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Impact of Macroeconomic Factors on Total Factor Productivity in Sub-Saharan African Countries

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Abstract

This study explores the effects of macroeconomic factors on total factor productivity (TFP) in 34 sub-Saharan African countries for the period 1980-2002. The econometric analysis shows that external debt is negatively and significantly related to TFP. Other factors that have significant negative effect include inflation rate, agricultural value-added as a percentage of GDP, lending rate, and local price deviation from purchasing power parity. However, our result shows that human capital, export–GDP ratio, credit to private sector as percentage of GDP, foreign direct investment as percentage of GDP, manufacturing value-added as a share of GDP, and liquid liabilities as percentage of GDP have significant positive effect on TFP. Taken together, the result shows that policies that reduce population growth rate and debt facilitate greater openness, sound macroeconomic fundamentals, price stability, financial deepening, and greater private participation; would lead to higher TFP in the sub-Saharan region.

Keywords: productivity, macroeconomic factors, sub-Saharan Africa, pooled

JEL classification: F34, O25, O55

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1 Introduction

The role of productivity in accelerating the pace of economic growth is well recognized in the literature on growth. In the neo-classical growth accounting framework, the growth of output is the sum total of the growth of capital accumulation, growth of labour and the growth of productivity or efficiency. Thus, for a given combination of factor inputs (capital and labour), the shifts in the production frontier are engendered by the improvements in productivity or efficiency. However, the neoclassical paradigm considers efficiency or technological progress as an exogenous process.[1] But, the standard neoclassical growth models (i.e. Solow 1956; Ramsey 1928, optimal growth models; or Samuelson's 1958 overlapping generation models and their adherents) have been challenged by the endogenous growth theorists. The endogenous growth models make technological process endogenous. One of the implications of endogenizing technological change is that government policies can have effect on total factor productivity (TFP). In effect, this means that many included determinants of growth may only indirectly affect output. Rather, these factors affect the efficiency of the real inputs, capital, labour, and possibly human capital. Hence, these determinants of output growth directly affect TFP. Few studies have attempted to examine the impact of these macroeconomic policies on TFP growth in recent years. However, the effects of most of these macroeconomic factors still remain an open issue with no clear conclusion. More importantly, most of the studies on the determinants of TFP have been focused on developed and other industrialized economies. So far, we have not identified any published empirical studies on the determinants of TFP that focused exclusively on sub-Saharan Africa (SSA).[2] In addition, none of the known empirical works on the determinants of TFP has explored the effect of debt on TFP.

This paper therefore seeks to examine the effect of macroeconomic factors on TFP in SSA countries. More importantly, we explore the effect of external debt on TFP in the continent. Analyzing TFP in SSA countries is important for several reasons. One: Africa is the slowest growth region of the world, it is important to know those factors that affect TFP as the latter is crucial to output growth. Two: as many countries in SSA implemented many wide ranging economic reforms including exchange rate, interest rate, fiscal and monetary reforms since the early 1980s, it is important to know how some of the macro policies have impacted TFP. Finally: to the extent that SSA countries face different set of economic and social conditions, policies that drive TFP in other regions may not work in the same way in the case of SSA. Hence, our analysis will shed light on ways via which policymakers might enhance TFP in SSA.

To this end, we follow the neoclassical growth accounting framework and use the Solow residuals (Solow 1957) as the measure of TFP. Three main results emerged from

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1 The productivity and efficiency aspects of growth have attracted considerable attention in the literature especially since the development of the business cycle models in the early 1980s. The real business cycle models initially extended Ramsey (1928) model to include aggregate economic fluctuations and emphasized the role of shocks of technology in the economy, that is, shifts in production function from one period to another for a given level of inputs.

2 In most of the empirical literature on the determinants of TFP, SSA only exists primarily as a dummy variable in a single reduced form regression or a part of panel data regression.

our econometric results. One: openness measured as either ratio of export to gross domestic product (GDP) or the sum of export and imports as ratio of GDP has a significant and robust effect on TFP. Two: human capitals, liquid liabilities, ratio of manufacturing value-added to GDP, foreign direct investment (FDI) as percentage of GDP, and ratio credit to private sector to GDP have significant positive effect on TFP. Three: debt stock and debt service ratio have significant negative effect on TFP. The same result obtains for inflation rate, outward orientation measured as local price deviation from purchasing power parity (PPP), lending rate, and population growth rate as well as ratio of agricultural value-added to GDP. The results suggest the need for further debt relief for SSA countries to generate higher TFP in the region. However, this would have to be complimented with domestic policies that facilitate greater openness, sound macroeconomic fundamentals, price stability, financial deepening, and greater private participation.

The remainder of this paper is organized as follows. Section 2 reviews existing literature regarding the potentials determinants of TFP. Section 3 explains the data used in our study. Section 4 discusses the methodology adopted and presents the results. Section 5 provides the policy implications of the results.

