the persistent per capita income gap between Latin America—a region where, as noted earlier, a number of countries appear to have fallen in a middle-income trap—and the United States, in contrast to differences in factor accumulation. In addition, there does not appear to be any *systematic* cross-country evidence to suggest that investment efficiency tends to deteriorate significantly when countries reach middle-income status.

Nevertheless, the fact that the cross-country evidence does not provide much support for either diminishing marginal returns to capital or a deterioration in investment efficiency does not mean that these hypotheses do not hold any explanatory power at the level of some *individual* countries. A case in point is Morocco, where for the past three decades growth has been fueled by high rates of public investment (see Agénor and El Aynaoui (2015)). While these investment rates—some of the highest in the world, even by Asian standards—had undeniably a positive effect on production capacity and output, the evidence shows that over time public capital accumulation also suffered from efficiency problems and diminishing returns: in particular, the incremental capital-output ratio (ICOR) increased from an average of less than 3 in the 1990s to an average of 8.1 during the past decade. By contrast, in China for instance, a country where government investment is widely seen as highly inefficient, ICOR rose from 3.8 to only 4.6 between 1983 and 2010 (Lee et al. (2012)). Thus, the diminishing returns to capital hypothesis may be useful to understand why some countries may transition to a slower growth path before catching up with richer countries.

3.2 Exhaustion of Cheap Labor and Imitation Gains

Another explanation of growth slowdowns is based on a Lewis-type development process. In that perspective, factors and advantages that generate high growth during an initial phase of rapid development—low-cost labor and imitation of foreign technology—disappear when middle- and upper-middle-income levels are reached, thereby requiring new sources of growth to maintain sustained increases in per capita income.

Indeed, during an initial phase, low-income countries can compete in international markets by producing labor-intensive, low-cost products using technologies imported from abroad. These countries can achieve large productivity gains at first through a reallocation of labor from low-productivity agriculture to higher-productivity manufacturing. Because producers of nontraded goods must compete with exporters for labor, they need to pay attractive wages. At the same time the chance of well-paid work in manufacturing creates an incentive for workers to move to cities and invest in education. However, once these countries reach middle-income levels, the pool of underemployed rural workers shrinks and wages begin to rise, thereby eroding compet-

itiveness. Productivity growth from sectoral reallocation and technology catch-up are eventually exhausted, while rising wages make labor-intensive exports less competitive on world markets—precisely at the time when other low-income countries initiate a phase of rapid growth. Put differently, *persistent* growth slowdowns coincide with the point in the growth process where it is no longer possible to boost productivity by shifting additional workers from agriculture to industry and where the gains from importing foreign technology diminish. This process is well supported by the evidence on productivity slowdowns provided by Eichengreen et al. (2012), as indicated earlier; it is also relevant for understanding the recent slowdown in China.⁸ More generally, as documented by Dabla-Norris et al. (2013), the reallocation of labor from low-productivity agriculture to high-productivity sectors (initially manufacturing and subsequently services) was a primary channel through which today’s advanced economies increased their living standards.⁹

This process is also consistent with the analysis in Perez-Sebastian (2007), Glass (2010), Agénor and Dinh (2012), and Agénor and Alpaslan (2014), where imitation, due to large externalities associated with technology diffusion, is the main source of productivity growth in the early stages of development, whereas broad-based innovation—defined as the application of new ideas, technologies, or processes to productive activities—becomes the main engine of growth as the economy approaches the world technology frontier. While imitation is intensive in low-skilled labor, innovation requires only skilled labor, as for instance in Vandebussche et al. (2006). Both imitation and innovation are costly, but the former is cheaper. By specializing initially in low-skilled intensive activities, a low-income country may be unable to provide sufficient incentives to workers to invest in education—hence reducing the rate of accumulation of human capital needed to promote at a later stage broad-based innovation. Thus, as much as a developing economy can use an imitation-based strategy to escape from a low-income poverty trap, the same strategy often becomes the major impediment that holds back

⁸In China, the industrialization-through-imitation and cheap labor costs process started in 1979, when the country’s leader then, Deng Xiaoping, chose the village of Shenzhen as the first special economic zone. Wages and productivity in urban factories were still substantially higher than in rural areas, creating a massive flow of workers from the countryside.

⁹Put differently, transitioning from middle- to high-income level is typically accompanied by a major industrial transformation, an issue that is further discussed later on.

the economy from switching successfully to innovation-driven growth.

The foregoing discussion also suggests that countries that are caught in a middle-income trap are often characterized by production structures that have changed little over time and have been unable to adapt to major structural changes in global trade, especially the vertical and spatial fragmentation of manufacturing into highly integrated global production networks (see Park et al. (2013)). As a result, exports of these countries are also characterized by a high degree of concentration in low-sophistication goods, as documented for instance by Felipe et al. (2012).

3.3 Insufficient Quality of Human Capital

Another factor that may explain a middle-income trap is poor quality of human capital. As noted earlier, tertiary education rates may be relatively high and increasing over time, yet the productivity of workers may remain relatively low and their skills insufficiently diversified. Poor quality of human capital acts as a constraint on the ability to absorb more advanced foreign technologies and on the expansion of innovation activities, thereby preventing the productivity growth that may allow a country to sustain high levels of economic growth.¹⁰ Stone and Shepherd (2011) for instance found that the availability of skilled labor is a particularly important determinant of a firm's ability to generate productivity gains from intermediate and capital goods imports, that is, to realize dynamic gains from trade.

A useful framework to understand these issues is the one developed by Redding (1996), in which deficiencies in training and education can constrain firms' investments in product quality. In the model, workers invest in the acquisition of skills, whereas firms invest in quality-augmenting R&D. The two forms of investment exhibit pecuniary externalities (through changes in wages) and are strategic complements. The incentives for both forms of investment are interdependent: individuals' returns from investing in human capital (the expected wage) depends on whether they expect firms to invest in R&D, whereas firms' decisions to invest in R&D depends on their ex-

¹⁰Conversely, the data for Korea, compared to other Asian countries, suggest a clear correlation between the quality of the labor force, the proportion of researchers in the economy, R&D expenditure, and growth in per capita income; see UNESCO (2014, Tables 12 and 13).

pectation of workers' investment in human capital, which affects the expected return to R&D. Both types of investment determine the economy's growth rate and, in the presence of fixed costs associated with research, multiple equilibria may exist. The low-growth equilibrium, characterized by no investment in R&D and growth driven only by (low investments in) human capital, can be interpreted in the present context as a middle-income trap, with stagnant technology and no product quality improvements. To escape from the trap (which entails a discrete jump to the high growth equilibrium), policies that contribute, in particular, to reducing fixed costs (possibly through public subsidies, assuming that they are not financed by distortionary taxes), increasing the probability of innovation, or improve the quality of time spent in education, are necessary.

Redding's model is fairly simple; in particular, it does not explicitly account for the skills distribution or physical capital accumulation, and production exhibits constant returns to human capital. Thus, as in Lucas-type models, it is the *growth rate* of human capital that sustains steady-state growth in output. However, similar results could be established in more general settings, such as Agénor and Dinh (2012), in which there is also interdependence (through wage incentive effects) between human capital decisions and the development of innovation activities. In that model, private capital exhibits constant marginal returns (as in typical AK models) and it is the *level* of human capital, that is, the proportion of skilled workers in the working age population, that affects the growth rate. Nevertheless, by adding fixed costs to innovation, results similar to those discussed by Redding could also be derived.

The theory of leapfrogging—or lack thereof—developed by Acemoglu et al. (2006) could provide an alternative conceptual basis for middle-income traps. In their framework, the selection of high-skill managers and firms is more important to promote innovation than for the adoption (or imitation) of foreign technologies. While in early stages of development selection matters relatively little, it becomes crucial as countries get closer to the world technology frontier and competition against foreign producers intensifies. The reason is that the *rent-shielding effects* that the low-skill managers benefit from as insiders protect them from potentially more efficient newcomers, and this is socially costly in the long run. The failure to improve the selection of managers

and the organization of production processes may constrain the ability to adopt frontier technologies, dampen productivity gains, and prevent full convergence to that frontier. This *non-convergence trap* is similar, in spirit at least, to a middle-income trap caused by poor quality of human capital.¹¹??

