

Death Spiral or Rallying Cry? In Search of a New Growth Model for Singapore

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Abstract

For the seven years following the advent of the global crisis, productivity in Singapore has slumped to an average of -0.2 percent. While this malaise is not unique to Singapore, existing explanations have typically been formulated by appealing to the experience of traditionally industrialized nations, with insufficient attention to the idiosyncratic Singaporean context. The problem of stagnant productivity is particularly troubling for Singapore's economy, which owes much of its impressive growth legacy to the accumulation of inputs to production. Between independence in 1965 and the crisis in 2007, the contribution of human and physical capital to gross domestic product (GDP) growth averaged 2.7 and 3.6 percent, respectively, with total factor productivity adding only 1.6 percent. The emerging trends in these factors do not bode well for Singapore's future growth. Even with continued immigration, the labor force will face a demographic drag from an aging society, which is only minimally offset by further increases in the educational level of the workforce, due to diminishing returns. A graying society will also reduce domestic saving available for investment, which is unlikely to be made up from foreign sources, given the relatively high cost of labor. Consequently, Singapore's impressive record of rapid, efficient resource mobilization may, paradoxically, herald a much faster breakdown in economic performance. The ability of Singapore to reverse this outcome depends on policy solutions that enable a smooth transition in the interim, while simultaneously establishing the preconditions for an innovation-led economy. Examples of refinements to the growth model include micro-structural policies that expand educational opportunities, improve the quality of investment, and raise productivity via not only research and development (R&D), but also through building intangible capital beyond research and development expenditure, such as in management expertise, digitized information, and strengthened social networks. Only then can Singapore secure its economic future.

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Introduction

Between independence in 1965 and the eve of the global financial crisis in 2007, Singapore's GDP grew, on average, at astonishing 7.9 percent per annum, on the back of rapid growth in technological efficiency—as measured by total factor productivity (TFP)¹—that averaged 1.4 percent over the period. Yet for the 7 years since the crisis, productivity in Singapore—along with the rest of the world—has slumped to an average of *negative* 0.2 percent, even taking into account the massive post-crisis bounce in 2010, where output growth peaked at 14 percent.

This productivity malaise is not confined to Singapore. Across industrialized economies, observers have puzzled over why productivity has been so anemic since the crisis.² While these explanations provide some rationalization for why slowing productivity may ultimately be a global phenomenon, such hypotheses offer insufficient attention to the Singaporean context. Stagnant productivity is particularly troubling for Singapore's economy, which has owed much of its impressive growth legacy to the accumulation of inputs to production,³ rather than advances in technological capability and institutional innovation. While such catch-up growth was a credible strategy when the economy remained some distance from the global technological frontier,⁴ the gains from this (hitherto successful) model are likely to have been exhausted.

This essay outlines the challenges that Singapore will face if it continues to embrace business as usual. The arguments are framed around an analytical framework that models the evolution of historical contributors to Singapore's economic growth.⁵ This methodology—known as growth accounting—offers important insights into the historical sources underlying Singapore's economic success. But the true strength of this approach is that it can also be used to speculate on the future evolution of the economy.

Incomplete Diagnoses and Misleading Prognoses

The leading explanations for the global slowdown in productivity growth include economic headwinds due to supply-side factors,⁶ especially demographic drags from older populations;⁷ the hangover from a severe financial crisis and the associated debt overhang;⁸ the absence of productivity-enhancing investment due to persistent negative real interest rates;⁹ and mismeasurement of aggregate productivity advances, due to difficulties inherent in capturing service-sector—especially information and communications technology (ICT)-related—advances,¹⁰ exacerbated by the speed of the ICT revolution.¹¹

Each of these explanations offer nuggets of truth, and the challenge of raising future productivity is undoubtedly a global one. The global policymaking community will therefore need to work together to fully realize the gains from ICT, resolve the global savings glut, reduce the shadow of debt burdens, and extract labor-force contributions even in the face of demographic decline. Yet these global aspects of the problem offer only a blinkered perspective of the

domestic challenges that a small, open economy such as Singapore will face.

Existing diagnoses simply do not account for Singapore’s unique development trajectory and prevailing economic structure—which has emphasized the rapid accumulation of physical and human capital, and a rapid transition from low-cost manufacturing to high value-added services—which suggests that such prognoses offer only an incomplete understanding of the country’s economic future.

