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Increasing Productivity Growth in Middle Income Countries

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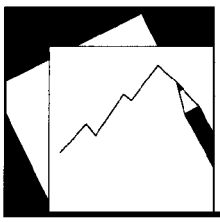

IMF Working Paper

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Aidar Abdychev, La-Bhus Fah Jirasavetakul, Andrew Jonelis, Lamin Leigh, Ashwin Moheeput, Friska Parulian, Ara Stepanyan, Albert Touna Mama

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African Department

Increasing Productivity Growth in Middle Income Countries

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Abstract

Many small middle-income countries (SMICs) in sub-Saharan Africa (SSA) have experienced a moderation in growth in recent years. Although factor accumulation, most notably capital deepening, was crucial to the success of many SMICs historically, this growth model appears to have run its course. The analysis in this paper suggests that the decline in the contribution of total factor productivity (TFP) to growth is largely responsible for the slowdown in trend growth in many SMICs, which highlights the need for policy actions to reinvigorate productivity growth. This paper explores the question of what kind of structural policies could boost productivity growth in SMICs and the political economy factors that may be contributing to the slow implementation of these critical reforms in these countries. The findings suggest that although macroeconomic stability and trade openness are necessary for productivity growth, they are not sufficient. SMICs need to improve the quality of their public spending, most notably on education to minimize the skill mismatch in the labor market, reduce the regulatory burden on firms, improve access to finance by small and medium-sized enterprises and create the enabling environment to facilitate structural transformation in these economies.

JEL Classification Numbers:JEL C53, E37, O41

Keywords: Growth, Productivity, potential growth...

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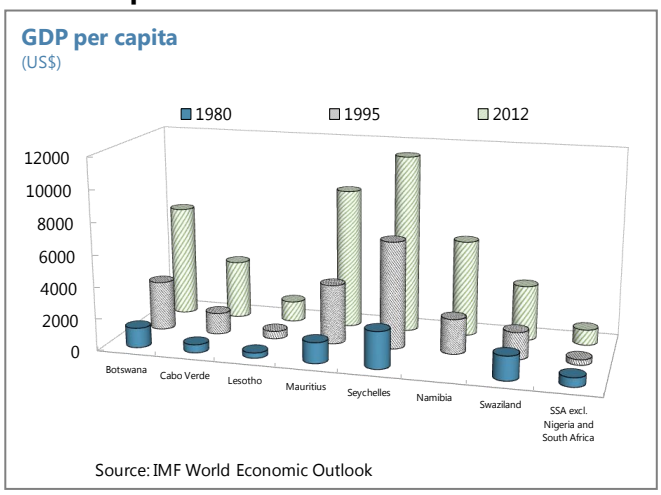
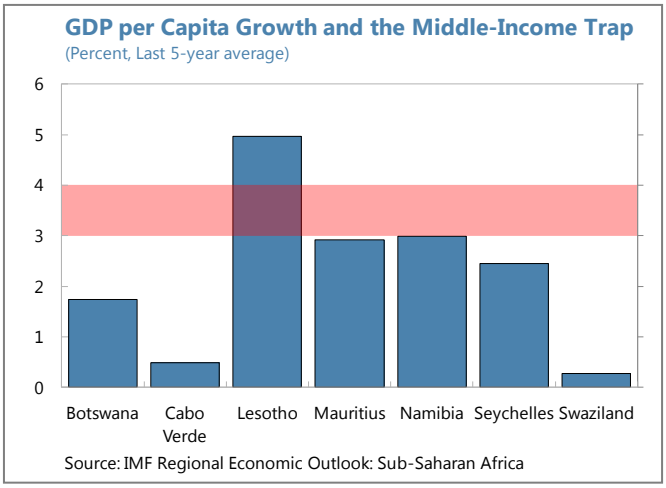
A. Introduction

1. Prudent macroeconomic management and improved institutional settings in many of the SMICs in SSA delivered impressive economic performance in the last few decades.[1] A prolonged period of strong growth has raised overall incomes and delivered good economic outcomes. GDP per capita of SMICs of SSA on average increased by more than 5 times over the last 30 years compared to only 1.7 times increase for the SSA average excluding South Africa and Nigeria (Text chart). The governments of these countries have generally been effective in addressing their development challenges, including narrowing the infrastructure gap and facilitating access to education and health.



2. However, in many of the SMICs, as in middle-income countries in other regions, growth rates are slowing, reflecting reduced contribution of TFP. Per capital real GDP growth for most of these countries has fallen short of the range of 3-4 percent average needed to escape from the so called "Middle-Income-Trap" (Text chart and Figure 1).[2] The growth moderation in many of these countries reflects the slowdown in the contribution of TFP to growth, which has reduced their potential to graduate from middle-income status into high income status (Figure 2 and Aiyar and others (2013)). This highlights the importance of SSA MICs reinvigorating policies to boost TFP growth.



3. This paper thus focuses on identifying policy reforms that would increase productivity growth—a key driver of long-term growth prospects.[3] The paper explores policy options that could boost productivity growth in SSA MICs based on the analysis of the role of productivity in the growth dynamics of these countries using a cross-country study. The paper

[1] The following SMICs are included in the analysis of this paper: Botswana, Cabo Verde, Lesotho, Mauritius, Namibia, Seychelles, and Swaziland.

[2] For more detail see J. Felipe, 2012, "Tracking the Middle-Income Trap: What is It, Who is in It, and Why?" Asian Development Bank.

[3] While the paper does not formally test the role of exchange rate regimes, the stylized facts suggest that exchange rate regimes do not play a discernible role on the evolution of growth, which is broadly consistent with the body of work in the literature stating that by and large the exchange rate regime by itself does not determine economic outcomes (see for example the recent Fund paper by J. G. Stotsky et al (2012)).

contributes to the existing growth literature in two ways: (i) it looks not only at the level of education but at its quality and the gap between skill supply and demand by introducing the index of skill-mismatch as an indicator explaining TFP growth and (ii) looks at the impact of macro-stability friendly forms of financial inclusion on productivity growth.[4] The main estimation challenges involve endogeneity, cross-country heterogeneity among the TFP determinants, and data availability limitation. As a result, we adopt several econometric techniques in an attempt to account for the endogeneity and heterogeneity problems, as well as to provide robustness to our estimates.

4. Our analysis suggests that structural reforms are needed to foster TFP growth and to accelerate convergence to higher income levels. In particular, boosting productivity growth would require reforms in the financial sector, reducing regulatory barriers on firms, improving the quality of public spending most notably on secondary and tertiary education to reduce skill mismatch, alleviating infrastructure bottlenecks, deepening capital markets, and investing in research and development and new technologies. In addition we find that there is a limit on how much the government can close the infrastructure gap by borrowing, because after a certain threshold, government debt's marginal impact on productivity growth becomes negative.

5. The rest of the paper is organized as follows: Section B provides the literature review; section C discusses stylized facts; section D presents the empirical analysis; and section E discusses the conclusions.

B. Literature Review: Determinants of Total Factor Productivity

6. This section reviews the main determinants of TFP from the relevant literature. TFP is related to economic growth through improvement in resource allocation, innovation, and productivity of each of the factor inputs, providing an opportunity to grow more efficiently and sustainably in the long run.[5] Based on the existing theoretical and empirical literature, a number of determinants have an impact on TFP's contribution to growth. These determinants of TFP can be summarized into several conceptual variables as follows.

7. Macroeconomic variables: A number of macroeconomic factors could play a role in determining the TFP and its growth as they may influence both input use and allocative efficiency. The two macroeconomic variables often discussed in the literature are inflation and size of government. The relationship between inflation and productivity growth is found to be negative in a number of cross-country empirical studies (see for example, Fischer (1993); De Gregorio (1993); Ghosh and Phillips (1998); Loko and Diouf (2009); Espinoza (2012); and Barro (2013)). While the role of government is potentially an important factor in growth performance, the relationship between these two variables remains ambiguous. The size of the public sector can both foster and hinder productivity growth (Ranis, 1989). Provision of basic public goods and

[4] As to be discussed in the following section, there is a literature on skill mismatch and productivity growth. Nonetheless, the earlier literature focuses more on theoretical models and empirical tests in low-income and advanced economy countries.

[5] Conceptually, TFP is unexplained residuals from a production function. In other words, it is the growth residual which cannot be accounted for by observed increases in factor inputs (Solow, 1957). Hence, one should analyze a growth decomposition and TFP-related information with caution. TFP could also reflect the quality of data and estimates on other components.

economic infrastructure would enhance overall productivity (Ghali, 1999). On the other hand, a number of studies point to the negative effect of government spending on economic growth, owing to government inefficiencies and low quality of public spending (see for instance, Barro, (1991); Sala-i-Martin, Doppelhofer, and Miller, (2004); Loko and Diouf, (2009), Danquah, Moral-Benito, and Outtara, (2013)).[6]

8. Openness and technology creation and transfer: Openness to the world economy is another important factor explaining total factor productivity growth. Trade openness increases international contacts and can be a source of learning, as technology is often embodied in goods (Lewis, 1979; Grossman and Helpman, 1993; Sachs and Warner, 1995; Sala-i-Martin et al, 2004; and Dollar and Kraay, 2004). FDI is also a key channel for the transfer of advanced technology and research and development (R&D) knowledge. In addition, Loko and Diouf (2009) emphasized that the level of FDI reflects the macroeconomic environment of a country.