The inability to improve the quality of the labor force as countries get closer to the world technology frontier is an important factor in understanding not only the emergence but also the persistence of middle-income traps, especially in Latin America. Indeed, it is consistent with the evidence on measures of cognitive skills for that region reported in Hanushek and Woessmann (2012*a*, 2012*b*). Brazil is a case in point (see OECD (2014)). Even though the average number of years of schooling increased dramatically between 1990 and 2010, PISA scores in mathematics, reading, and science, put the country’s rankings at 58, 55, and 59, respectively, out of 65 countries, in 2012. Poor quality of human capital is also one of the key issues for Malaysia (see Hill et al. (2012) and Flaaen et al. (2014)). Indeed, although a net labor importer, Malaysia remains a net skills exporter, with growing numbers of professionals migrating to Singapore and other industrialized countries. Partly as a result of this brain drain, workers in Malaysian manufacturing remain largely low skilled, with more than 80 percent holding only a high school degree, and just 7 percent of manufacturing employees holding a university degree (Menon and Woo (2014)). The country’s PISA scores are not much better than Brazil’s, even though education attainment, measured in terms of average years of schooling, was close to the OECD average in 2010 (see OECD (2014, Tables 2.1 and 2.8)). Even though education attainment was not as high in Thailand, a similar contrast between years of schooling and PISA scores scenario can also be observed for that country.

3.4 Distorted Incentives and Misallocation of Talent

Related to the previous argument is the possibility that pecuniary externalities may translate into a misallocation of talent; individuals with potential ability to be highly productive in innovation activities end up working in sectors that are less beneficial in

¹¹Yet another alternative theory of nonconvergence traps could be based on the model of “catching up” and “falling back” with endogenous worker productivity developed by Benhabib et al. (2014).

terms of growth, because wages there are higher or less uncertain. The issue therefore is the (sectoral) *distribution* of human capital, rather than the accumulation of human capital *per se*.

This issue is addressed formally by Agénor and Canuto (2015), in an overlapping generations (OLG) model with endogenous occupational choices.¹² They distinguish between two types of labor skills, basic and advanced, with the latter defined as specialized knowledge that can be acquired by devoting a given amount of time to higher education in early adulthood. Thus, in contrast to models with disembodied knowledge and endogenous schooling time allocation, in the Lucas-Uzawa tradition, human capital cannot be accumulated indefinitely. Individuals with either basic or advanced skills can both work in the production of final goods, whereas only those with advanced skills can work in the innovation sector. Occupational choices are endogenous; individuals choose to invest in education only if wages in the innovation sector are high enough, compared to other sectors. In addition, unlike existing models, where the marginal productivity gain associated with the stock of ideas is either constant or decreasing, this gain is assumed to be *increasing* over a certain range due to learning-by-doing effects.

A simplified version of the Agénor-Canuto model is as follows. Consider an economy populated by individuals, who possess different innate abilities and live for two periods, adulthood and old age. Population is constant at \bar{N} . There are three production sectors; the first produces a final good (manufacturing), the second intermediate inputs, and the third designs, which consist of blueprints used for the production of intermediate inputs. Designs are partially excludable but nonrival. Each individual is endowed with one unit of time in the first period of life, and zero unit in old age. A fraction $\delta \in (0, 1)$ of individuals are born with average cognitive skills (*L*-type) and a fraction $1 - \delta$ with high cognitive skills (or *H*-type). Whatever his or her type, an individual can work in the production of final goods. However, only individuals with high cognitive skills can work in the design sector. For that, he/she must also acquire

¹²Actually Agénor and Canuto consider jointly the issue of insufficient access to (advanced) infrastructure and misallocation of talent. For pedagogical reasons, these issues are discussed separately here.

additional skills through schooling, which in turn requires spending a fraction $\varepsilon \in (0, 1)$ of available time at the beginning of adulthood. Schooling is publicly provided and (for simplicity) free of charge.

Let $c_{t+k}^{h,t}$ denote consumption at period $t+k$ of an individual working in sector h , where $h = Y, R$, with Y (R) denoting the final goods (design) sector, and $k = 0, 1$. Discounted utility is given by

$$U_t^h = \ln c_t^{h,t} + \frac{\ln c_{t+1}^{h,t}}{1 + \rho}, \quad (1)$$

where $\rho > 0$ is the discount rate.

The period-specific budget constraints, which depend on the sector of employment in adulthood, are given by

$$c_t^{h,t} + s_t^h = \begin{cases} w_t^Y & \text{if } h = Y \\ (1 - \varepsilon)w_t^R & \text{if } h = R \end{cases}, \quad (2)$$

$$c_{t+1}^{h,t} = (1 + r_{t+1})s_t^h, \quad (3)$$

where w_t^h is the wage rate in sector h , s_t^h the savings rate, and $1 + r_{t+1}$ the rate of return on physical assets.

The final good is produced by a continuum of unit mass competitive firms indexed by $i \in (0, 1)$. Production requires the use of labor, $N_t^{Y,i}$, private capital, K_t^i , and a Dixit-Stiglitz combination of a continuum of intermediate inputs, $x_{s,t}^i$, where $s \in (0, M_t)$. The production function of firm i is

$$Y_t^i = A_t^Y (K_t^i)^\alpha (N_t^{Y,i})^\beta \left[\int_0^{M_t} (x_{s,t}^i)^\eta ds \right]^{\gamma/\eta}, \quad (4)$$

where $\alpha, \beta, \gamma \in (0, 1)$, $\eta \in (0, 1)$, A_t^Y is productivity and $1/(1 - \eta) > 1$ the price elasticity of demand for each intermediate good. The condition $\eta > \gamma$ is also imposed, thereby implying that intermediate goods are gross substitutes ($\partial Y_t^i / \partial x_{j,t}^i \partial x_{k,t}^i < 0$). Constant returns prevail in all inputs, so that $\alpha + \beta + \gamma = 1$. As a result of an Arrow-Romer learning-by-doing externality, productivity depends on capital per worker:

$$A_t^Y = \left(\frac{K_t}{N} \right)^{\beta + \gamma}, \quad (5)$$

where $K_t = \int_0^1 K_t^i di$ is the aggregate private capital stock.¹³

As shown in the Appendix, with population normalized to unity, aggregate output

$$Y_t = \int_0^1 Y_t^i di = (n_t^Y)^\beta m_t^{\gamma/\eta} x_t^\gamma K_t, \quad (6)$$

where n_t^Y is the proportion of adults engaged in the production of final goods (defined later) and $m_t = M_t/K_t$ the knowledge-capital ratio.

Firms in the intermediate sector are monopolistically competitive. There is only one producer of each input s , and each of them must pay a fee (patent) to use the design for that input. Production of each unit of an intermediate good s requires a single unit of the final good. Once the fee has been paid, each intermediate good producer sets its price to maximize profits, given the perceived demand function for its good. In a symmetric equilibrium, as shown in the Appendix, it can be established that, $\forall s$,

$$p_t = \eta^{-1}, \quad (7)$$

$$x_t = (\gamma\eta Z_t)^{1/(1-\eta)} = \gamma\eta \left(\frac{Y_t}{M_t}\right). \quad (8)$$

Intermediate-input producing firms last only one period and patents are auctioned off randomly to a new group of firms in each period. Thus, each producer of a new intermediate good holds a patent only for the period during which it is bought, implying monopoly profits, Π_t^I , during that period only; yet patents last forever.¹⁴ As shown in the Appendix, in a symmetric equilibrium, the patent price is

$$p_t^R = \Pi_t^I = (1 - \eta)\gamma \left(\frac{Y_t}{M_t}\right). \quad (9)$$

Firms engaged in the design sector generate blueprints for new intermediate inputs, using the same technology. Each firm produces a single design and there is no aggregate uncertainty in design activities. The aggregate stock of designs evolves according to

$$M_{t+1} - M_t = A_t^R \frac{(1 - \varepsilon)N_t^R}{\bar{N}}, \quad (10)$$

where A_t^R is a productivity factor and $(1 - \varepsilon)N_t^R$ the number of H -type individuals with higher education in the population, adjusted for the time spent acquiring skills.

¹³In principle it is total labor employed in the final good sector only, N_t^Y , that should appear in (5). Using total population simplifies the derivations.

¹⁴See Agénor and Canuto (2015) for a more detailed discussion of these assumptions.

In addition, as in Dinopoulos and Thompson (2000), there is also a dilution effect, related to the size of the population.