Deconstructing Sources of Singapore’s Success

Between 1965 and 2000, Singapore rode the demographic wave of a young nation: rapid population growth, coupled with liberal immigration policies, more than tripled the size of its economically-active labor force.¹² This was accompanied by a sharp increase in educational levels, which had doubled by the turn of the millennium. This dual complementarity of labor force growth and educational attainment meant an unprecedented rate of accumulation of human capital.¹³

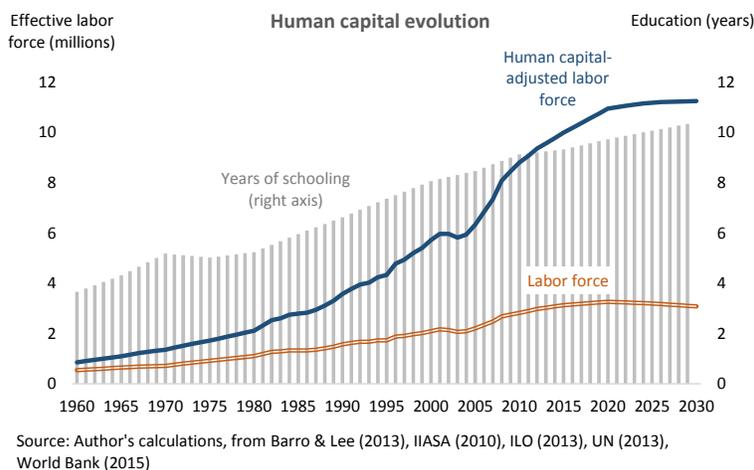


Figure 1: The evolution of human capital, defined as a function of the education-adjusted labor force, historical (1960–2014) and projected (2015–2030). After an exponential rate of increase through 2010, human capital accumulation reached a point of inflection, and will stagnate into the future as the labor force shrinks (due to demographic change) and the benefits of education temper (due to diminishing returns).

Coincident to this unprecedented accumulation of human capital was a large increase in physical capital,¹⁴ as mandatory saving and foreign direct investment increased the share of capital in the economy from 2 to 3.4 times of GDP by 2000.¹⁵

The rate of productivity growth implied by these patterns of human and

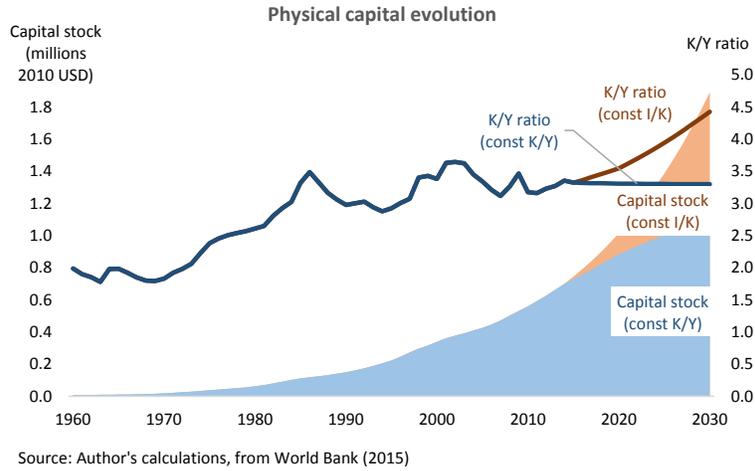


Figure 2: The evolution of physical capital, defined as the depreciated flow of fixed capital accumulation, historical (1960–2014) and projected (2015–2030). Before peaking in 2001, physical capital rose steadily as a share of output, roughly doubling from the trough in 1963. Since the mid-1980s, the capital-output ratio appears to have stabilized around an equilibrium. Maintaining an investment rate comparable to the average since 1990 (constant $\frac{I}{K}$) thus seems unlikely, compared to the more plausible case where capital remains a stable share of output (constant $\frac{K}{Y}$).

physical capital accumulation has never been particularly impressive,¹⁶ but more worrisome is that productivity has yielded ever-decreasing contributions to economic dynamism since independence: TFP growth averaged 1.9 percent in 1965–1984, slumped to 1.2 percent over the next two decades, and has slumped to a mere 0.5 percent to growth since 2005.