9. Quality of labor input and efficient allocation: An increase in human capital base can have a positive impact on TFP growth by facilitating structural change and technological improvement (Romer, 1990; Barro, 2001). In addition, human capital can help to absorb positive externalities from international trade and FDI (Loko and Diouf, 2009). The gaps between the supply of and demand for skills could account for the decline in TFP growth, especially in low-income countries that make use of technology developed by advanced economies (Acemoglu and Zilibotti, 2001).

10. Female labor force participation: Higher labor force participation, particularly among women, may increase TFP growth if technological progress and the female labor force are complementary (Galor and Weil, 2000; and Madsen and Ang, 2013). However, some of these show that the impact of increased female labor force participation on productivity growth is likely to be concave and decline over time (McGuckin and Van Ark, 2005).

11. Sectoral composition and structural change: Many studies address the importance of structural change, captured by sectoral production or sectoral employment, in determining TFP growth. A transition from concentration in less productive to more productive sectors would positively affect aggregate productivity growth (Lewis, 1954; Ranis and Fei, 1961). While most of the literature finds a positive relationship between structural change and TFP growth at the cross-country level (see for example, Poirson (2000); Jaumotte and Spatafora (2007); Loko and Diouf (2009)), some specific country studies show ambiguous results owing to the pre-conditions on market institution, openness, and labor market mobility (Lu, 2002). A less diversified economy could portend risk and vulnerability, which will in turn undermine TFP growth.

12. Monetary and financial development: The positive impact of financial sector development on productivity has been well documented (see for instance, Roubini and Sala-i-

[6] Based on similar cross-country literature on macroeconomic determinants of TFP, Akinlo (2005) investigates the importance of these macroeconomic determinants of TFP particularly within the SSA region during 1980-2002. Specifically, Akinlo (2005) finds that external debt and inflation negatively contribute to TFP while human capital, trade orientation, and financial development are positively related to TFP.

Martin, (1992); King and Levine, 1993; and Aghion, Howitt and Mayer-Foulkes, 2005).[7] The main intuition is that financial markets enhance productivity through efficient capital reallocation and that financial development also brings in technological innovation.

13. Institutional and regulatory factors: Many recent papers have shown that institutional factors can enhance productivity growth by ensuring resource reallocation efficiency and encouraging a good economic environment for investment, (see for example, Hall and Jones (1999); Acemoglu, Johnson and Robinson (2004); Glaeser and others (2004); Acemoglu and Johnson (2003); Easterly (2006)). In addition, political instability is often regarded as another institutional factor undermining productivity growth as it inhibits investment in innovation and creates market distortions that are likely to lower productive efficiency (see for example, Edwards (1998), Nachega and Fontaine (2006), and Aisen and Veiga (2013)).

The table below presents a summary of the key influential factors from the literature and the variables, which will be used in the qualitative and quantitative analysis of this paper.

Summary of TFP Determinants and Variables Used in SMICs Analysis	
TFP determinants from the literature	Variables
1. Macroeconomic conditions	Inflation, government debt, public employment
2. Openness, and technology creation and transfer	Trade, FDI, R&D, infrastructure
3. Quality of labor inputs and efficient allocation	Years of schooling, skill mismatch
4. Female labor force participation	Female labor force participation rate
5. Sectoral composition and structural change	Sector shares of output, economic diversification
6. Monetary and financial development	Credit, market capitalization
7. Institution and regulatory factors	Labor and business regulation indices, doing business indicators, income inequality

C. Stylized Facts

14. Total factor productivity has played a prominent role in influencing growth episodes in many SMICs. In earlier decades, during periods of a relatively supportive global economic environment, SMICs generally used capital deepening in the form of infrastructure investment programs and FDI to bolster productivity and thus growth (Figure 2). However, in more recent years, in the face of a less favorable external environment, the growth momentum in many SMICs waned because structural reforms that might sustain TFP growth—such as a business friendly environment—were not fully in place in many SMICs. This was compounded by

[7] While most papers measure financial sector development by using financial dept, Levin and Zervos (1998) use several financial development indicators. They find that the initial level of stock market liquidity and bank credit have a significant positive impact on productivity improvement. However, in their study, the impact of stock market size is found to be ambiguous.

weak regulatory systems, which often impinged on their institutional setup and prevented their TFP from rising further, although this issue is being addressed in many SMICs.[8]

15. During the years of high historical growth, while FDI inflows and infrastructure investments were crucial for enhancing productivity growth, a high regulatory burden on firms hampered productivity growth (Figures 2 and 3)**.**[9]

- Years of significant FDI inflows helped most of the SMIC to accumulate productive capital and bolster TFP growth. The correlation between FDI and TFP growth has been positive in most SMICs (Figure 3).

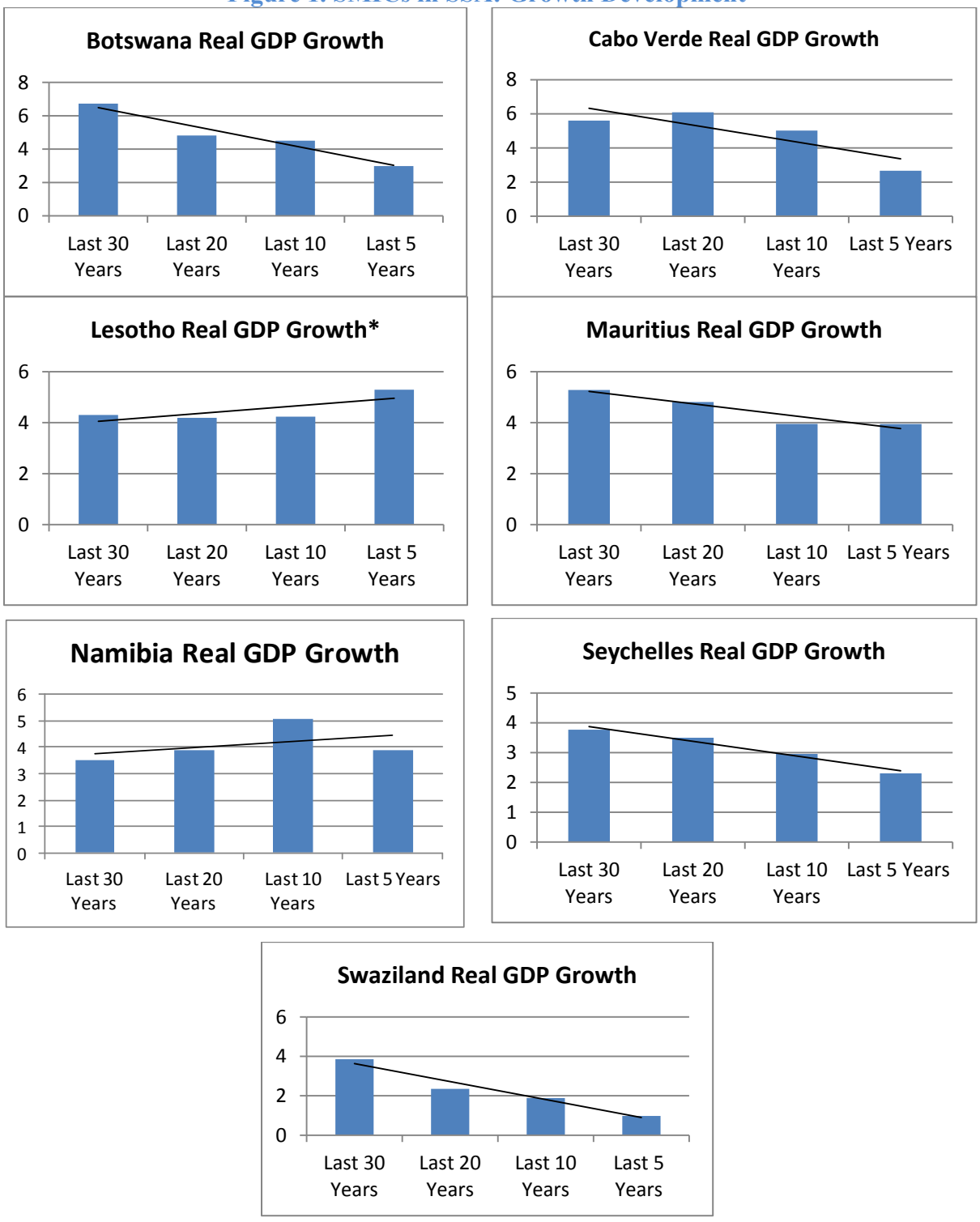
- SMICs managed to address the infrastructure gap by ensuring country-wide coverage of basic infrastructure services such as electricity, water and telecommunications network, which constituted the bedrock of productivity growth (Figure 3).

- However, the confluence of a less favorable external environment and regulatory barriers to private sector development negatively affected productivity growth in many SMICs. The structural constraints include regulatory burden inhibiting private sector development, restrictive labor market regulations, and high financial access costs.

[8] As an additional source to boost TFP, the need for structural transformation and laying the enabling environment for factors to move from low return sectors to high return sectors (see Table in Box 1) and consistently experimenting and innovating through the implementation of new ideas are also important ingredients in lifting up potential growth in an environment characterized by structural impediments (see Box 1).