Productivity depends on the existing stock of designs:

$$A_t = \bar{A} m_t^\phi M_t, \quad (11)$$

where $\bar{A} > 0$ and $\phi \geq 0$. The usual reason for introducing a positive impact of the stock of designs (or ideas) on productivity is the existence of a *standing-on-shoulders* effect, that is, the assumption that each design creates a positive externality for future design activities.¹⁵ In standard Romer (1990)-type models, $\phi = 0$ and the marginal effect of M_t on A_t is linear. Here, by contrast, $\phi > 0$ as a result of a *learning-by-doing* effect, which results from the fact that the very production of designs (scaled by the size of the economy, as measured by the capital stock) helps to improve efficiency. This mechanism is particularly important for developing countries, as suggested in some studies. Addison (2003) for instance, in a cross-country study of 29 countries, found that the largest source of productivity growth in developing countries is product variety imitation, which represents a key source of (nonrival) knowledge. In the same vein, Amiti and Konings (2007), Kasahara and Rodriguez (2008), Goldberg et al. (2010), Halpern et al. (2011), and Zhang (2014) found a link between the import variety of intermediate inputs and productivity gains at the firm level for Indonesia, Chile, India, Hungary, and Colombia, respectively. A broader study by Stone and Shepherd (2011) also found firm-level evidence of a significant and positive impact (especially for developing countries) of imports of intermediate goods on productivity and innovation.

Profit maximization in the design sector yields

$$w_t^R = \frac{p_t^R A_t}{\bar{N}}. \quad (12)$$

The asset market clearing condition requires the private capital stock in $t + 1$ to be equal to savings in period t by individuals born in $t - 1$:

$$K_{t+1} = s_t^Y N_t^Y + s_t^R N_t^R. \quad (13)$$

As noted earlier, all H -type individuals who choose not to invest in specialized skills work in the final good sector. Let θ_t denote the proportion of high-ability individuals

¹⁵See Gancia and Zilibotti (2005) for instance.

who decide to acquire more education; the numbers of workers in the design and final good sectors are given by

$$N_t^R = (1 - \delta)\theta_t\bar{N}, \quad (14)$$

$$N_t^Y = [\delta + (1 - \delta)(1 - \theta_t)]\bar{N}, \quad (15)$$

where δ , as defined earlier, is the fraction of individuals with average ability. The “maximum” (relative) size of the labor force in the design sector is thus $1 - \delta$, which obtains when $\theta_t = 1$. All H -type individuals are then employed in design activities. As shown in the Appendix, θ_t evolves according to

$$\theta_t = 1 - \frac{1}{1 - \delta} \left\{ [(1 - \varepsilon)(1 - \eta)\gamma \frac{\bar{A}m_t^\phi}{\beta}]^{-1} - \delta \right\}, \quad (16)$$

which depicts a positive relationship between m_t and θ_t . All else equal, a higher knowledge-capital ratio makes education more desirable because it raises productivity and wages in the design sector; it therefore attracts a higher proportion of high-ability individuals in that sector.¹⁶

Now, let m^C be the value of m_t for which $\theta_t = 1$; from (16) this value is

$$m^C = \left[\frac{\beta\delta^{-1}}{\bar{A}(1 - \varepsilon)(1 - \eta)\gamma} \right]^{1/\phi}. \quad (17)$$

Thus, θ_t is a nonmonotonic function:

$$\theta_t = \begin{cases} f(m_t) & \text{if } m_t < m^C \\ 1 & \text{if } m_t \geq m^C \end{cases}, \quad (18)$$

where $f()$ is defined in (16), with $f' > 0$.

The Appendix also shows that the fundamental dynamic equation of the model is given by

$$m_{t+1} = \Phi(m_t, \theta_t) = \begin{cases} \Phi^1(m_t, \theta_t) & \text{if } m_t < m^C \\ \Phi^2(m_t) & \text{if } m_t \geq m^C \end{cases}, \quad (19)$$

where

$$\Phi^1(m_t, \theta_t) = \frac{\Lambda_1^{-1}(1 + \chi_2 m_t^\phi \theta_t)}{\sigma(\beta + \chi_1 m_t^\phi \theta_t)[\delta + (1 - \delta)(1 - \theta_t)]^{\beta/(1-\gamma)}} m_t^{(1-\gamma\eta^{-1})/(1-\gamma)}, \quad (20)$$

¹⁶To avoid a corner solution with no activity in the design sector, the restriction $\theta_0 > 0$ must be imposed. In turn, this requires $m_0 > m^S = \{\beta/\bar{A}[(1 - \varepsilon)(1 - \eta)\gamma]\}^{1/\phi}$, which is also shown in Figure 1.

and $\Phi^2(\cdot)$ is given by setting $\theta_t = 1$ in (20):

$$\Phi^2(m_t) = \frac{\Lambda_1^{-1}(1 + \chi_2 m_t^\phi)}{\sigma(\beta + \chi_1 m_t^\phi) \delta^{\beta/(1-\gamma)}} m_t^{(1-\gamma\eta^{-1})/(1-\gamma)}, \quad (21)$$

with $\chi_1 = (1-\delta)(1-\eta)(1-\varepsilon)\gamma\bar{A}$, $\chi_2 = (1-\delta)(1-\varepsilon)\bar{A} > \chi_1$, and $\Lambda_1 = (\gamma\eta^2)^{\eta\gamma/(1-\eta)}$.

The steady-state growth rate is given by

$$1 + \mathbf{g} = \frac{\Lambda_1 \sigma(\beta + \chi_1 \tilde{m}^\phi \tilde{\theta})}{[\delta + (1-\delta)(1-\tilde{\theta})]^{-\beta/(1-\gamma)}} \tilde{m}^{\gamma(\eta^{-1}-1)/(1-\gamma)}, \quad (22)$$

where $\tilde{\theta}$ and \tilde{m} are the steady-state solutions obtained by solving (16) and (19) simultaneously. Thus, the growth rate depends both directly and indirectly on the effective proportion of H -type individuals in the design sector. However, an increase in $\tilde{\theta}$, from an initial value lower than unity, has in general an ambiguous effect on growth. On the one hand, it fosters innovation; as long as $\tilde{m} < m^C$, (18) implies that $\tilde{m} = f^{-1}(\tilde{\theta})$, so that the knowledge-capital ratio rises. This has a direct, positive effect on growth. On the other, an increase in $\tilde{\theta}$ reduces the supply of labor in manufacturing, which has a negative effect on growth. In what follows it will be assumed that, because labor is relatively more productive in the innovation sector, an increase in the supply of workers with advanced skills is unambiguously growth-enhancing.

The transition function $\Phi(\cdot)$ is highly nonlinear and an explicit steady-state solution value \tilde{m} cannot be derived, regardless of whether $\tilde{m} \leq m^C$. However, the steady-state equilibrium can be characterized directly in terms of $\tilde{\theta}$ and \tilde{m} , given that these variables are interdependent, as implied by (16) and (19).

To determine whether the equilibrium (unique or not) is locally stable, consider first the standard case where $\phi = 0$. Equation (16) implies that θ_t is constant $\forall t$; and from (19), stability requires only that $|(1-\gamma\eta^{-1})/(1-\gamma)| < 1$, or equivalently $1-\gamma\eta^{-1} < 1-\gamma$. This condition boils down to $\eta < 1$, which is always satisfied, given the assumption on the degree of substitutability between intermediate inputs. If so, multiple equilibria cannot arise. However, for $\phi > 0$, as shown in the Appendix, it cannot be established analytically that $|dm_{t+1}/dm_t| < 1$ in the vicinity of the steady state; thus, local stability cannot be guaranteed.¹⁷

¹⁷In fact, neither the sign nor the magnitude of dm_{t+1}/dm_t can be established analytically. Conse-

The adjustment process of the knowledge-capital ratio, as characterized in equation (19), is displayed in a standard 45-degree diagram in Figure 1 with $\phi = 0$. The figure also assumes that $1 - \gamma\eta^{-1} > 0$ or equivalently $\eta > \gamma$, to eliminate oscillatory convergence. If the steady-state equilibrium point is located *before* the threshold level m^C , it will be reached in a smooth fashion (as shown at point E^1). By contrast, if the steady-state equilibrium is located *after* m^C (as for instance at point E^2), and if ϕ is small but positive, the slope of the transition curve will generally change at m^C , as occurs at point B .¹⁸ For $\phi > 0$ the transition curve may turn convex, implying either no equilibrium or two equilibria. Moreover, it can easily be established that if there are two equilibria, only the lower one is stable.