The Hunt for Contributors to Future Growth

Unfortunately, Singapore’s very record of rapid, efficient resource mobilization may herald a much faster breakdown in economic performance. This outcome is well-captured by unfolding trends in its historical drivers of production. The contribution from physical capital accumulation has stabilized around a fixed share of output since the mid-1980s. With an aging population, domestic saving available for financing investment will shrink as retirees dissave,¹⁷ and investment from foreign sources is increasingly difficult for a society without a low-cost labor supply. Likewise, the contribution from human capital is expected to unwind over course of the next decade, even with an anticipated inflow of foreign talent: a graying population will steadily contract the labor force after 2020, and the rate of increase in schooling is likewise diminishing. The erosion of

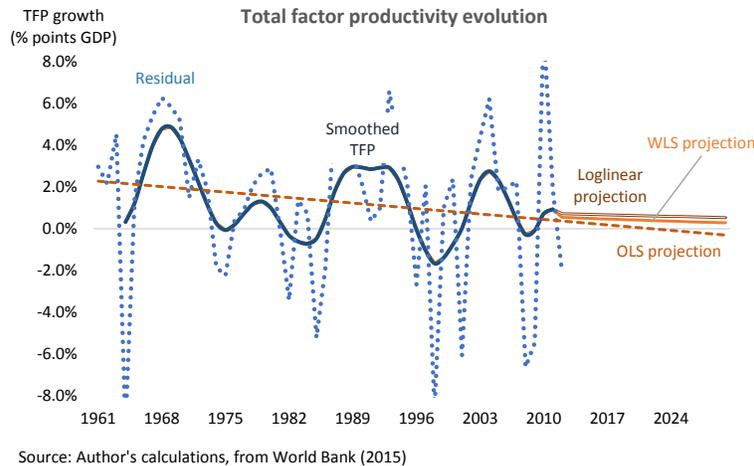


Figure 3: The evolution of total factor productivity, defined as the smoothed residual of the growth accounting exercise, historical (1960–2014) and projected (2015–30). The TFP estimate is smoothed using a Hodrik & Prescott (1997) filter, and fitted loglinear, linear ordinary least squares (OLS) and weighted least squares (WLS) regression lines all trend downward.

human capital will accelerate as slowing education interacts negatively with the shrinking workforce.

It is unlikely that this reversal will be arrested solely by productivity growth. The gains to improving resource allocation appear to have largely disappeared.¹⁸ Furthermore, the absence of legacy technologies and the rapid diffusion of ICT-related innovations imply that most of the gains from the diffusion¹⁹ and adoption²⁰ of innovations from the global frontier are also likely to have been realized. The direction of productivity growth thus points unmistakably downward.

Taken together, it is not difficult to conceive of scenarios where, were Singapore to rely on its historical sources of growth, economic performance would not only slow but actually collapse. In the absence of renewed drivers, Singapore’s growth rate will stagnate at less than 3 percent through the remainder of the decade, and languish at less than 1 percent through the rest of the next.

Tailored Policy Solutions

Although improvements in TFP are assuredly the only viable, long-term solution to sustainable economic growth, what is required is a growth strategy that enables a smooth transition over the next decade, while simultaneously establishing the preconditions for an innovation-led economy by the next generation. This calls for a shift to a new growth model, alongside refinements to the current model.

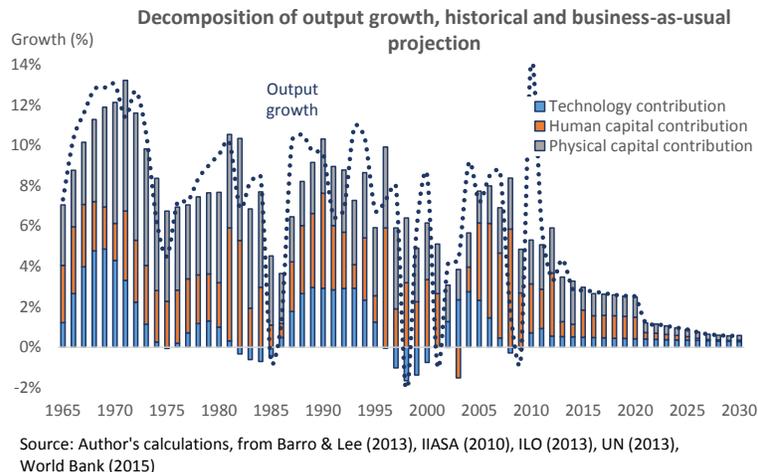


Figure 4: Decomposition of growth by physical capital, human capital, and TFP contributions, historical (1960–2014) and projected (2015–2030). The business-as-usual projection assumes a contribution of human capital consistent with demographic, labor supply, and educational projections from United Nations (2013), International Labor Organization (2013), and K.C. *et al.* (2010), physical capital consistent with a constant capital-output ratio, and the TFP contribution assumes a weighted least squares projection, using the temporal dimension as weights. The difference between observed output and the sum of input contributions is the output gap, which captures the deviation between actual and potential GDP.