2 Literature review

2.1 Theoretical issues

In the neoclassical growth accounting framework, improvements in productivity or efficiency are treated as exogenous in the growth models. These models are couched in terms of the Solow's (1957) models. According to Solow's basic neoclassical model, productivity evolves exogenously as determined by technology. This simply means that government policies cannot affect the steady state, and 'the engine of growth' is technological progress. However, the emergence of the new growth theories in the mid 1980s has reviewed the conventional neoclassical theory to formally incorporate the technical progress and to account for what may be called the non-traditional determinants of economic growth. The endogenous growth models have brought to focus the role of endogenous policy changes in affecting the efficiency of factors of production and the TFP. The new growth theory with its endogeneity of technological change, in tandem with the new international trade theory which integrates the notion of imperfect competition, opens up the possibility of achieving perpetually higher growth rates, at least in theory. Openness to trade and FDI allows the transfer of technology, while world class management practices are assimilated which in turn, introduces innovation, cost-cutting and thus eliminates monopolies. These factors can permanently raise growth rate and TFP.

Romer (1992), Grossman and Helpman (1991), and Barro and Sala-I-Martin (1995) among others, indeed argued that countries that are more open to the rest of the world have a greater ability to absorb technological advances generated in the leading nations. However, according to Coe and Helpman (1995), the transfer of technology and concomitant knowledge spillovers from advanced to developing countries through export and import routes will be more successful in economies with better and more advanced education. This, indeed, forms the core another class of growth models that

postulate that productivity requires more than just direct investment in physical capital and the basic labour as well as trade but also investment in knowledge and human capital, research and development (R&D) and in infrastructure.

Increasing an economy's skill base can have a positive effect impact on TFP growth by facilitating structural change and technological improvements. Education is critical to higher productivity in view of the complimentary effect between it and more skilled activities including R&D activities. The two are crucial in enhancing the level of technology, while the productivity of R&D requires higher standards knowledge in the economy. Several variables have been used in the literature to measure the impact of education. These include public expenditure on education as a percentage of GDP (Barro and Lee 1994), and primary, secondary, and higher school attainment (Sachs and Warner 1995; Barro and Lee 1994).

However, while the positive effect of education and R&D activities on TFP might not be in doubt in the advanced economies, the same cannot be said of SSA countries. This is based on the abysmally low government expenditure on education, low school enrolment rate, and low investment in R&D activity. As a matter of fact, to create a supportive framework for R&D activity, an economy needs a well-developed risk capital market, a good system to protect intellectual property rights, and research supportive activities. Only few of these conditions are obtainable presently in most SSA countries.

Another set of variables that could play a role in determining the level of productivity as they may influence the quality and efficient allocation of factors of production and their rate of utilization are classified under macroeconomic environment. Under this, we have variables such as inflation, size of government, inflation, inflation variability, exchange rate instability, among others. The general consensus in the literature of growth is that sound macroeconomic environment including well managed public finances; low inflation, and exchange rate stability, among others, can contribute to raising trend productivity growth in the medium term through a positive impact on confidence and by promoting efficient resource allocation. However, theoretical and empirical works on this subject have not specifically focused on TFP. Thus, for most of these macroeconomic environment variables, the question of how they affect TFP is still open.

An important variable that could impact either positively or negatively on TFP especially in SSA is the level of external debt. Although empirical studies have related it to growth of the GDP and established negative effect of debt overhang, however, it remains to be related to TFP. High debt stock can adversely affect TFP where it worsens macroeconomic environment. In a situation where foreign investors perceive high debt stock as a sign of domestic macroeconomic instability and a host government's inability to maintain expedient monetary and fiscal policy, it could lead to cessation of FDI inflow and generate high capital flight with adverse effect on investment and thus TFP. On the other hand, where a high debt stock is interpreted as evidence of credit worthiness signaling higher expected availability of foreign exchange, FDI inflows could be enhanced with its concomitant positive effect on TFP.

Theoretically, what most arguments seem to suggest is that the extent to which TFP will increase depends on the economic and social conditions or in short, the quality of environment of the country. The quality of the environment relates to the degree of

openness, level of technological development, size of government, pattern of government expenditure, level of deficit, level of inflation among others. A country with a sound and stable macroeconomic environment including a well-managed public finances, not too large a government sector, price stability, high technological level, high R&D activity can contribute to raising trend productivity growth in the medium term through a positive impact on confidence and by promoting efficient resource allocation.

However, this still remains an empirical issue in SSA given the economic and social conditions of the continent. The SSA economies is still characterized with low growth rate, low share of manufacturing value-added to GDP, limited R&D activity, and low school enrolment rate. In addition, the SSA economies still face the problems of high inflation, unstable exchange rate high debt burden and limited inflow of FDI.