Suppose now that when the share of H -type workers employed in the design sector is low ($\theta_t < \theta_L$), the productivity effect of knowledge is limited and $\phi = 0$. Thus, the adjustment process of m_t is stable, as discussed earlier. Once a critical mass θ_L is achieved, that is, for $\theta_t > \theta_L$, the marginal gains increase in a discrete fashion, and $\phi = \phi_H > 0$. Beyond another point, say $\theta_t > \theta_H$, the network effect is exhausted, and ϕ falls back to 0. There is therefore an intermediate stage where the critical mass of H -type workers employed in the design sector is large enough to generate strong marginal benefits associated with the existing stock of disembodied knowledge; there is a *knowledge network externality*.¹⁹

Given that from (16) the knowledge-private capital ratio is positively and monotonically related to θ_t (until the maximum value of unity is reached), the critical values θ_L and θ_H are associated with two unique threshold values of m_t , given by m_L and

quently, a variety of outcomes are possible: a continuum of unstable steady-state equilibria, periodic equilibria, and complex dynamics. Given the issue at hand, however, a detailed discussion of these cases is abstracted from.

¹⁸As shown in the Appendix, $dm_{t+1}/d\theta_t$ may be either positive or negative. Thus, when m_t reaches m^C , at which point θ_t remains constant at unity, the transition curve may either become steeper or flatter. In the case shown in Figure 1, the latter occurs.

¹⁹Evidence on knowledge networks and their impact on innovation is provided for instance by Brahmabhatt and Hu (2010). In a study of knowledge flows to East Asia based on an international knowledge diffusion model using patent citations data, they found that while East Asian innovations continue to draw heavily on knowledge flows from the US and Japan, citations to the same or to other East Asian economies are quickly rising, indicating the emergence of national and regional knowledge stocks as a foundation for innovation. See UNIDO (2012, Chapter 4.5) for a general discussion of the role of domestic and cross-country knowledge networks in promoting innovation capacity.

m_H . Thus, in the presence of a knowledge network externality, multiple, locally stable steady-state equilibria may emerge. The reason is that, if ϕ_H is high enough, the transition curve may well be convex in the interval (m_L, m_H) . If so, there are several possible outcomes: one equilibrium, and two or three equilibria. Figure 2 displays the case where there are indeed three steady states: one with a low knowledge-private capital ratio, \tilde{m}_1 , corresponding to point A^1 ; one with a high knowledge-private capital ratio \tilde{m}_3 , corresponding to point A^3 ; and an intermediate equilibrium, \tilde{m}_2 , corresponding to point A^2 . Points A^1 and A^3 are stable, whereas A^2 is unstable.²⁰ To the low (high) knowledge-private capital ratio corresponds a low (high) share of H -type workers in the design sector, and a low (high) growth rate. From (16) a low value of m_t means a low value of θ_t ; from (22), as assumed earlier, the net effect of lower $\tilde{\theta}$ (despite the fact that more workers are now employed in the production of final goods) is negative. The equilibrium at A^1 may therefore be labeled a (middle-income) growth trap, and whether or not the economy settles on that equilibrium depends on initial conditions. In particular, economies with a relatively low initial knowledge-private capital ratio—or, equivalently here, a low initial share of high-ability workers engaged in the design sector—may converge to a lower-growth trap.

Indeed, if the initial knowledge-private capital ratio is such that $m^S \leq m_0 < \tilde{m}_2$, the economy will converge to \tilde{m}_1 , whereas if $m_0 > \tilde{m}_2$, it will converge to \tilde{m}_3 . Put differently, the level of the knowledge-private capital ratio that corresponds to the unstable equilibrium A^2 acts as a threshold level that a country must cross if it wants to evolve from “moderate” long-run growth to high growth.²¹ In the first scenario, the knowledge-capital ratio falls during the transition to the trap, and so does productivity. At the equilibrium point A^1 , given that (as noted earlier) the ratio A_t/M_t is constant,

²⁰This case occurs if $\Phi(m_L) < m_L$, $\Phi(m_H) > m_H$, $\Phi(m_t) < m_t$, $\forall m_t \in (\tilde{m}_1, \tilde{m}_2)$, and $\Phi(m_t) > m_t$, $\forall m_t \in (\tilde{m}_2, \tilde{m}_3)$. Note that in the figure it is assumed that the high-growth equilibrium is located to the left of the threshold point m^C , implying that at that point the effective share of H -type workers who have chosen to acquire higher education is less than $1 - \delta$. This is simply to avoid cluttering the graph; m^C and \tilde{m}_3 could be made arbitrarily close to each other.

²¹Note that the high-growth steady state remains inefficient for standard reasons associated with the decentralized equilibrium of Romer-type models—monopoly power (which allows intermediate goods firms to charge a price in excess of marginal cost) and the fact that firms in the design sector do not internalize the intertemporal spillover associated with the creation of ideas. In addition, because entry of new firms in the design sector does not dissipate rents, growth may be suboptimally low. See Gancia and Zilibotti (2005) for a discussion.

the growth rate of productivity is lower as well, consistent with the “productivity slowdown” documented in the empirical studies reviewed in the previous section. Note also that at A^1 , $\tilde{\theta}_1 < 1$; a proportion $1 - \tilde{\theta}_1$ of H -type workers has chosen not to engage in higher education and instead prefers to work in the manufacturing sector. There is, therefore, a *misallocation of talent*, due fundamentally to the fact that the wage in the design sector is *ex ante* too low relative to the going wage in manufacturing.²²

More generally, it is worth noting that the misallocation of talent may also result from poor contract enforcement and protection of intellectual property rights, and the inadequate provision of incentives to engage in risky entrepreneurial activities or, as discussed later, from constraints in accessing finance. The key reason is that innovation is an inherently risky activity; the returns to investment can be highly uncertain. So unless appropriate measures are taken to encourage individuals to engage in these activities, and to ensure that they can enjoy the rewards of their discoveries, even those with high potential and some appetite for risk may (rationally) choose to get safer jobs—a decision that may be socially very costly.

3.5 Lack of Access to Advanced Infrastructure

Modern day infrastructure can be classified into two types: *basic* infrastructure (which consists of roads, electricity, and basic telecommunications) and *advanced* infrastructure, which consists of advanced information and communication technologies (ICTs) in general, and high-speed communication networks in particular. It is now well established that access to broadband facilitates the buildup of domestic and international knowledge networks, thereby promoting dissemination and research as well as innovation and growth (see Canuto et al. (2010) and Czernich et al. (2011)). Broadband networks also provide a platform that other sectors can leverage to develop other platforms (such as distance education and telemedicine) and enable the development of digital content—all of which can help to increase productivity.

Agénor and Canuto (2015) have emphasized, in the model with heterogenous abil-

²²At the higher-growth equilibrium A^3 there may of course be also some misallocation of talent; the point, however, is that it is less significant, and less costly to the economy, than what occurs at the lower-growth equilibrium.

ities described earlier, the lack of access to advanced infrastructure as a cause of a middle-income trap. To highlight the benefit of ICTs, they assume that advanced infrastructure serves to promote activity only in the design sector.²³ Because labor supply decisions are endogenously related to relative wages, there is therefore a two-way interaction between these activities and the proportion of the population acquiring advanced skills. The key result that they establish is that, in line with the foregoing discussion, if the marginal benefits associated with nonrival knowledge depends in a nonlinear fashion on the share of the population involved in design activities, as a result of knowledge network externalities then multiple equilibria may emerge—one of them (the lower-growth equilibrium) being synonymous with a middle-income trap. Intuitively, to create ideas and benefit the most from existing knowledge, there must be enough high-ability individuals involved in the design sector; but if productivity in that sector is low, because access to advanced infrastructure is limited, wages will be relatively low—implying that few high-ability individuals will choose to invest, to begin with, in the advanced skills needed to operate in that sector. Thus, lack of access to advanced infrastructure, through its effect on relative wages and the acquisition of skills, may also contribute to a misallocation of talent.

3.6 Lack of Access to Finance

There is growing evidence that access to finance represents a major constraint on innovation and growth in developed and developing countries alike.²⁴ A key reason for that is the inherent difficulty for firms engaged in innovation to resort to external finance. Assets held by these firms are mainly intangible; as a result, they may lack collateral value. Spending in the form of salaries and wages for scientists and researchers, which

²³This assumption helps to simplify matters but it is not crucial; what matters is that advanced infrastructure be relatively more productive in innovation activities, compared to the production of goods.