[9] Fortunately, most of the SMICS have not been challenged by conflicts recently, which contributed to the enabling environment for growth.

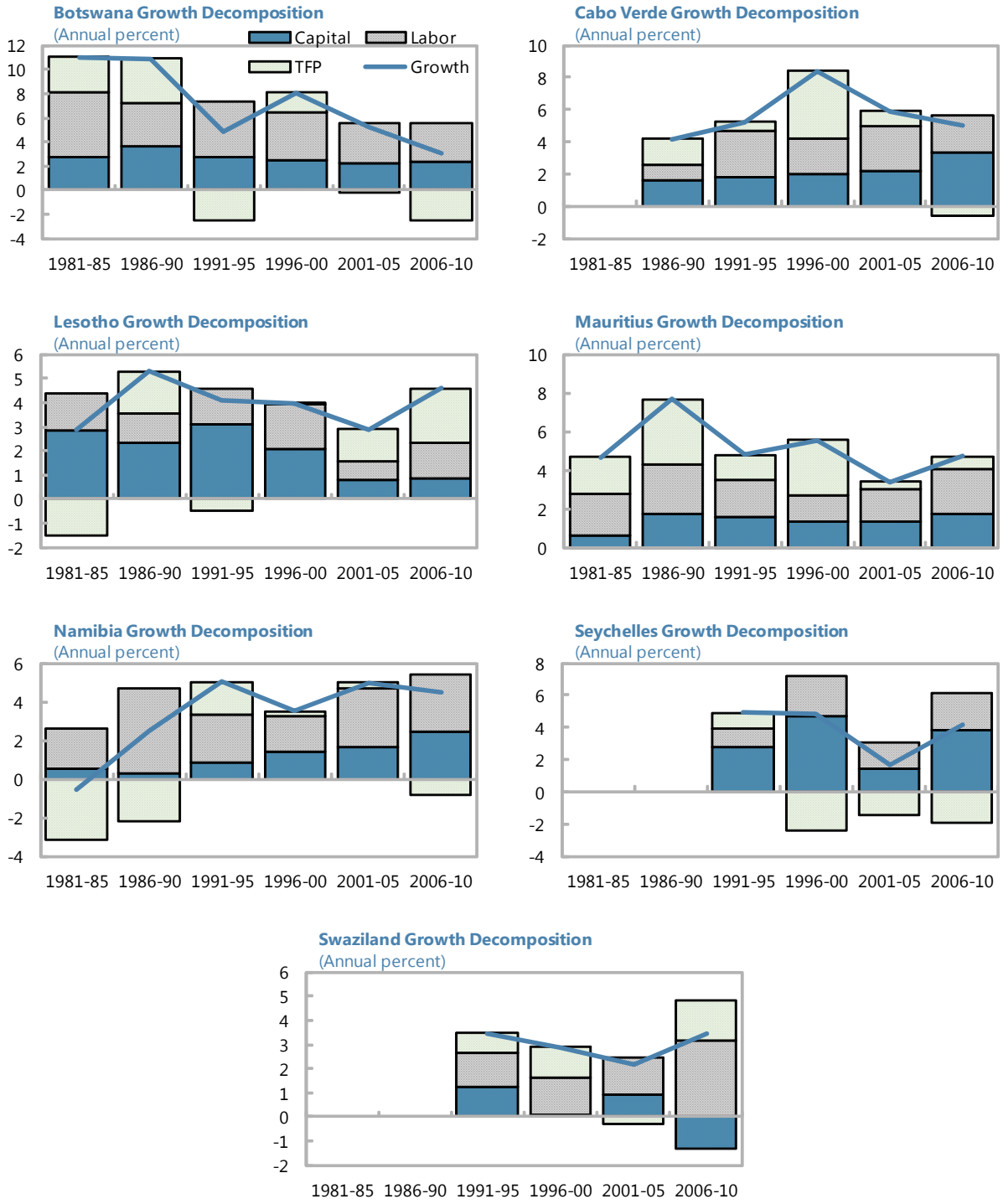
Figure 1. SMICs in SSA: Growth Development



* As a new entrant into the SMIC group, Lesotho's relatively strong growth pattern in recent years probably reflects a base effect that other more established SMICs have also experienced. In addition, strong performance in the diamond and textiles sectors, which benefited from a favorable external environment and preferential trade treatment also helped. Over time, one would expect the convergence process to set in, which will likely lead to the growth slowdown pattern seen in the other SMICs.

Source: IMF World Economic Outlook.

Figure 2. SSA SMICs' Growth Decomposition



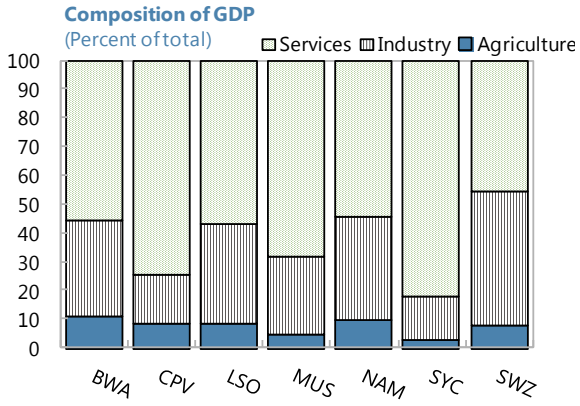
Sources: Penn World Tables and IMF Staff calculations

Source: Penn World Tables and IMF staff calculations.

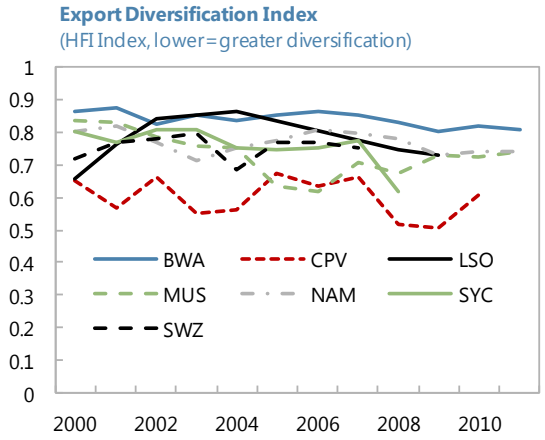
1/ We used the human-capital augmented growth accounting framework to derive the contribution of total factor productivity to growth.

Figure 3. Factors Affecting Productivity in Selected SMICs in SSA

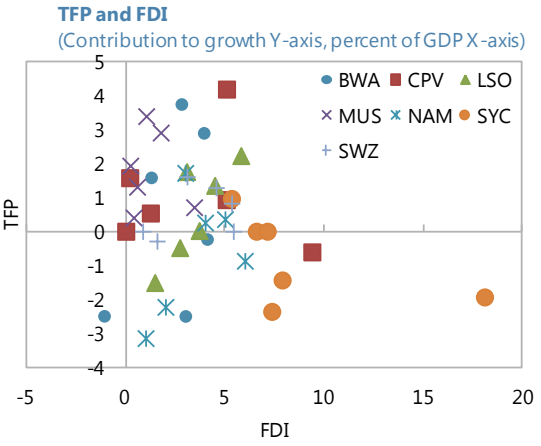
With the exception of Swaziland, the production structure of most SMICs is concentrated in the tertiary sector…..



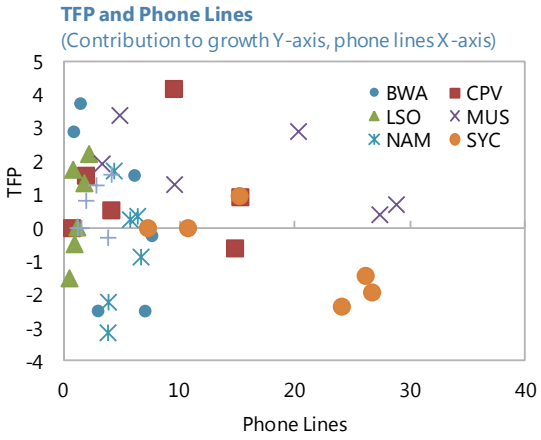
…and there is low diversification in their exports….



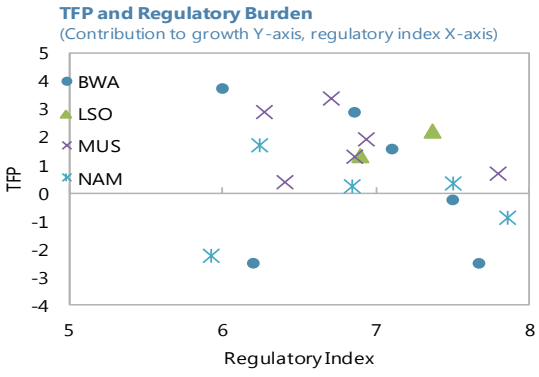
TFP has been generally higher in those years in which FDI inflows have also been high ….



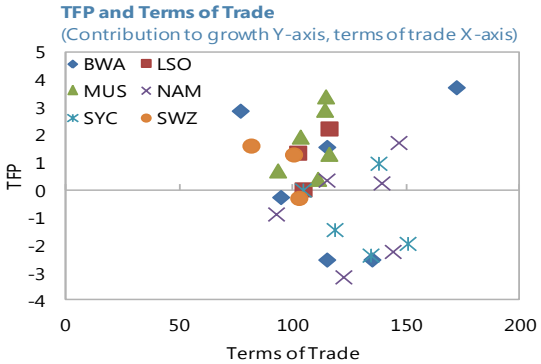
The relationship between infrastructure development and contribution of TFP to growth, in general, is positive …..