One such refinement lies in the continued expansion of educational opportunities, which has the potential to mediate the slowing contribution from human capital. If Singapore were to simply grow its level of educational attainment to that of the United States prevailing in 1976,²¹ it would more than offset the negative demographic drag from population growth. Doing so would even allow policymakers to stem the current flow of economic migrants—the sharp increase in recent years having been a source of social friction among the local populace—without severely threatening growth prospects.²²

In practical terms, raising the average level of schooling requires going beyond the existing structures of the local educational system. One important gap is the existing approach toward non-academic training. This goes beyond the well-worn critique that creative and critical thinking is underemphasized by the existing educational curriculum; it entails a systematic effort to evolve a mindset that legitimizes technical and vocational streams. While the ITE/polytechnic system exists, Singapore has failed to design and implement systems that elevate the quality of professional training in a way that yields consistently high value-added qualifications. The system can be strengthened by including dual apprenticeship programs (Germany/Switzerland), expanded industry certifica-

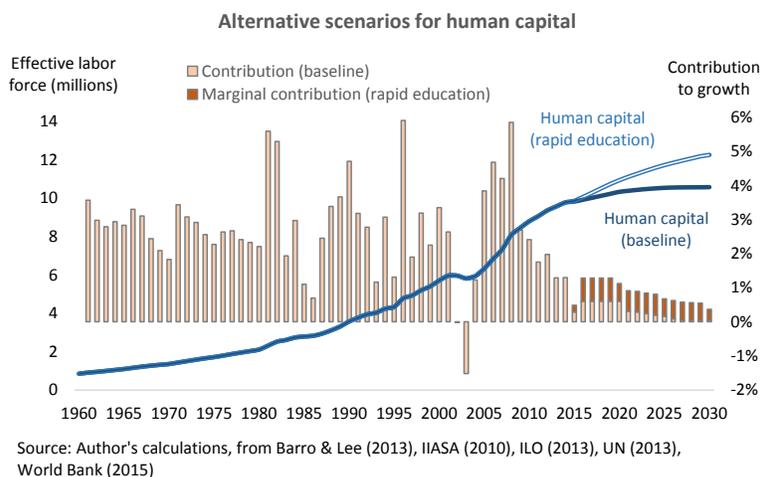


Figure 5: Alternative scenarios for evolution of human capital (lines) and related contribution to growth (bars), with projections through 2030. The rapid education scenario assumes that educational attainment follows the path for the U.S. for the historical period 1961–1976. The initial average years of schooling in each case are roughly similar (9.3 in Singapore in 2015, and 9.4 in the U.S. in 1961).

tions (United States), and increasing the flexibility of vocational program graduates to re-enter academic tracks (the Netherlands).²³

Moreover, the existing school system also treats the majority of pre-primary education as largely optional. Yet targeting early childhood can yield enormous payoffs, and provides the foundation for educational efforts later in life.²⁴ Just as important, the set of life skills acquired through early childhood education—especially concerning social interactions and emotional maturity—extend beyond formal knowledge. The government-linked Early Childhood Development Agency currently exists as more of a funding and regulatory body, but its role can be expanded to an agency that develops a nationwide early-childhood learning program, performs pedagogical and psychological research on preschool learning, and provides training to adult family members to support child development.

Another refinement involves a shift away from crude capital deepening, toward improving the quality of investment. Since the turn of the century, Singapore has sought to relieve its blunt reliance on capital-intensive growth through the pursuit of financial deepening: in the three decades between 1982 and 2012, the share of financialization in GDP doubled, to around 500 percent. Yet real investment activity has fallen during this time, consistent with the mixed empirical record of financial development in fostering investment activity worldwide.²⁵ A more discretionary focus on high marginal-product industrial sectors, consistent with alleviating the most binding constraints faced by firms,²⁶ would raise

the overall efficiency with which capital is being deployed.