²⁴See Ayyagari et al. (2011), Brown et al. (2012), and Hottenrott and Peters (2012). As pointed out by the Inter-American Development Bank (2010), lack of finance—in addition to a shortage of highly qualified personnel (alluded to earlier) and small domestic markets—is one of the key obstacles to innovation in Latin America. At the same time, it can be argued that although a country like Korea has succeeded—mainly because the R&D activities of its largest and most competitive conglomerates were financed internally or through captive funds—in becoming an innovation-based economy without highly developed venture capital markets, it could have performed even better if its small and medium-size innovative firms had not faced financial constraints.

often represent a large fraction of innovation-related activities and help to build human capital, cannot be collateralized. Furthermore, to protect their proprietary information over innovation, firms may be unwilling to offer fully transparent signals about the effectiveness of their intended innovation programs to potential lenders. Limited collateral value and information frictions may thus help to explain why some of these firms—especially the smaller ones—rely little on debt finance and instead fund most of their investments with their own resources or (at later stages and where available) equity. Indeed, the high degree of information asymmetry that characterizes investment in innovation projects may induce lenders to demand higher rates of return than in the case of investments in physical assets. Thus, although information asymmetries may matter for external financing of all types of investments, they may be particularly significant for innovation activity due to its specificity.²⁵ If financing constraints are binding for a sufficient number of innovative firms, economic growth may be adversely affected.

An analysis of how interactions between access (or lack thereof) to finance, product innovation, and labor supply can generate a middle-income trap is presented in Agénor and Canuto (2014). Their analysis shows that if research activity involves borrowing from financial intermediaries and monitoring is costly, high intermediation costs may adversely affect innovation. This is in line with some other contributions in the literature, including Aghion et al. (2005). In addition, if monitoring costs are high, fewer individuals may choose to invest in skills and engage in design activities. The reason is that high monitoring costs lead to lower wages in the design sector, which in turn lead (for a given cost of education) to reduced incentives to invest in skills and thus a lower share of the labor force engaged in research. From that perspective, lack of access to finance not only has a direct, adverse effect on innovation activity and growth, but also an indirect effect that operates in the same direction.

They also show that if unit monitoring costs (as a result of positive information externalities, for instance) fall with the number of successful projects, multiple equi-

²⁵Moreover, funding through equity is either costly—especially for firms whose values are determined mainly by their growth potential and hence are severely exposed to asymmetric information frictions—or simply not available, as is often the case for younger and smaller firms.

libria may emerge—one of which, a middle-income trap, characterized by low wages in the design sector, a low share of the labor force engaged in innovation activity, and low growth. A sufficiently ambitious policy aimed at alleviating financial constraints—through the development of capital markets rather than government subsidies, which may be difficult to target effectively—may allow a country to move away from such a trap, not only by reducing the cost of finance but also by improving incentives to invest in skills and promoting the production of ideas.²⁶

This analysis also has implications for the debate on the optimal size of the financial sector. Indeed, there is growing evidence on the existence of “too much finance,” as documented by Law and Singh (2014), Cecchetti and Kharroubi (2015), Sahay et al. (2015), and Samargandi et al. (2015). Yet, these contributions may have missed an important point; indeed, what the recent literature on the role of finance in causing middle-income traps suggests is that there is also a paradox: there can be at the same time “too much finance”, but not enough of the “right finance,” that is, the type of finance that may promote risky activities in innovation.

3.7 Income Inequality

Another possible cause of a middle-income trap is changing income inequality over time. The well-known Kuznets Curve suggests that greater income inequality is a price to pay for rapid growth in the early stages of economic development.²⁷ As low-income countries develop, with production shifting from agriculture to industry, income gaps between the top and the bottom income groups tend to increase. After reaching a middle-income stage, mass education and continued industrialization combine to foster reductions in income inequality. However, persistence in inequality during the middle-income stage may act as a constraining factor on growth; a key reason for that is that it

²⁶It is worth noting that this analysis also has some relevance for slow-growing industrial countries. Indeed, there is compelling empirical evidence to suggest that in many of these countries access to finance remains an equally important constraint on the innovation activity of small and medium-sized firms. Inadequate access to finance may therefore be the source of a slow-growth equilibrium. In such conditions, a forceful policy aimed at promoting access to finance is also essential to escape from a low-growth equilibrium and put the economy on a path that would allow it to converge to a high-growth, high-innovation equilibrium.

²⁷See for instance Grimalda and Vivarelli (2010) for a recent model of growth of the Kuznets-Lewis type.

may prevent individuals (and their children) with low assets from acquiring skills, due to their inability to raise collateral and secure loans to finance advanced education.²⁸ Egawa (2013) for instance offers a similar line of reasoning to explain why a middle-income country cannot continue to grow at sustained rates if income inequality remains high or worsens at that stage of development.

Some observers had indeed argued that countries like China, Malaysia, and Thailand are suffering from inequality in income distribution that may hinder their prospects for sustained economic growth. It has also been argued that one reason why Brazil (which had a growth rate comparable to South Korea until the 1980s, as noted earlier) was unable to transition into an innovation-based economy is a high degree of income inequality. However, between 2001 and 2009 income inequality fell significantly in that country. During that time, the income growth rate of the poorest decile of the population was 7 percent per year, while that of the richest decile was 1.7 percent; as a result, income inequality (as measured by the Gini index) fell markedly, from 0.594 in 2001 to 0.521 in 2011, that is, a fifty-year low.²⁹ Thus, it is hard to argue that income inequality has been a major factor in explaining the country's persistent growth slowdown. More generally, there appears to be no formal evidence to suggest that greater inequality is associated with a sustained drop or stagnation in productivity.

4 Escaping from Middle-Income Traps

The perspective adopted in the foregoing analysis is that a middle-income trap is best understood not as a *transitional state* (the economy's position at a specific moment in time) but rather as an *equilibrium state*, which tends to be self-perpetuating. The issue then is not only what causes growth to slow down, but also what to do (from a policy standpoint) when the slowdown has occurred and the economy has settled to a stable equilibrium in a context where multiple equilibria exist.

²⁸Cingano (2014) argued that this channel is the main factor explaining the negative correlation between inequality and growth observed in recent years in OECD countries.

²⁹Key drivers of these achievements have been low inflation, sustained economic growth (at a yearly average of 4.0 percent during 2002-08 and 5.1 percent during 2010-11), well-focused social programs, and real increases in the statutory minimum wage. See Cornia (2012) and Lustig et al. (2012) for a more detailed discussion of what accounts for the reduction in inequality in Brazil during the past two decades.

In such conditions, just like what the theory of poverty traps predicts, moving away from that equilibrium—as in any model with stable, multiple equilibria—requires a major change, namely a policy that is bold enough to shift the economy from the initial, low-growth equilibrium to a path that can lead it to a high growth equilibrium. Small changes in policies can only induce temporary deviations away from the initial equilibrium and the economy will eventually return to it. Yet, if a middle-income trap is viewed as a “bad” equilibrium in a setting where multiple equilibria exist, then *temporary*, properly targeted interventions can also have *permanent* consequences. And because what drives a country into a trap when it reaches middle-income status may often be a combination of factors (poor quality of human capital interacting with lack of finance, for instance), a *critical mass of well targeted reforms* may often be indispensable to set the economy in motion toward a high-growth path.

This section considers various public policies that can help a country avoid falling into, or escape from, a middle-income trap. To a significant extent, these policies are directly related to, or motivated by, the causal factors highlighted in the preceding section. Thus, policies or reforms that may be desirable in general from a growth standpoint (such as product market reform, as emphasized by OECD (2014)) are not discussed, because they are not fundamental from the perspective of avoiding, or escaping from, a middle-income trap.

4.1 Raising the Quality of Education

As noted earlier, the quality of education may be a key constraint that prevents a country from transitioning to higher-income status. The role of public policy in the presence of the type of threshold externalities discussed in Agénor and Canuto (2015), and summarized earlier, is illustrated in Figure 3. Suppose that the economy is initially at a knowledge-private capital ratio m_0 , located to the *left* of the unstable equilibrium, \tilde{m}_1 , and consider a policy that helps to increase productivity \bar{A} in the design sector. As can be inferred from the foregoing discussion, such a policy has two opposite effects on the knowledge-private capital ratio. On the one hand, it tends to increase that ratio, because higher productivity in the design sector raises wages *ex ante* and the supply of labor in that sector. On the other, higher wages and higher employment translate

into higher saving per H -type worker, which tends to increase investment and the private capital stock. But the shift in the workforce toward the design sector also means less workers, and thus less savings, from those employed in the manufacturing sector. Even though the reduction of employment in the manufacturing sector puts upward pressure on wages there, wages in the design sector must also increase for the transfer of labor across sectors to actually occur. Thus, the positive effect on the degree of product diversification dominates, and the knowledge-capital ratio increases following an autonomous increase in productivity in the design sector. Graphically, the transition curve $\Phi(m_t)$ shifts upward, whereas the threshold values m_L and m_H shift to the left.³⁰ If this shift is large enough (that is, if the increase in \bar{A} is of a sufficient magnitude) it may be such that the initial knowledge-capital ratio m_0 may now be positioned to the *right* of the new unstable equilibrium (located at point B^2), thereby ensuring convergence to the new higher-growth equilibrium, located at B^3 .