….but negatively correlated with regulatory constraints……



….and the contribution of TFP to growth is positively correlated with terms of trade improvement



1/ Country codes: Botswana (BWA), Cabo Verde (CPV), Lesotho (LSO), Mauritius (MUS), Namibia (NAM), Sychelles (SYC), and Swaziland (SWZ).
2/ The Herfindahl index computes the sum of squared shares of the total exports attributed to the i-th industry. It lies between 0 and 1where being close to 0 indicates well diversified exports.

Box 1. Structural Transformation in Selected SMICs in SSA—Mauritius and Namibia

The reallocation of economic activity from low to high productivity activities lies at the heart of the rapidly growing work on structural transformation. An alternative view is that drivers of growth cause both growth and structural change to move simultaneously. The period 1995 to 2010 was characterized by high growth for a significant number of countries in SSA, most of which have experienced some degree of structural transformation, albeit at different speeds. Although there has been some reduction in the share of agriculture in the GDP in SSA SMICs, employment has not moved from agriculture into industry or services. This contrast with Asian economies that have registered strong growth over the years (text Table). An empirical study by Dabla-Norris et al (2013) suggests that product and labor market reforms, openness to trade, and access to finance are factors that explain the variation in sectoral shares across countries.

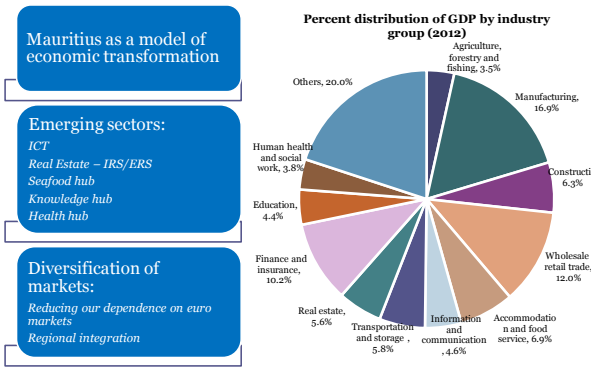
Change in Output, Employment Shares, and GDP per Capita, 1990–2011

	Output Shares			Employment Shares [1]			Average GDP Per Capita
	Agriculture	Industry	Services	Agriculture	Industry	Services	(PPP, 2005 constant USD)
Asian countries:							
Bangladesh	-0.5	0.5	0.0	-0.3	0.4	-0.1	3.6
Cambodia, 1998—2010	-1.8	0.7	1.0	-1.5	0.8	0.8	5.6
Vietnam	-0.7	0.8	-0.1	-1.2	0.5	0.6	5.5
Indonesia, 1993—2011	-0.2	-0.1	0.3	-0.9	0.3	0.6	3.2
India	-0.7	0.0	0.7	-0.7	0.4	0.3	4.8
SSA MICs, 1995—2010 unless indicated otherwise:							
Botswana	-0.5	-0.1	0.1	0.9	-0.4	-0.1	3.0
Cabo Verde	-0.4	-0.2	0.1	-0.2	-0.1	0.2	7.2
Lesotho	-0.3	0.4	-0.1	…	…	…	2.7
Mauritius, 2000—2010	-0.3	-0.2	0.1	-0.3	-0.3	0.3	3.4
Namibia	-0.4	0.0	0.1	-0.2	0.2	0.1	2.3
Seychelles, 2004—2010	-0.4	-0.1	0.0	…	…	…	2.9
Swaziland	-0.1	-0.1	0.2	…	…	…	1.1

Sources: Haver Analytics; WDI; and IMF staff calculations.

[1] Employment shares data for Botswana was calculated through period of 1996-2006, Cabo Verde (1995-2007), and Namibia (2000-2011).

Mauritius is often paraded as a successful structural transformation story in the region. Several factors underpin the Mauritian success: (i) a diverse and competitive political system supportive to the economic reforms, and (ii) better sequencing of reforms, particularly investing in appropriate education and training, which enhanced the absorptive capacity and buttressed the authorities' resolve to create new sectors. In addition, flexibility in acquiring necessary skills in the labor market, attracting FDI (DTT with India), and the coherence of micro and macro policies were other factors contributing to the success of Mauritius' transformation. However, the country also faces some challenges including public sector administration and efficiency of public service. The authorities plan to accelerate the transformation of the island into a cyber-state while leveraging various opportunities offered by the vast potential of ocean-based sectors.



Source: Country Authorities.

As a relatively young nation, Namibia has been successful in achieving political and macroeconomic stability, which has helped improve the living standards of the population. The country is also very active in enhancing the diversification process where a focus on business-oriented infrastructure and support contributed to rising manufacturing activities. However, Namibia's exports relied on mining. The Namibian authorities embarked on an export diversification strategy through several initiatives such as the creation of export processing zones (EPZ) and the establishment of small-and-medium enterprise development programs. Given the relative lack of success of these policies, the Namibian authorities current strategy is to develop commodity-based value chains to enhance growth and economic diversification. This said, Namibia still faces the key challenge of lack of skills in its labor market. In addition, the difficulties in obtaining working permits is a challenge for the private sector. Moreover, the economy of Namibia is characterized by high regulation. This, combined with the socioeconomic challenges of a dual economy, creates difficulties to open the labor market further to pave the way for the high skills that are needed to boost its economy-wide productivity and thus potential growth.

Table 1. Structural Impediments to Productivity Enhancement in SMICs

	Macroeconomic Environment	Labor Market	Financial Sector	Public Sector	Environment
Resource-Rich MICs					
Botswana	Lack of economic diversification	High reservation wage and skill mismatch	High concentration of bank loans to households	Effectiveness of tax system; quality of public spending	
Namibia	Lack of economic diversification	Lack of skill	High concentration of bank loans to households, in particular mortgages	Quality of public spending (not getting value for money) and large public sector	
Non Resource-Rich and Non-Island MICs					
Lesotho	Lack of economic diversification	High and persistent structural employment; HIV prevalence among labor force	Small and inefficient; high lending rates; large risk premiums	Large and ineffective public sector distorts labor market incentives and creates unfavorable business environment	Droughts; soil degradation
Swaziland	Lack of economic diversification; depressed capital accumulation; uncompetitive business environment			Large expansion with no clear evidence of high fiscal multiplier	
Non Resource-Rich and Island MICs					
Cabo Verde	Lack of economic diversification; reliance on imports for food, fuel, manufacturing items, and capital goods	Low labor market efficiency owing to restrictive labor market regulations and shortage of technical skills	Predominantly bank-based, high concentration (four systemic banks account for more than 80 percent); sizeable exposure to the real sector	Large public investment in infrastructure financed by borrowing, leading to deteriorating fiscal balance and high public debt	
Mauritius	Although economy is relatively diversified, there is still reliance on European markets for trade and tourism	Structural labor market problems, including youth unemployment			Environmental degradation and weather-related
Seychelles	Lack of economic diversification; reliance on imports for food, fuel, manufacturing items, and capital goods	Structural problems including shortage of adequate skills and expertise; complex procedures for hiring qualified foreign workers	Lack of financial deepening	Inefficient public investment; presence of large parastatals operating in quasi-monopoly environoments	Environmental degradation and weather-related disasters

Source: IMF staff.

D. Empirical Analysis

Methodology

16. This section assesses empirically the relationship between macroeconomic, structural and, institutional variables and TFP growth in SMICs. In addition to the standard factors and channels identified in the literature (Section B), this paper also looks at two relatively less explored areas. First, it goes beyond the level of education and looks at its quality, because in many of SSA SMICs, while the literacy rates are high and government spends significant portion of budgetary resources on education, a lack of relevant skills has contributed to the persistently high unemployment. Second, the paper looks at the relationship between stability-friendly forms of financial inclusion and TFP growth.[10]

17. We use several panel data techniques to identify determinants of TFP growth and estimate their impact. These selected panel data technique can complement each other with each having different practical advantages and limitations (Appendix I). The following methods are used:

- **Dynamic panel estimation:** This method allows the lag-dependent variable to affect the dependent variable and controls for endogeneity.[11] [12] Given that it is conducted at the country and year-levels, the dynamic panel estimates are expected to provide short-run cross-country evidence. While this method is widely used in recent cross-country empirical analyses, it does not allow for heterogeneous effects of the TFP determinants across countries.

- **Cointegration for heterogeneous panels:** This approach enables us to identify and estimate the long-run relationship between TFP growth and its endogenous determinants.[13] [14] In addition, this approach allows for heterogeneity among countries in the panel and adjusts for potential endogeneity and cross-sectional dependence. However, the cointegration analysis is relatively more data-intensive. This, together with limited data availability for middle-income countries, limits the number of explanatory variables that can be included in each specification.