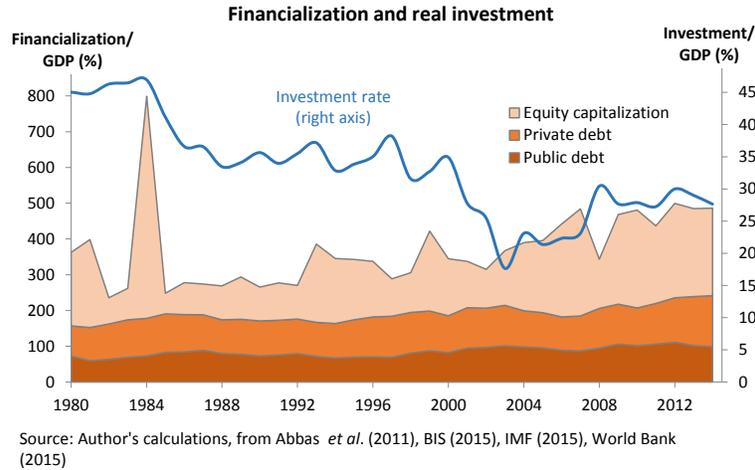


Figure 6: Financialization, proxied by the sum of equity market capitalization, debt by the public sector, and private nonfinancial debt, and real investment, measured using gross capital formation. Even as financialization has gradually increased since the 1980s, real investment activity has trended in the opposite direction.

One application of this principle is to expand financial access, especially for entrepreneurship in more traditional economic sectors. While venture capital activity began to take off in 2012—assisted by catalytic efforts by the government—market activity remains focused on trendy clusters such as biotech, greentech, and ICT. In contrast, seed funding for non-tech startups is harder to come by, and financial inclusion in Singapore—as gauged by the penetration of saving and borrowing in the formal banking sector—still lags the OECD average.²⁷ Enhancing inclusion could enable the sort of revolving credit and microloans that have been an invaluable source of startup financing elsewhere.

These refinements should occur concurrently with direct efforts at raising TFP in the medium run. For starters, it is helpful to recognize that TFP *is itself endogenous*; that is, technological change can result from intentional investment decisions in innovative activities.²⁸ This reality is not lost on policymakers. Between 1996 and 2012, R&D expenditure in GDP rose by half, from 1.3 to 2 percent, and researchers and technician involved in R&D rose more than threefold, to 36,700 personnel. Yet efforts on this front have fallen behind comparable economies: average R&D expenditure among high-income OECD countries was 2.6 percent of GDP in 2012, and in innovation-intensive economies such as Japan and South Korea they are closer to 3.5 and 4.1 percent, respectively.

Furthermore, an understanding of TFP-boosting innovation should not be constrained to science, technology, engineering, and mathematics (STEM). In-

tangible capital that can boost TFP exists in many forms; productivity can be raised through more sophisticated managerial techniques, finding value in information (especially in digitized form), and strengthening cooperative linkages through social networks.²⁹ Innovation is not exclusively about building something better, cheaper, or more useful; it is about introducing fundamentally new approaches that displace existing practices across the economy. Of course, not all innovation should be limited to “disruptive” innovation; incremental innovations can also enhance TFP.

While Singapore has sought to introduce a number of research parks, such efforts have focused on STEM, to the detriment of innovation in other old-economy economic activities. More generally, the purpose of innovation clusters is to encourage spillovers between knowledge activities; such clusters should provide an environment that promotes information exchange and network formation regardless of field, rather than seek to identify likely winners, which is always difficult to do *ex ante*. To the extent that such targeted industrial policies are entertained, they should focus on addressing intra-cluster coordination failures, and be subject to sunset clauses.³⁰ For instance, they should support broadly-defined innovation and promote inter-firm cooperation, and target internationally-oriented exporters, rather than only startups: the former have a proven track record, and are more likely to be highly productive.³¹

Conclusion

Time and again, Singapore has confounded pessimists that have dismissed its ability to navigate challenging economic waters.³² This time is no different, although the stakes involved in getting the diagnosis—and hence remedy—wrong are significantly higher. There remain levers that can be exploited to eke out further growth on the basis of Singapore’s existing model, but policymakers must simultaneously build the foundations that ensure longer-term productivity growth. These foundations should be built on a richer understanding of education, investment, and innovation that currently perceived. Policies that ensure that the growth is broadly distributed across all levels of society are also the ones that hold the greatest potential to transform a growth malaise into a renewed rallying cry.