Of course, the upward shift in the transition curve could be so large that it eliminates entirely the possibility of multiple equilibria, leaving only a single, stable equilibrium.³¹ Note also that from (17), the increase in \bar{A} lowers the threshold m^C above which all H -type individuals choose to engage in schooling. Although this shift is not shown to avoid cluttering the figure, what it means is that the degree of talent misallocation is now likely to be smaller at the high-growth equilibrium, in addition to the fact that the new equilibrium B^3 is located to the Northeast of A^3 .

More generally, increasing knowledge absorption capacity, namely, the ability to adopt and capitalize on ideas from more advanced economies and technology transfers (not only through international trade but also through foreign direct investment, as documented by the World Bank (2008) for instance) is key to promote innovation. From that perspective, targeted *microeconomic* reforms of the education system (such as increases in teacher-student ratios, better incentives for teachers, improved access to the internet in schools, and so on), rather than higher public spending on education *per*

³⁰As noted earlier, equation (16) implies that the threshold levels m_L and m_H depend negatively on \bar{A} . To avoid cluttering the figure, the shift in m_L and m_H is not shown. Note that if the shift in m_L is large enough, the lower-growth equilibrium point B^1 may actually disappear, leaving only the higher-growth equilibrium.

³¹This is the same outcome that would obtain if the leftward shift in m_L is large enough, as noted in the previous footnote.

se, may be critical. In some countries, stopping the brain drain, and favoring “brain circulation” (capitalizing on the diaspora by promoting knowledge-sharing networks) may also be important.

Improving the quality of education is, indeed, one of the key policy prescriptions to accelerate the transition to high-income status in the coming two decades in Asia (Lee and Francisco (2012)) and Latin America (Inter-American Development Bank (2010)). At the same time, it must be recognized that high quality scientific knowledge and technical skills, while necessary, are not sufficient for the emergence of an innovation-based economy. The degree of diversification of competencies and skills is also important.

4.2 Subsidies to Innovation

Traditionally, government subsidies to R&D are justified in terms of a divergence between private and social marginal returns (see OECD (2010)). From the perspective of escaping a middle-income trap, the justification is slightly different—it is mainly in terms of equilibrium selection. To the extent that they help to prop up wages in the innovation sector and reduce the inherent degree of uncertainty associated with the returns to innovation, temporary public subsidies can also help to mitigate the misallocation of talent alluded to earlier. However, subsidies to innovation are unlikely to work if the binding constraint on productivity growth in the innovation sector is related to another factor, such as the lack of access to advanced infrastructure. In that case, correcting distortions in terms of incentives to work in innovation activities requires a combination of policies.

4.3 Contract Enforcement and Protection of Property Rights

Poor contract enforcement and lack of protection of property rights (especially intellectual rights) are key weaknesses in developing countries in general, and middle-income countries in particular. According to the OECD (2014, p. 176) for instance, countries like Brazil and Morocco fare poorly compared to industrial countries in terms of a “contract enforcement score” and an intellectual property index. These weaknesses tend to weaken confidence and may have an adverse effect on all aspects of economy activity; but they may be particularly detrimental to innovation activities. Indeed, the

inability to sanction in the event of a contract being breached, and especially inadequate intellectual property protection, may act as major constraints on the incentives to engage in innovation because the return to that activity is not certain and because (as noted earlier) firms may be unwilling to offer fully transparent signals about the effectiveness of their intended innovation programs to potential lenders. As a result, this may make it more difficult to secure access to finance.

Contract enforcement requires that a legal system incorporates effective mechanisms of law enforcement, namely, an impartial judicial system, whereas securing intellectual property rights requires not only to develop new legislation but also to raise awareness of existing laws. However, very few countries that have been thought to be in a middle-income trap (in Latin America and elsewhere) have managed to make improvements in that regard.

4.4 Promoting Advanced Infrastructure

As noted earlier, lack of access to advanced infrastructure may be an important barrier to the development of national and international knowledge networks and the increase of productivity. As discussed earlier, if the marginal benefits associated with nonrival (disembodied) knowledge depends in a nonlinear fashion on the share of the population involved in design activities (being high for a range of values for that share), as a result of the knowledge network externality alluded to earlier, then a middle-income trap, characterized by low productivity growth may emerge. Intuitively, to create ideas and build on existing knowledge, there must be enough “high IQ” individuals involved in R&D; but if productivity in that sector is low, because access to advanced infrastructure is limited, wages will also be low—implying that few people will choose to invest in the advanced skills needed to operate in that sector. Escaping from the trap may be achieved by a sufficiently large increase in investment in advanced infrastructure.³² The

³²Because of nonlinearities associated with the benefits of advanced infrastructure (as is the case for broadband networks documented by Cz (2011), for instance, the critical mass of reforms advocated here may well involve a Big Push in that category of investments. However, this does not have to come from an overall increase in public spending, it could very well come from a reallocation of investment, away from spending on basic infrastructure. This is indeed an important consideration for countries like China and Morocco where, as discussed earlier, the efficiency of public investment may have fallen significantly in recent years.

key reason is that improving access to this type of infrastructure boosts productivity and wages in the design sector, which draws more labor there and may trigger the shift in labor supply that magnifies (at least temporarily) the benefits associated with exploiting ideas and absorbing new technologies.

Because of the lumpy nature of infrastructure investments in general, and the nonlinearities associated with the benefits of advanced infrastructure in particular (as is the case for broadband networks documented by Czernich et al. (2011), for instance), the increase in spending in that category of investments may well need to be substantial. However, it does not have to come from an overall increase in public spending, as a *Big Push* theory would advocate. It could instead come from a *reallocation* of public investment, away from spending on basic infrastructure, and improved management of investment projects. These are indeed important considerations for countries like China and Morocco where, as discussed earlier, the efficiency of public investment (much of it still devoted to basic infrastructure) may have fallen significantly in recent years. Moreover, advanced infrastructure does not need to be provided by the public sector only; given the costs involved and tight budget constraints in many countries, partnerships between the state and the private sector could provide viable alternative options.³³

4.5 Improving Access to Finance

As noted earlier, information asymmetries are likely to be especially binding on talented individuals and small enterprises that lack collateral, credit histories, and connections, and limit their ability to secure external funds for the financing of innovation projects. The foregoing discussion, based on Agénor and Canuto (2014), suggested that access (or lack thereof) to finance may constrain growth not only by increasing the cost of monitoring innovation activities, as emphasized in other contributions such as Aghion et al. (2005) and Aghion and Howitt (2009), but also by altering incentives to acquire skills. Indeed, the degree to which firms innovate and the distribution of skills among

³³See Engel et al. (2014) for a discussion of issues associated with public private partnerships in the provision of infrastructure.

workers (which conditions the development of innovation activities) are jointly determined; lack of skills and poor access to finance are interrelated.³⁴ These interactions can lead to a middle-income trap, characterized by a misallocation of talent and a high cost of financial intermediation.³⁵

In this context, public policy aimed at mitigating the impact of these imperfections (or, more specifically, those aimed at reducing the unit cost of monitoring R&D projects) may allow a country to avoid falling into, or to escape from, that trap. Ensuring access to more funding sources may lead to more intensive innovation, more successful R&D projects which, in turn, may result in lower unit monitoring costs, thereby helping to further promote financial intermediation, innovation, and economic growth.³⁶ However, rather than providing direct subsidies (given well-known targeting problems), an alternative policy would be to implement measures that are aimed directly at mitigating asymmetric information problems and reducing unit monitoring costs, such as for instance the creation of credit bureaus or registries that help to collect, analyze, and disseminate information about potential borrowers to lenders. The evidence suggests, for instance, that more effective credit information sharing is associated with greater availability and lower cost of bank loans to firms (World Bank (2014, Chapter 3)). Such a policy may actually be more effective in middle-income countries, given a weak institutional environment and the practical difficulties that may arise in selecting research projects whose outcomes are inherently uncertain.