- **Binary response model (panel probit analysis):** The panel probit analysis measures the extensive margin effects to get a broader understanding of what structural policy factors contribute to positive TFP: the outcome of interest is a binary response variable for TFP (1 if

[10] As specified in Section B, educational attainment of the labor force (as a measure of human capital) is one of the explanatory variables. While the outcome variable, TFP, is obtained from a human capital augmented production function, the justifications for including education in the analysis of TFP determinants are as follows. First, human capital has both a direct effect on the stock of human capital and an indirect effect on innovation, as well as a spillover effect through technological diffusion (Nelson and Phelps, 1966, Benhabib and Spiegel, 1994, and Coe, Helpman, and Hoffmaister, 1997). As a result, it is customary to include a measure of human capital in the TFP analysis to capture the indirect and spillover effects (see for example, Griffith, Redding, and Van Reenen, 2004, Engelbrecht, 2002, and Fleisher, Li, and Zhao, 2010). Second, education should also be viewed as a necessary control variable for investigating the effects of skill mismatch on TFP growth.

[11] See Arellano and Bond (1991), and Blundell and Bond (1998).

[12] To avoid the problem of over-identification, the instrument set was restricted by (i) creating one instrument for each variable and lag distance (collapsing instrument set) and (ii) restricting the number of components from the principal component analysis on the instrument set. By doing so, all the dynamic panel regression analyses pass the over-identification tests (namely the Hansen P-values are strictly less than 1).

[13] For more detail see Pedroni (2000) and (2004).

[14] In the cointegration analysis we used routines, which were kindly provided by Peter Pedroni.

TFP contributes positively to growth, and 0 otherwise). As the approach is relatively simple, it allows us to explore the role of other variables, whose data availability is limited, on productivity growth in the long run.[15] These variables include the regulatory environment in the product and labor markets, and the size of the financial sector. In addition, this approach provides estimates of the country-specific predictive probabilities for TFP contribution to growth, based on various model specifications.

Data issues

18. Our dataset comes from five primary sources: The Penn World Tables (PWT), the IMF's World Economic Outlook (WEO), the World Bank's World Development Indicators (WDI), the Economic Freedom of the World (EFW) project, and the Barro-Lee database. Our dataset covers 33 upper-middle-income countries for the period 1980–2010 (Appendix I). For TFP, we used the human capital augmented TFP data calculated by the latest PWT for 30 of the countries in our panel data. The sample size was driven by the paper's focus on middle-income countries and the availability of data across this group. We derived TFP for Cabo Verde, Seychelles, and Swaziland with the latest available country data using a growth accounting tool from the World Bank's Economic Policy and Debt Department. TFP derived this way closely matches TFP from the PWT for other countries in our panel data. We constructed a skill-mismatch index, following Estevão and Tsounta's (2011) methodology (Appendix II).

19. For many of the SMICs in our study, a known issue we faced is data availability and quality of those statistics. For example, Swaziland has not published national accounts data in a number of years, and the data used to calculate TFP come from data published in the WDI database.

Empirical Results

20. The results across different methods depict a broadly consistent picture. Our analysis confirmed the findings of the literature that traditional variables such as trade openness and macroeconomic stability have a significant and positive impact on productivity growth (Table 2). In addition, the index of skill-mismatch has statistically significant and negative impact on productivity growth both in the short and long-term horizon. Another important factor is government debt, which has a concave relationship with TFP growth: at low levels, debt has a positive impact on TFP growth, while at high levels its impact on TFP growth becomes negative. Our estimates suggest that in the long run the threshold of public debt to GDP ratio when its marginal impact on TFP becomes zero is 32-55 percent[16], while in the short run the threshold is 80 percent.

21. However, there are also some differences with the literature. The interpretation and estimates of the thresholds for the public debt to GDP ratio in our study are different from those of Reinhart and Rogoff (2010) and Herndon et al (2013), who estimate a 90-percent threshold of government debt to GDP. Possible explanations for the different results are as follows. First, our study includes only middle income countries during the year 1980 to 2010, and controls for other heterogeneous structural characteristics across countries. Second, our interpretation of the estimates is based on the concept of marginal returns to government debt on TFP's contribution to

[15] Our panel probit estimates should reflect the long-run effects of the TFP determinants as they are estimated using five-year data averages.

[16] The threshold increases to 55 percent when we control for market capitalization.

economic growth, while the earlier literature estimates the direct impact of government debt on GDP growth and a country's vulnerability to a financial crisis. In addition, we also found some ambiguous results that seem counterintuitive and inconsistent with the findings in other studies. Particularly, in some of our specifications we found a negative relation between TFP and female participation in the labor force. Other results include a negative sign of estimated coefficients for the credit to GDP ratio and tertiary education. In the subsequent sections we try to provide some explanation for these findings.

Table 2. Summary of the Empirical Results

	Short-Run	Long-Run	
	Dynamic Panel	**Cointegration**	**Panel Probit**
Government debt to GDP (DBT)	(-) or Concave *	(-) or Concave *	(+)/(-) or Concave *
Trade to GDP (TRD)	(+)	(+)*	(-)
FDI to GDP (FDI)	(+)	(+)/(-)*	
Credit to GDP (CRD)		(+)/(-)[1]*	(+)
Share of agriculture sector in GDP (AGR)		(-)*	
Share of manufacturing sector in GDP (MNU)			(+)*
Female labor force participation (FEM)	(+)/(-)	(+)/(-)[2]*	
Inflation (INF)	(+)/(-)	(-)*	(-)*
Years of education (EDU)	(+)	(+)*	
Skill mismatch (SKL)	(-)*	(-)*	(-)*
Credit market regulation index (CRG)	(+)		(+)*
Labor market regulation index (LRG)			(+)*
Goods market efficiency index (GME)	(+)/(-)		
SMEs with credit line (SMC)			(+)*

(+)/(-) indicates ambiguous results; * indicates statistical significance at least at the 10 percent level.

[1]This probably reflects the high number of countries in our sample that have experienced financial crisis.

[2]The impact of female participation becomes positive after controlling for the share of agriculture in GDP.

[3]The labor and good market regulation indices range from 0-7. A high value implies a less-restrictive regulatory system and/or a more competitive market

System Generalized Method of Moments (GMM)

22. The dynamic panel estimation results suggest that skill-mismatch and government debt have statistically significant short-term effects on TFP growth.[17] The selected results are presented in Table 3. TFP growth significantly declines as the level of skill mismatches increases. For every 10-point increase in the skill-mismatch index, TFP growth tends to decline by about 0.03 percentage points.[18] The relationship between government debt and TFP appears to be concave.[19] This implies that a higher level of government debt reduces the TFP growth, and the negative impact is increasing with the level of debt. This suggests that some initial government debt may improve TFP growth. However, its positive impact on TFP growth, when significant, declines with the level of debt. These results are robust even after controlling for variables for infrastructure development.[20]

23. Based on these results, the level of government debt at which the positive returns to government debt will decline to zero is 80 percent. That is, if the specifications are correct,

[17] This model includes four SSA SMICs of interest: Botswana, Cabo Verde, Mauritius, and Namibia.

[18] See Appendix II for more detail on the skill-mismatch index.

[19] While the relationship between TFP growth and government debt is negative and concave, the coefficient estimates on government debt are not statistically significant for some specifications (Table 3, Columns 1-A and 1-B). In the last two specification, the coefficient estimates on government debt become negative for the linear term, and insignificant for the square terms. This could be due to the fact that too many variables are added to the specification, while the number of panel observations (countries) is reduced substantially.

[20] The results of the regressions with telephone lines as an additional explanatory variable are not shown here.

additional government debt has a positive impact on TFP growth, but this positive effect declines as the debt level increase, and will become negative when the debt is above 80 percent of GDP.[21]

24. The impact of economic freedom/efficiency indicators on TFP growth is ambiguous.[22] Better credit market regulation seems to be positively correlated with TFP growth, but is not statistically significant (Table 3, Columns 3-A and 3-B). The effects of goods market efficiency on TFP growth are ambiguous and are not robust to changes in model specification and the inclusion of a lagged dependent variable. Other variables included in the model specifications, while having economically plausible signs, are statistically insignificant.

Table 3. Dynamic Panel Result (System GMM)

	(1-A)	(1-B)	(2-A)	(2-B)	(3-A)	(3-B)
Lagged TFP		0.131		-0.165		0.139
		(0.091)		(0.234)		(0.452)
DBT	0.031	0.004	0.222*	0.254*	-0.441*	-0.364*
	(0.070)	(0.059)	(0.120)	(0.132)	(0.238)	(0.185)
$DBT^2/100$	-0.041	-0.026	-0.141*	-0.155**	0.320	0.248
	(0.036)	(0.030)	(0.068)	(0.068)	(0.215)	(0.185)
TRD	0.010	0.004	0.097	0.106	-0.018	-0.009
	(0.034)	(0.021)	(0.088)	(0.084)	(0.059)	(0.042)
FDI	0.110	0.033	0.037	0.130	0.201	0.235
	(0.168)	(0.099)	(0.242)	(0.256)	(0.261)	(0.187)
FEM	-0.390	-0.327	-0.155	-0.391	-0.318	-0.231
	(0.239)	(0.204)	(0.598)	(0.596)	(0.221)	(0.181)
INF	0.079	0.047	-0.028	-0.056	0.621	0.506
	(0.059)	(0.047)	(0.060)	(0.065)	(0.421)	(0.319)
SCL			1.599	0.416	0.384	-0.268
			(2.745)	(2.914)	(1.492)	(0.743)
SKL			-0.279*	-0.304**	-1.715	-1.079
			(0.152)	(0.135)	(2.567)	(1.649)
CRG					2.696	2.390
					(2.230)	(2.680)
GME					-0.993	0.639
					(4.635)	(4.569)
Constant	13.686	13.094	-13.495	0.938	-5.572	6.809
	(9.097)	(7.956)	(18.461)	(20.017)	(68.703)	(56.218)
N	434	433	265	265	73	73
Countries	30	30	23	23	19	19