(1,999 words, excluding 300-word abstract, section titles, figures, endnotes, references, and appendix)

Endnotes

¹In this essay, TFP is used as the measure of productivity, instead of the more commonly-used labor productivity. Since TFP abstracts from non-labor factor contributions, improvements in labor productivity accruing to, say, human and physical capital accumulation are discussed independently.

²McGowan, Andrews, Criscuolo & Nicoletti (2015).

³Krugman (1994); Young (1995).

⁴Keller (2004).

⁵The appendix describes this analytical framework in greater detail.

⁶Gordon (2016).

⁷Sharma (2016).

⁸Cerra & Saxena (2008); Reinhart & Rogoff (2009).

⁹Bernanke (2005); Caballero, Farhi & Gourinchas (2008); Summers (2014).

¹⁰Diewert & Fox (1999); Young (2014).

¹¹For potential refutations, see Summers (2016) for the limitation explanatory power of debt buildup, Mokyr (2014) for why technological progress is greater than supply-side pessimists allow, Favero & Galasso (2015) on why demographic explanations are inconsistent with the empirical evidence, Syverson (2016) on why mismeasurement is unlikely to be a sufficient explanation, and Blanchard, Furceri & Pescatori (2014) on why low rates are, at best, an incomplete explanation of the problem.

¹²Yap & Gee (2015). The economically-active labor force is defined as the share of the population, aged between 15 and 64, that is supplying labor for production, net of the unemployment.

¹³Human capital can be approximated in a number of ways. Here, we adopt a micro-Mincer (1974)-consistent specification, where schooling is moderated by returns to education, consistent with Bils & Klenow (2000).

¹⁴The capital stock is the depreciated accumulated flow of gross fixed capital formation, computed using the perpetual inventory method.

¹⁵Ermisch & Huff (1999). Singapore benefited, in particular, from the so-called “flying geese” model of capital importation (Akamatsu 1962) and, relatedly, vertical specialization as part of the East Asian production network (Hummels, Ishii & Yi 2001).

¹⁶Krugman (1994); Pang & Lim (2015); Young (1995).

¹⁷Attanasio & Weber (2010).

¹⁸Hsieh & Klenow (2009) attributes TFP gains from correcting resource misallocation in the order of 30–50% for China and 40–60% for India. Given Singapore’s starting point as a developing economy, gains of a comparable order of magnitude were certainly possible, but as of today, the persistence of resource misallocation is highly unlikely.

¹⁹Keller (2004).

²⁰Comin & Hobijn (2004).

²¹This particular year was chosen as the end-point over 15 years when U.S. educational attainment grew from around 9.3 years—Singapore’s current level—to 11.6 years. It is around twice as fast as the projected rate for Singapore, a compound annual rate of 1.4 instead of 0.7 percent.

²²These results are not shown in the figure, but are available on request. Such a simulation essentially subtracts the accrued difference in the projected labor force increase for all years between 2015 and 2020, and holding constant the cumulative difference for all years thereafter. It should be noted that there are certainly other benefits to sustaining immigration flows, including the filling of

low-skilled jobs that are unappealing to many Singaporeans, or the importation of knowledge capital from high-skilled expatriates. This exercise nevertheless suggests that there are other possible strategies for human capital expansion that are not wholly reliant on policies that espouse unmitigated migrant inflows.

²³Hoeckel & Schwartz (2010); OECD (2014).

²⁴Cunha, Heckman, Lochner & Masterov (2006).

²⁵Lim (2014).

²⁶Hausmann, Rodrik & Velasco (2005).

²⁷In 2014, the share of saving accounts held at financial institutions by those aged 15 and over was 46 percent, compared to the OECD average of 52 percent; the equivalent statistics for borrowing was 14 versus 18 percent, respectively.

²⁸Aghion & Howitt (1997); Romer (1990).

²⁹See Bloom, Mahajan, McKenzie & Roberts (2010) on the importance of management capital for growth, Oliner, Sichel & Stiroh (2007) for the value of digitized information, and Tabellini (2008) and Knack & Keefer (1997) for theoretical and empirical arguments in favor of social capital for economic performance.