Improved access to finance for innovative firms may also have side benefits—it may improve incentives to acquire skills, and therefore indirectly help to promote innovative research. At the same time, however, it is important to realize that in practice a strategy of promoting the financial sector across the board may not yield only benefits. The reason is that it could lead (as discussed earlier) to a misallocation of talent.

³⁴Attitude toward risk matters as well; to turn a promising idea into a new firm, researchers must also face the right incentives to give up safe employment for a risky entrepreneurial career.

³⁵These characteristics of the middle-income trap could equally apply to some high-income OECD countries where growth has remained anemic for significant periods of time, and promoting innovation remains a key policy challenge.

³⁶The fact that in practice the importance of financial constraints may vary with firm characteristics points also to another conclusion: for any innovation policy program to be effective it is vital not to rely on uniform R&D and innovation support measures, but to provide programs that support different firms in different ways.

Indeed, if the expansion of the financial sector, by offering higher earnings and rewards, draws too many talented individuals, it could hamper in the long run the development of the innovation sector. Thus, rather than promoting finance in general, what is needed is a well-targeted policy aimed at making it easier for innovative firms to secure adequate funding for their activity. Put differently, from the perspective of escaping a middle-income trap, the problem is not too much finance (the size of the financial sector) but the degree of diversification of finance.

In sum, the middle-income trap is not an unavoidable outcome. To steer clear from it and manage the transition to high-income status requires structural reforms to boost technological catch-up, facilitate structural transformation into higher productivity sectors and new activities, and better allocate existing resources in the economy.

5 Concluding Remarks

The purpose of this paper was to provide an overview of the recent analytical and empirical literature on middle-income traps. The first part of the paper reviewed the evidence on these traps and pointed out some of the limitations of existing cross-country studies. It was argued that, despite these limitations, the concept of a middle-income trap is useful from a policy perspective because it calls attention to the limited number of middle-income countries that have been successful in attaining a developed economy status—even if absolute incomes have risen and non-income dimensions have improved substantially in many of them. In so doing, it helps to recognize the particular challenges that countries may face once they reach a particular stage of development.

In the second part of the paper the various arguments that have been put forward to explain the existence and persistence of middle-income traps were discussed. A key conclusion of the analysis is that a middle-income trap is often an imitation trap, that may result from interactions between the lack of advanced public capital or inadequate access to finance, and lack of high quality human capital involved in innovation activities. It was also argued that from an analytical perspective, rather than slow movement toward a unique equilibrium due to structural and policy differences across countries, as emphasized in the conventional literature on growth convergence, a middle-income

trap is best viewed as a bad but stable equilibrium to which a country may gravitate as a result of different initial conditions.

The analysis then focused on policies aimed at escaping from, or avoiding, a middle-income trap. The key issue from that perspective is what type of policy reforms must be implemented to boost productivity growth and create incentives to engage in R&D. The discussion emphasized the importance of raising the quality of human capital, investing in advanced infrastructure, improving contract enforcement and securing intellectual property rights, and improving access to the right type of finance to promote innovation. Complementarities between these policies means that reform programs must be sufficiently ambitious in terms of their breadth. Moreover, at the level of each policy *threshold effects* may exist; a reasonably high stock of high quality human capital may be needed before an economy can shift to an innovation-based growth process, access to advanced infrastructure must be sufficiently broad to allow knowledge networks to develop, and so on. The existence of these effects, combined with the fact that by their very nature middle-income traps are stable equilibria, means that targeted policy reforms must be sufficiently bold to allow an economy to shift toward higher value-added, knowledge-intensive activities, promote product differentiation (increasing the variety and the characteristics of goods produced) and product upgrading (improving the quality of the existing goods), and eventually transition to higher income status.

The foregoing analysis also has important implications for the sequencing of growth strategies in low-income countries. For many of today's poor countries, imitation is an important initial phase; policy should focus first on strengthening the basic infrastructure necessary for the successful adoption, diffusion, and implementation of already existing technologies, and on developing basic domestic human capital. At the same time, if there are spillover effects on learning associated with imitation activities, they may also promote knowledge accumulation. This two-way causality implies that an initial phase of specialization in imitation activities is not necessarily detrimental to sustained growth in these countries. However, the risk for countries specializing in low-skilled intensive activities is that they entail rapidly diminishing returns. With inadequate incentives to invest in higher education, and insufficient investment in research-promoting infrastructure, their longer-term prospects may be constrained and they may fall into

a low-growth imitation trap. It is therefore important to act in a timely fashion and begin early enough to step up investment in human capital and advanced infrastructure, to improve the country’s capacity to compete at the global technological frontier and ensure sustained growth. Delays in making these investments may be costly, as some slow-growing middle-income countries have now found out.³⁷

The existing literature can be expanded in several directions. At the theoretical level, further research is needed to understand how R&D spillovers and income inequality can lead to a low-growth trap.³⁸ A better understanding of the role of political economy factors is also needed; it is possible, for instance, that as countries become richer, the demand for democratic rights increases; this may exacerbate the common pool problem—because interest groups do not internalize the impact on the government budget of their competing demands for public resources—thereby leading to chronically high fiscal deficits and public debt, which deter private investment and stifle growth. Alternatively, “institutional reversals,” associated with changes in the political environment may also explain growth slowdowns, as argued for instance by Acemoglu and Ucer (2015) in the case of Turkey.

Yet another fruitful direction would be to examine to what extent the recent literature on secular stagnation in an industrial-country context—such as the contribution of Eggertsson and Mehrotra (2014), which highlights in particular the role of increases in inequality and a fall in the relative price of investment as sources of persistence in output slumps—could provide additional insights, above and beyond those discussed here, to understand the growth slowdowns that may occur in a middle-income context. At the empirical level, better attempts to estimate how the various causes of poverty traps interact is essential to inform policy choices. It is also important to develop empirical tests based on more advanced nonlinear techniques, such as for instance the tests for threshold effects in the context of dynamic heterogeneous panel data models developed by Chudik et al. (2015) in a different context.

³⁷The “unbundling” of manufacturing into global supply chains also has important implications for the type of growth strategy that today’s low-income countries should pursue to avoid falling into a middle-income trap. See UNIDO (2009) and Rodrik (2015) for instance for a discussion.

³⁸Chen and Chu (2010) for instance found that with R&D spillovers across firms, strengthening patent protection may actually stifle innovation and deter growth. However, this result is based on a model that does not capture the benefits of intellectual property protection for risk taking.

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Figure 1
 Dynamics of the Knowledge-Capital Ratio
 with $\phi \geq 0$ and $\eta > \gamma$