[1] The results shown here are similar to Column 9 of Tables 1-A, 1-B, 2-A, 2-B, 3-A, and 3-B in Appendix III.
One-step GMM estimation method. Standard errors in parentheses.
* p<0.1, ** p<0.05, *** p<0.01

Cointegration Analysis

25. Cointegration analysis confirms the importance of skill-mismatch for productivity growth and the concave relationship between government debt and TFP growth. [23] [24] [25]

[21] The 90-percent confidence interval of the debt-to-GDP threshold is (40.3, 86.4).
[22] The model includes only three SSA SMICs (Botswana, Mauritius, and Namibia).
[23] The presence of cointegration is tested by Pedroni's seven statistics. The results for all specifications reject the no cointegration hypothesis at least with four out of seven statistics, including the group mean Augmented Dickey Fuller test.

a. The results suggest that skill-mismatch has a statistically significant and negative impact on TFP growth in the long-run, which underscores the importance of the quality of education (Table 4). An increase in the index by 10 points reduces the long-run TFP growth by about 0.2 percentage points. This result is mostly robust to the different model specifications. Only in the specification that controls for stock market capitalization the size of skill-mismatch coefficient is reduced. [26]

b. The results also suggest that at a lower level of debt to GDP ratio the impact of government debt on TFP growth is positive, possibly reflecting the positive impact of public borrowing to finance infrastructure spending and other public goods. However, when debt exceeds 32 percent of GDP, the marginal impact of government debt on TFP growth becomes negative in the long run. In addition, the debt threshold increases to 55 percent of GDP when we control for stock market capitalization.

c. An alternative interpretation of the concavity could be given through government debt's impact on the financial sector. At the initial stage, issuance of government debt contributes to the development of financial markets, which positively affects productivity growth. However, at a high level of government debt, it starts to crowd out private investments and pushes long-run interest rates up, which has negative implications for productivity. These results broadly confirm the thrust of the findings of the system GMM analysis. The estimated threshold of debt to GDP ratio obtained in the cointegration analysis is lower than the one obtained in the dynamic GMM analysis because it represents a long-run relation, while dynamic GMM estimates are short-run effects.

26. Consistent with other studies, we found that macroeconomic stability, a small agricultural sector, and trade openness are conducive to TFP growth. The results suggest that high inflation and a large agricultural sector reduces TPF growth, while high FDI and large foreign trade relative to GDP support TFP growth.[27] An increase in FDI to GDP ratio by one percentage point increases TFP growth by about 0.1 to 0.6 percentage points in the long run. However, when we include the share of foreign trade in GDP with FDI, the impact of FDI becomes negative.[28] Also reducing the relative size of the agricultural sector would improve long-run TFP growth.

27. The analysis reveals some ambiguous results as well.[29] In particular, we found a negative relationship between female participation in the labor force and TFP growth. However, when we control for the share of agricultural sector in GDP, the impact of female participation turns positive. This may suggest that the negative coefficient in the first specification could reflect the fact that in

[24] The consistent set of explanatory variables cannot be applied across the three methodologies due to limited data availability (the selected econometric approaches require more data points and we cannot afford to lose more degree of freedom). In particular, the panel cointegration approach requires more time series relative to probit or system GMM methods.
[25] Employed panel unit root tests rejected no unit root hypotheses.
[26] Market capitalization refers to the total value of listed companies' outstanding shares.
[27] The large coefficient estimates on inflation potentially reflect the impacts of inflation on other additional macroeconomic variables that influence TFP growth. Another possible explanation is that the impact of inflation may not actually be linear as specified by the model.
[28] The FDI coefficient is not robust, as it changes the sign in other specifications as well, probably reflecting the change in the sample due to the availability of data.
[29] It is important to note that, due to data availability limitation, a different set of countries is included in each of the specifications. This may be another source of mixed results.

many of the sample countries women are more involved in the low-productivity agricultural sector. Another interesting result is that the impact of the credit to GDP ratio is negative in some specifications. Some of the countries in our sample including Latin American and Asian countries, experienced credit expansion followed by financial crises, which could be driving this result. This may also highlight the negative long-run effect of financial crises on TFP growth. In contrast to the findings in the literature, the coefficient of tertiary education turned out negative, when we include it together with years of schooling. This may probably reflect the quality and efficiency of tertiary education in the countries of our sample.

Table 4. Panel Group Mean Fully Modified OLS Results

	(I)	(II)	(III)	(IV)	(V)	(VI)
SKL	-1.92***	-1.87***	-1.30***	-1.62***	-0.14***	
	0.017	0.019	0.015	1.59E-12	1.23E-03	
INF	-3.32***	-4,23***	-7.99***			0.09
	0.247	0.234	0.36			0.074
FEM	-1.89***	0.64***	-3.08***	-0.84***	-0.3	-2.31***
	0.413	0.096	0.178	2.63E-12	0.6	0.278
FDI	0.34***	0.59***	-2.56***	0.11**	-0.15***	-0.02**
	0.073	0.033	0.378	0.044	0.01	0.008
CRD	0.09***	-0.44***		-1.06***		-0.07***
	0.018	0.025		9.30E-13		0.015
TRD			1.44***			
			0.066			
DBT				1.41***	0.24***	
				1.54E-12	0.02	
$DBT^2/100$				-2.17***	-0.22***	
				1.62E-12	0.01	
MKT					0.01***	
					0.00	
SCL						6.45***
						1.706
TED						-1.01***
						0.094
AGR		-0.99***				
		0.265				

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

Panel Probit Analysis

28. The panel probit results broadly support the findings in the system GMM and panel cointegration long-run analysis. In particular, a higher skill mismatch index decreases the chance of TFP increasing growth in the long run (Table 5). In line with the previous empirical analysis, higher inflation decreases the probability that TFP contributes to growth. A one percentage point increase in inflation reduces the probability of TFP contributing to growth by about 2 percent in the long run. We also find that the link between the probability of TFP contributing to growth and government debt is concave, although the coefficients are not always statistically significant.

29. The results suggest that less strict regulation in credit and labor markets and higher access to finance by SMEs increases the likelihood of TFP adding to growth. Less strict regulation on the labor market boosts the chance of TFP contributing to growth significantly (Table 5). Lowering the index of labor regulation by one point is associated with a 34 percent increase in the probability of positive TFP contribution to growth. The credit market variables are found to be significant with less strict credit regulation and a higher percentage of SMEs with a credit line increasing the likelihood of TFP increasing growth.

30. Macroeconomic policies in SMICs are conducive for TFP to contribute for future growth, while they lag in terms of structural reforms. The predictive estimates based on the first model specifications, where we have mostly macroeconomic variables are largely similar for our SMICs showing a higher chance for positive contribution of TFP to growth (Table 6). This suggests that these countries have generally managed to achieve macro-stability, which contributed to their good economic performance and historically strong growth. However, the estimated predictive probabilities based on the last three specifications, where we added structural variables, like the regulatory burden on firms and the skill-mismatch index in the labor market, reduce the probability of TFP contributing to GDP growth significantly for all SSA SMICs, except for Mauritius. This highlights the need for structural reforms to unlock the productivity growth in many of SSA SMICs and explains the favorable outcomes in Mauritius relative to some other SMICs in SSA.

Table 5. Panel Probit Analysis, TFP

	(1)	(2)	(3)	(4)	(5)
INF	-0.018**	-0.022*	-0.027***	-0.0315	-0.030***
	0.0086	0.012	0.0075	0.15	0.011
DBT	-0.0052	-0.0025	0.063**	0.082*	0.015
	0.009	0.0081	0.029	0.047	0.033
$DBT^2/100$	0.00075	-0.00023	-0.032	-0.048	0.0038
	0.0046	0.0042	0.024	0.034	0.029
MNU		0.38*			0.013
		0.020			0.036
TRD		-0.018			
		0.042			
CRD		0.00016			
		0.0044			
LRG			0.34*		
			0.18		
SKL			-0.051**		-0.031*
			0.021		0.017
CRG				0.57***	0.17
				0.16	0.24
SMC				0.033**	
				0.016	
Constant	0.729**	0.067	-2.12	-8.78	-0.82
	0.35	0.46	1.48	0	2.57
Observations	112	107	49	22	53
Number of Countries	33	32	20	22	20

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

Table 6. Predictive Probabilities					
	(1)	(2)	(3)	(4)	(5)
Botswana	69.1	57.5	11.8	13.8	35.3
Cabo Verde	63.3	62.0			
Lesotho	63.9	63.8			
Mauritius	64.5	68.0	71.3	86.6	65.9
Namibia	69.3	63.4	11.3	12.8	34.6
Seychelles	48.2	29.0			
Swaziland	69.4	92.0			

E. Conclusion

31. This paper has looked at factors that could boost total factor productivity and thus potential growth in SMICs in SSA. Estimating the relation between TFP and its determinants is complicated by the existence of endogeneity and cross-country heterogeneity among these economic variables. These concerns together with limited data availability are behind the motivation for using several econometric techniques that attempt to address endogeneity and heterogeneity problems and provide robustness to our estimates. Our empirical results confirm the existing literature results that macroeconomic stability and trade openness are conducive to productivity growth. However, they are not sufficient. SMICs need to improve the quality of public spending, most notably on education to minimize the skill mismatch in the labor market, and reduce the regulatory burden on firms. In addition, an impact of government debt on productivity growth is significant and nonlinear. The impact of government debt turns negative, when government reaches a certain threshold of GDP. There is also some evidence, although not robust, that improved access to finance for SMEs might be useful.