³⁰Harrison & Rodríguez-Clare (2009).

³¹OECD (2014).

³²Auyong & Low (2016).

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Annex: Analytical Framework & Data Sources

As discussed in the main text, the essay relies on a growth accounting framework (Barro 1999). We combine a production function approach (Artus 1977; Feenstra, Inklaar & Timmer 2015) with a statistical filter (Hodrik & Prescott 1997). More specifically, we first obtain total factor productivity (TFP) as the Solow (1956) residual of a growth decomposition involving physical capital and human-capital augmented labor. We then extract the trend component for this residual using our statistical filter, and reintroduce this smoothed TFP into the augmented production function to compute potential output. To maximize the quality of our estimates, we pay careful attention to idiosyncratic factor inputs and parameters.

Our point of departure is the production function in the Cobb-Douglas form

$$Y_t = A_t K_t^\alpha H_t^{1-\alpha}, \quad (1)$$

where, at time t , gross domestic product Y_t takes as factor inputs physical capital, K_t , and human capital, H_t , which are distributed according to the share

parameter $0 \leq \alpha \leq 1$. Human capital is a function of education-augmented labor according to

$$H_t = e^{\phi S_t} L_t, \quad (2)$$

such that the effectiveness of the labor force, L_t , is moderated by the average years of schooling, S_t , relative to returns to education, $\phi \geq 0$. The labor force is, in turn, a function of the participation rate, ρ_t among the working age population (aged 15 to 64), P_t , net of the unemployed:

$$L_t = \rho_t \varepsilon_t P_t, \quad (3)$$

where ε_t is the employment rate. Capital accumulates according to the equation of motion

$$\dot{K}_t = Q_t - \delta K_t, \quad (4)$$

where Q_t is the flow of investment, δ is the rate of depreciation of capital, and $\dot{K}_t \equiv \frac{dK_t}{dt}$. Output growth is obtained by re-expressing (1) in temporal terms; taking logarithms and differentiating with respect to time yields

$$\begin{aligned} \hat{y}_t &= \hat{a}_t + \alpha \hat{k}_t + (1 - \alpha) \hat{h}_t, \\ &= \hat{a}_t + \alpha \hat{k}_t + (1 - \alpha) [\phi \hat{s}_t S_t + (\hat{\rho}_t + \hat{\varepsilon}_t + \hat{p}_t)], \end{aligned} \quad (5)$$

where for a given variable x , its logarithmic derivative is given by $\hat{x}_t \equiv d \ln X_t = \dot{X}_t / X_t$.

For the analysis in the essay, we estimate the capital stock using the perpetual inventory method from the flow of gross fixed capital formation, with a constant depreciation rate of $\delta = 0.06$. Average schooling corresponds to attainment for the population aged 15 and over, which is measured in 5-year periods up till 2010 (Barro & Lee 2013), with intervening years interpolated. Beyond 2010, schooling projections are spliced with projections from the International Institute for Applied Systems Analysis and the Vienna Institute of Demography (K.C. *et al.* 2010). The historical participation rate, working age population, and employment rate are from the World Bank's World Development Indicators. Due to the incomplete coverage of the unemployment series, unemployment is inferred as the cyclical deviations identified by the Hodrik & Prescott (1997) filter, which is then used to augment the raw labor force. For years from 2014 onward, working age population projections and participation rate projections are from the United Nations' World Population Prospects (United Nations 2013) and International Labor Organization's Estimates and Projections of the Economically Active Population (International Labor Organization 2013), respectively (unemployment is assumed to be constant). Finally, TFP is computed as the filtered residual of the growth accounting exercise.

Factor share parameters are assumed to be stable over time, and are calculated mainly from the United Nations' National Accounts Statistics. Following Gollin (2002), we impute mixed income from the informal sector by distributing it proportionately between wages and profit, based on estimates reported in Guerriero (2012), to obtain $\alpha = 0.40$. Education returns rely on average returns

to schooling calculated by Montenegro & Patrinos (2014), and is parameterized as $\phi = 0.12$.

For Figure 6, data for public debt stocks are from Abbas, Belhocine, El-Ganainy & Horton (2011), supplemented by the IMF's World Economic Outlook database for 2013 and 2014. Private debt stocks are from the BIS database for credit to the nonfinancial sector. Stock market capitalization and the gross investment rate are from the World Bank's World Development Indicators.