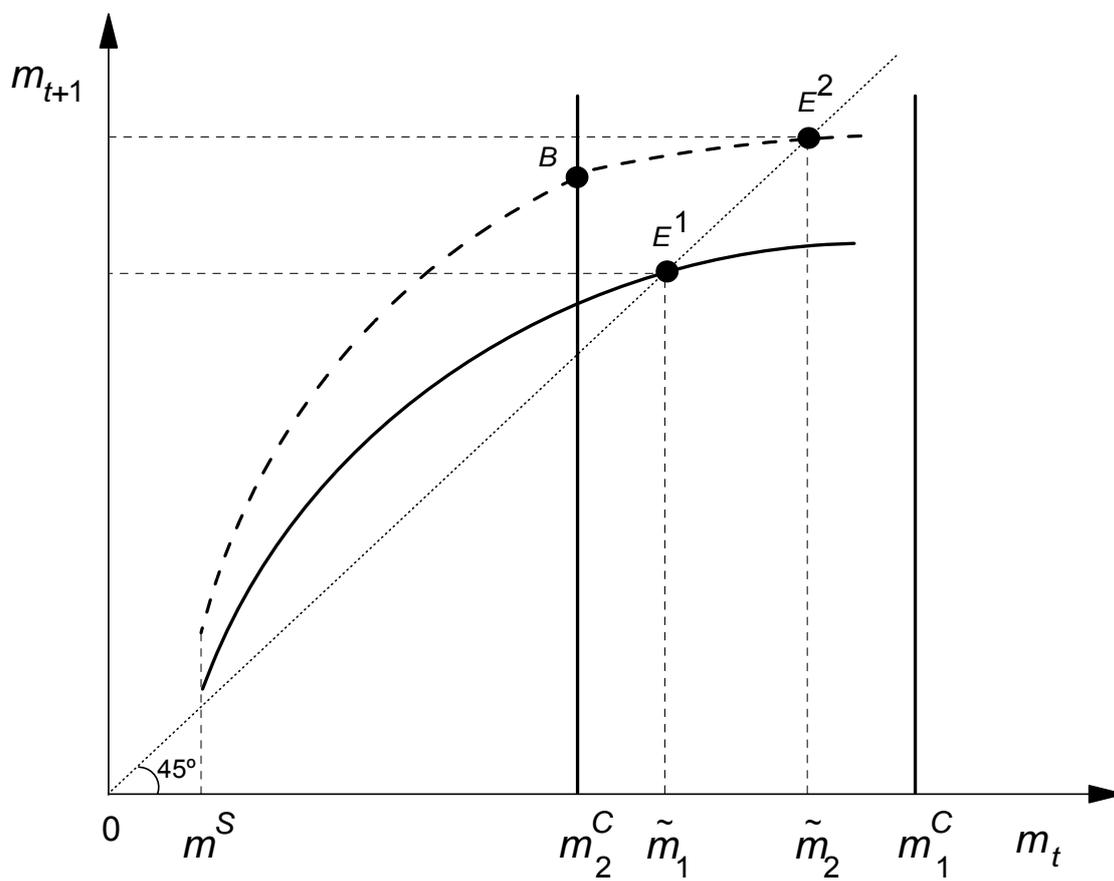


Figure 2
Knowledge Network Externality and Multiple Equilibria

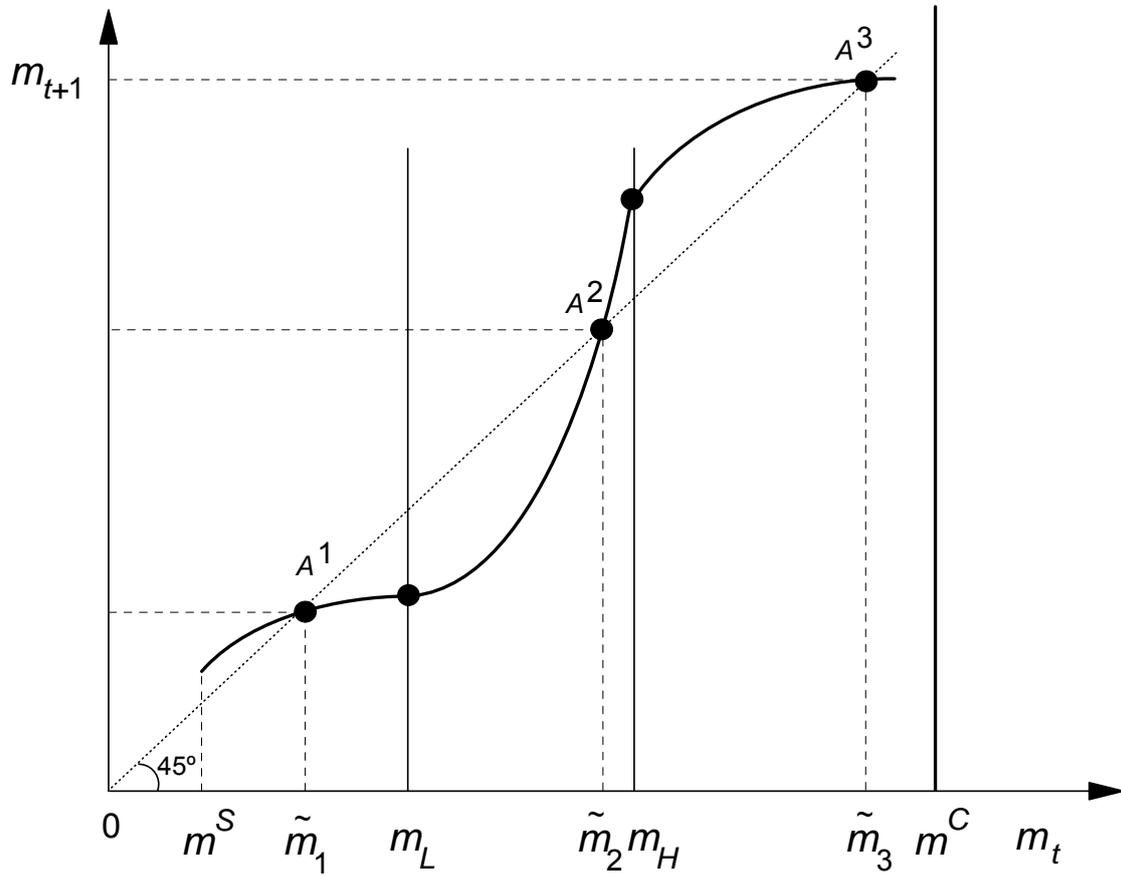
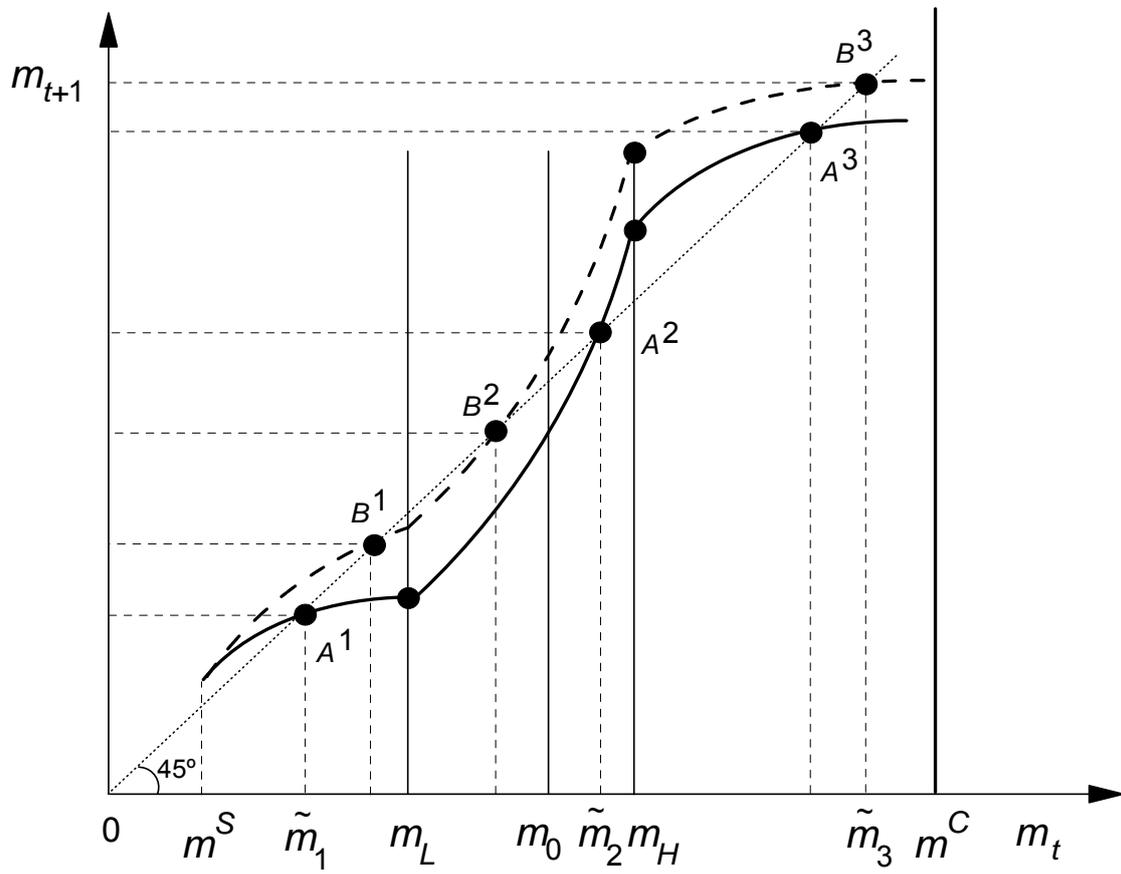


Figure 3
Escaping from a Middle-Income Growth Trap



“Sur quoi la fondera-t-il l'économie du monde qu'il veut gouverner? Sera-ce sur le caprice de chaque particulier? Quelle confusion! Sera-ce sur la justice? Il l'ignore.”

Pascal



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