References

Acemoglu, D. and S. Johnson: 2003, `Unbundling Institutions'. Working Paper 9934, National Bureau of Economic Research.

Acemoglu, D., S. Johnson, and J. Robinson: 2004, `Institutions as the Fundamental Cause of Long-Run Growth'. NBER Working Papers 10481, National Bureau of Economic Research, Inc.

Acemoglu, D. and F. Zilibotti: 2001, `Productivity Differences'. The Quarterly Journal of Economics 116(2), 563–606.

Aghion, P., P. Howitt, and D. Mayer-Foulkes: 2005, `The Effect of Financial Development on Convergence: Theory and Evidence'. The Quarterly Journal of Economics 120(1), 173–22.

Aisen, A. and F. J. Veiga: 2013. `How does political instability affect economic growth? '. European Journal of Political Economy, Elsevier, vol. 29(C), pages 151-167.

Aiyar S., R. Duval, D. Puy, Y. Wu, and L. Zhang: 2013, `Growth Slowdowns and the Middle-Income Trap'. IMF working paper (WP/13/71).

Akinlo, A. E.: 2005, `Impact of Macroeconomic Factors on Total Factor Productivity in Sub-Saharan African Countries'. Working Paper Series RP2005/39, World Institute for Development Economic Research (UNU-WIDER).

Arellano, M. and S. Bond: 1991, `Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations'. Review of Economic Studies 58(2), 277–97.

Barro, R. J.: 1991, `Government Spending in a Simple Model of Endogenous Growth'. NBER Working Papers 2588, National Bureau of Economic Research, Inc.

Barro, R. J.: 2001, `Human Capital and Growth'. American Economic Review 91(2), 12–17.

Barro, R. J.: 2013, `Inflation and Economic Growth'. Annals of Economics and Finance 14(1), 121–144.

Behar A.: 2010, `Would More Skills Raise Demand for Those Who Do Not Get Them? Evidence from South African Manufacturing'. Journal of African Economies, Vol. 19, number 4, pp. 496–535.

Benhabib, J. and M. Spiegel: 1994. `The role of human capital in economic development evidence from aggregate cross-country data'. Journal of Monetary Economics, Elsevier, vol. 34(2), pages 143-173, October.

Blundell, R. and S. Bond: 1998, `Initial conditions and moment restrictions in dynamic panel data models'. Journal of Econometrics 87(1), 115–143.

Coe, D. T. and E. Helpman: 1995. `International R&D spillovers'. European Economic Review, Elsevier, vol. 39(5), pages 859-887, May.

Coe, D. T., E. Helpman, and A. W. Hoffmaister: 1997, `North-South R&D Spillovers'. Economic Journal, Royal Economic Society, vol. 107(440), pages 134-49, January.

Danquah, M., E. Moral-Benito, and B. Ouattara: 2013, `TFP growth and its determinants: a model averaging approach'. Empirical Economics 46, 1–25.

De Gregorio, J.: 1993, `Inflation, taxation, and long-run growth'. Journal of Monetary Economics 31(3), 271–298.

Dollar, D. and A. Kraay: 2004, `Trade, Growth, and Poverty'. Economic Journal 114(493), F22–F49.

Easterly, W.: 2006, `Reliving the 1950s: the big push, poverty traps, and takeoffs in economic Development'. Journal of Economic Growth 11(4), 289–318.

Edwards, S.: 1998, `Openness, Productivity and Growth: What Do We Really Know? '. Economic Journal, Royal Economic Society, vol. 108(447), pages 383-98, March.

Engelbrecht, H. J.: 2002, `Human capital and international knowledge spillovers in TFP growth of a sample of developing countries: an exploration of alternative approaches'. Applied Economics, Taylor & Francis Journals, vol. 34(7), pages 831-841.

Espinoza, R.: 2012, `Factor Accumulation and the Determinants of TFP in the GCC'. OxCarre Working Papers 094, Oxford Centre for the Analysis of Resource Rich Economies, University of Oxford.

Estevão, M. and E. Tsounta: 2013. `Has the Great Recession Raised U.S. Structural Unemployment?'. IMF working paper (WP/11/105).

Fischer, S.: 1993, `The role of macroeconomic factors in growth'. Journal of Monetary Economics 32(3), 485–512.

Fleisher, B., H. Li, and M. Q. Zhao: 2010. `Human capital, economic growth, and regional inequality in China'. Journal of Development Economics, Elsevier, vol. 92(2), pages 215-231, July.

Ghali, K.: 1999, `Government size and economic growth: evidence from a multivariate cointegration analysis'. Applied Economics 31(8), 975–987.

Ghosh, A. R. and S. Phillips: 1998, `Inflation, Disinflation, and Growth'. IMF Working Papers 98/68, International Monetary Fund.

Glaeser, E. L., R. L. Porta, F. L. de Silane, and A. Shleifer: 2004, `Do Institutions Cause Growth?'. NBER Working Papers 10568, National Bureau of Economic Research, Inc.

Griffith R., S. Redding, and J. Van Reenen: 2004. `Mapping the Two Faces of R&D: Productivity Growth in a Panel of OECD Industries'. The Review of Economics and Statistics, MIT Press, vol. 86(4), pages 883-895, November.

Grossman, G. M. and E. Helpman: 1993, `Innovation and Growth in the Global Economy'. Vol. 1 of MIT Press Books. The MIT Press.

Hall, R. E. and C. I. Jones: 1996, `The Productivity of Nations'. NBER Working Papers 5812, National Bureau of Economic Research, Inc.

Hall, R. E. and C. I. Jones: 1999, `Why Do Some Countries Produce So Much More Output Per Worker Than Others?'. The Quarterly Journal of Economics 114(1), 83–116.

Herndon, T., M. Ash and R. Pollin: 2013. `Does High Public Debt Consistently Stifle Economic Growth? A Critique of Reinhart and Rogoff '. Working Papers wp322, Political Economy Research Institute, University of Massachusetts at Amherst.

Jaumotte, F. and N. Spatafora: 2007, `Asia Rising: A Sectoral Perspective'. IMF Working Papers 07/130, International Monetary Fund.

King, R. G. and R. Levine: 1993, `Finance and Growth: Schumpeter Might Be Right'. The Quarterly Journal of Economics 108(3), 71–37.

Leigh, L., and I. Flores: 2013, `Closing the Jobs Gap in the Southern Africa Customs Union (SACU), Chapter 6 of a book entitled "Building a Common Future in Southern Africa'. (Washington: International Monetary Fund).

Levin, R., and S. Zervos: 1998 `Stock Markets, Banks, and Economic Growth'. American Economic Review, American Economic Association, Vol. 88(3), 537-58, June.

Lewis, A.: 1979, `The Slowing Down of the Engine of Growth'. Nobel Prize in Economics documents 1979–2, Nobel Prize Committee.

Lewis, W. A.: 1954, `Economic Development with Unlimited Supplies of Labor'. The Manchester School 22(2), 139–191.

Loko, B. and M. A. Diouf: 2009, `Revisiting the Determinants of Productivity Growth: What's new?'. IMF Working Papers 09/225, International Monetary Fund.

Lu, D.: 2002, `Sectoral Factor Reallocation and Productivity Growth: Recent Trends in the Chinese Economy'. Journal of Economic Development 27(2), 95–111.

Madsen, J. B. and J. B. Ang: 2013, `The Asian Growth Miracle: Factor Accumulation, the Demographic Transition, and R&D-Driven Growth'. No 23-13, Monash Economics Working Papers, Monash University, Department of Economics

McGuckin, R. and B. v. Ark: 2005, `Productivity and participation: an international comparison'. GGDC Research Memorandum 200578, Groningen Growth and Development Centre, University of Groningen.

Nachega, J. C. and T. Fontaine: 2006. `Economic Growth and Total Factor Productivity in Niger'. IMF Working Papers 06/208, International Monetary Fund.

Nelson, R. and E. Phelps: 1966. `Investment in humans, technological diffusion, and economic growth'. American Economic Review Papers and Proceedings 56, 69–75.

Pedroni, P.: 2000, `Fully Modified OLS for Heterogeneous Cointegrated Panels'. Advances in Econometrics, Vol. 15, 93–130.

Pedroni, P.: 2004, "Panel Cointegration; Asymptotic and Finite Sample Properties of Pooled Time Series Tests with an Application to the PPP Hypothesis," Econometric Theory, 20, 597–625.

Poirson, H.: 2000, `Factor Reallocation and Growth in Developing Countries'. IMF Working Papers 00/94, International Monetary Fund.

Ranis, G.: 1989, `The role of institutions in transition growth: The East Asian newly industrializing countries'. World Development 17(9), 1443–1453.

Ranis, G. and C. Fei: 1961, `A theory of economic development'. The American Economic Review 51, 533–565.

Reinhart, C. M. and K. S. Rogoff, 2010.`Growth in a Time of Debt'. American Economic Review, American Economic Association, vol. 100(2), pages 573-78, May.

Romer, P. M.: 1990, `Human capital and growth: Theory and evidence'. Carnegie-Rochester Conference Series on Public Policy 32(1), 251–286.

Roodman, D.: 2009, `A Note on the Theme of Too Many Instruments'. Oxford Bulletin of Economics and Statistics 71(1), 13–158.

Roubini, N. and X. Sala-i Martin: 1992, `Financial repression and economic growth'. Journal of Development Economics 39(1), 5–30.

Sachs, J. D. and A. Warner: 1995, `Economic Reform and the Process of Global Integration'. Brookings Papers on Economic Activity 26(1, 25th A), 1–118.

Sala-I-Martin, X., G. Doppelhofer, and R. I. Miller: 2004, `Determinants of Long-Term Growth: A Bayesian Averaging of Classical Estimates (BACE) Approach'. American Economic Review 94(4), 813–835.

Solow, R. M.: 1957, `Technical Change and the Aggregate Production Function'. Review of Economics and Statistics 39: 312-20.

Weil, D. N. and O. Galor: 2000, `Population, Technology, and Growth: From Malthusian Stagnation to the Demographic Transition and Beyond'. American Economic Review 90(4), 806–828.

Appendix I. List for Countries Included in the Analysis

Countries included in regressions		
Argentina	Gabon	Panama
Botswana	Hungary	Peru
Brazil	Iran	Romania
Bulgaria	Jamaica	Serbia
Cabo Verde	Jordan	Seychelles
China	Kazakhstan	South Africa
Colombia	Lesotho	Swaziland
Costa Rica	Malaysia	Thailand
Dominican Republic	Mauritius	Tunisia
Ecuador	Mexico	Turkey
Fiji	Namibia	Venezuela

Appendix II. Methodologies for Modeling Total Factor Productivity

Summary: This paper has used three methodologies to empirically assess the factors that determine total factor productivity (TFP) in SMICs and thus their potential growth.

Underlying model for 1.-3.

$$y_{i,t} = \gamma yi, t-1 \quad + \boldsymbol{X}_{i,t}\boldsymbol{\beta} + \theta_t + \left(u_i + e_{i,t}\right)$$

where $y_{i,t}$ is total factor productivity (TFP) obtained from the growth decomposition exercise; $\boldsymbol{X}_{i,t}$ is a vector of time-varying country-specific characteristics (including structural policy factors and other factors influencing the TFP); θ_t is the time effects; u_i is the time-invariant country fixed effects (both observed and unobserved); and $e_{i,t}$ is the unobserved error term which are time-varying.

1. Dynamic Panel Estimation: Dynamic-Panel Generalized Method of Moments (Difference and System GMM)[1]

Pros:

(i) The dynamic-panel GMM allows the lag-dependent variable ($y_{i,t-1}$) to affect the dependent variable.

(ii) It can control for the endogeneity issues arising from both the time-varying and time-invariant unobservable.

Cons/Assumptions required:

(i) The coefficient estimates are consistent only when $\mathrm{N} \to \infty$, and requires $\mathrm{T} \geq 3$.

(ii) The model requires an additional assumption on the error terms, which depends on the selected instrumental variables.[2]

[1] See Arellano and Bond (1991), and Blundell and Bond (1998).

[2] See Roodman (2009) for the criteria of instrumental variables used.

(iii) The estimation requires the included variables to be stationary.

Note 1: When data are persistent (which is likely to be in our case), System-GMM has been shown to outperform Difference-GMM (Blundell and Bond, 1998; Bond et al. 2001). This is because System-GMM additionally uses the cross-country variations to identify the effects of interests.

2. Panel Co-integration Analysis

We test for the presence of cointegration using Pedroni's seven statistics: (i) pooled variance ration statistic (nonparametric), (ii) pooled rho-statistic (semi-parametric), (iii) pooled t-statistic (semi-parametric), (iv) pooled t-statistic (parametric), (v) group mean rho-statistic (semi-parametric), (vi) group mean t-statistic (semi-parametric), and (vii) group mean t-statistic (parametric).

Cointegration tests:

$$y_{i,t} = a_i + \beta_i \boldsymbol{X}_{i,t} + e_{i,t}$$

where $y_{i,t}$ is total factor productivity (TFP) obtained from the growth decomposition exercise; $\boldsymbol{X}_{i,t}$ is a vector of time-varying country-specific characteristics (including structural policy factors and other factors influencing the TFP); and ei, t is the unobserved error term which are time-varying.

Individual cointegration OLS regression is estimated for each country and depending on the type of the test pooled or group mean tests are computed based on the estimated residuals. Then appropriate adjustment terms are used to turn the statistics into standard normal distribution (the adjustment terms defer depending on the type of the test and the number of regressors). [3]

Group Mean Fully-modified Ordinary Least Squares (FMOLS):

FMOLS estimates the same regression by OLS for each country individually and uses the estimated residuals to compute country specific long-run covariance matrix. This long-run covariance matrix is used to compute country specific adjustment terms to adjust individual FMOLS estimates and t-statistic for country specific serial correlation dynamics and endogeneity. Group mean FMOLS estimators and t-statistics are calculated based on country specific adjusted FMOLS estimates and t-statistics. [4]

Pros:

(i) The estimations are more suitable to non-stationary data and allow for unit-root regressor processes.
(ii) Allows both heterogeneous dynamics and heterogeneous cointegtation vectors.
(iii) Allows heterogeneous cointegrating slopes with straightforward interpretation.
(iv) FMOLS provides estimates (only) for the long-run dynamics.
(v) Good small sample size and power properties.
(vi) Accounts for serial correlation dynamics and endogeneity.

Cons/Assumptions required:

[3] For more detail see Pedroni (2004).
[4] See Pedroni (2000).

(i) FMOLS estimator is computationally complex.
FMOLS estimators depend on the assumption of exact unit roots for all the regressors.

3. Binary or multinomial response model: Probit/Logit estimation

$$I_{i,t} = f(\boldsymbol{X}_{i,t}, u_i, e_{i,t})$$

where $I_{i,t}$ is an index indicating whether the TFP contribution is positive/negative (i.e. $1\{y_{i,t} \geq 0\}$), or whether TFP is fall in a specific range; $\boldsymbol{X}_{i,t}$ is a vector of time-varying country-specific characteristics (including structural policy factors and other factors influencing the TFP); u_i is the time-invariant country fixed effects (both observed and unobserved); and $e_{i,t}$ is the unobserved error term which are time-varying.

Pros:

(i) The probit/logit estimations allow for non-linear effects of the explanatory variables.
(ii) An index variable can mitigate the problem of measurement errors in the TFP contribution.

Cons/Assumptions required:

(i) The dependent variable contains less information (as we convert a continuous dependent variable to be a discrete dependent variable).
(ii) The choice of thresholds in the multinomial response model can be very arbitrary.
(iii) The estimations are a bit more complicated when there is an endogenous regressor and/or a lagged dependent variable.

In addition to the empirical methodologies, the paper also looked at sectoral shift analysis.[5] This approach uses ideas of structural transformation in economies and shift to dynamic sectors that often leads to a boost in TFPs.

Pros:

(i) The sector shift analysis identifies how each sector contributes to the total productivity growth.
(ii) This is a decomposition exercise. So, it is not subject to any econometrics assumptions.

Cons:

(i) The analysis requires information on sectoral productivity and employment.
(ii) It may not fully answer our questions of interests. The policy implementation related to this would be labor force reallocation, and labor market flexibility (not how public sector size affects the TFP contribution).

[5] See World Bank (2008)'s *Unleashing Prosperity*, pp.176-177.

4. Construction of the Skill Mismatch Index

As discussed in Leigh and Flores (2011), skill-mismatch could be one of the reasons for high structural unemployment in many of the SSA SMICs. For our analysis, we constructed a skill-mismatch index, following (Estevão and Tsounta 2011), to determine if changes in TFP could be captured by country differences in matching supply and demand for skills. The skills mismatch index is calculated by taking the difference between the skill demand and supply for each country in the sample. Following Estevao and Tsounta (2011), the skills mismatch index for each country i at time t is constructed using equation:

$$Skill\ Mismatch\ Index_{it} = \sum_{j=1}^{3} (S_{ijt} - M_{ijt})^2$$

in which j is the skill level; S_{ijt} is the percentage of the population with skill level j at time t in country i (skill level supply), and M_{ijt} is the percentage of employees with skill level j at time t in country i (skill level demand).

- *Skill level supply*. World Bank educational attainment data are used to construct skill level supply using primary education (as low skilled), secondary education (as semi-skilled), and college and tertiary education (as high skilled).

- *Skill level demand*. Skill level demand is approximated by the percentage of employees in three key sectors: mining and construction (to proxy low-skilled workers), manufacturing (for semi-skilled workers), and government and financial services (for high-skilled workers).[6]

[6] Although the Estevao and Tsounta (2011) method of estimating skill supply is reasonably robust based on educational attainment, the measures of skill demand and skill intensity does have some weaknesses, including treating mining sector as low skilled in the skill-intensity spectrum when most of the mining sector employees in SMICs are at least medium to high skilled.