2.2 Empirical evidence

There are legion of empirical literature on the impact of macro economic factors on growth.[3] However, not many have been focused specifically on TFP, especially in SSA. As our work is specifically of TFP, we review previous empirical works devoted specifically to TFP. Table 1 summarizes the main findings from samples of micro and macro studies in developing countries. Although results differ, due in part to differences in the measurement of TFP, adjustment factor utilized, and differences in econometric techniques and specification, some important empirical regularities have emerged. In what follows, we not only discuss those factors that have been focused in the literature but also identified some others that could affect TFP bringing out the various channels through which they could do so.

2.2.1 Trade and trade orientation

The effect of trade on growth has received a lot empirical works over the decades. However, the nature of the relationship remains a highly contentious issue. Theoretically, trade theory provides three main channels through which trade could affect TFP.[4] These include exploitation of comparative advantage, economies of scale, and exposure to competition. However, endogenous growth theory has expanded on the notion of scale economies, suggesting that trade may increase the generation and diffusion of knowledge through such as learning by doing, in the sense that increasing current production brings about higher productivity in the future, the learning by doing affects involve dynamic economies of scale. It is equally contended that expansion could relax the foreign exchange constraint and allow for larger import of key inputs in the production process. Mankiw (1995) and Ventura (1997) argue that the equalization

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3 For a comprehensive review of empirical studies on the determinants of TFP, see Nelson (1981) and Griliches (1994).

4 Various measures of trade have been adopted in empirical work. These include among others export share in GDP, export plus imports share of GDP, terms of trade, average black market premia, Sachs and Warner openness index, Learner's openness index, and average import tariffs on manufacturing, average coverage of non tariff barriers, Heritage foundation, index of distortions in international trade and collected trade taxes ratio.

of factor prices internationally could improve the substitutability of capital and labour, thus improving growth prospects.

However, some authors are skeptical of the trade–growth nexus. Grossman and Helpman (1991) argue that trade could hurt productivity. They cite various examples: intensified competition due to trade could discourage efforts for invention by lowering expected potentials profitability of a successful innovation; a country with abundant unskilled labour may be led by trade to specialize in traditional low tech manufacturing and international competition with a technologically advanced country can bring about a slowdown of innovation and productivity growth in a country with a disadvantage in research productivity.

Many empirical studies on the trade–TFP nexus using both micro, time series-cross analysis provide support for positive linkage between the two (Edwards 1998; Miller and Upadhyay 2000; Dollar 1992; Sachs and Warner 1995). However, some authors have raised the issue of direction of causality between trade and growth. Harrisson (1996) shows that causality between openness and growth runs in both directions. However, the question of the impact of trade on TFP still remains an empirical issue in SSA considering the economic and social condition of the continent. And as pointed out by Edwards (1998), there is still the need to do more empirical works to answer the question of how openness and trade affect output growth. Edwards (1998) tries to solve measurement and endogeneity problems associated with some previous studies on the issue by using nine indices of trade policy and additionally applying instrument variable regression. The result shows a positive correlation between openness and productivity growth, and is robust to the use of openness indicator, estimation technique, time period and functional form.

2.2.2 Competition policy

In addition to the international trade, other aspects of markets for goods and services may be very important for TFP. This relates to the relationship between regulation (commercial policy) and TFP. The possible links are quite parallel to many found in the discussion about the link between international trade and TFP. Excessive regulation and administrative burdens can hinder entrepreneurship and business development. Thus, improvements in the regulatory environment can have a positive effect on productivity growth. For example, greater competition by engendering more efficient and flexible markets can enable firms to achieve higher productivity growth through organizational change and less slack in the use of inputs. In contrast, an uncompetitive environment would result in prices being higher than they would otherwise be and output and employment being less than is socially optimal. In addition to thee static gains in productivity levels, dynamic gains can equally be enhanced if increased competition requires firms to continue to innovate and develop new products. Empirical study by Salgado (2002) shows that the structural reforms implemented in OECD countries during 1985–95, including lowering regulatory burdens and increasing standards of competition, increased TFP growth between 0.2 to 0.3 percentage points on average. This issue needs to be explored in the SSA.

Table 1 Selected empirical studies (micro and macro) on macroeconomic factors and TFP[a]

Author(s)	Country	Sample & method	Model specification	Trade policy	Capital flows	Fiscal Policy	Monetary policy	Macro environment	Others factors
A. Studies on Sub-Saharan Africa									
1. Mulaga & Weiss (1996)	Malawi	Inter-firm cross-sectional panel Panel of firms	TFP as function of trade & market structure	Effective rate of protection (+)					
2. Harrison (1994)	Cote d'Ivoire	IF panel Fixed effect panel of firms	Production function framework	Import penetration (-)					
3. Haddad (1993)	Morocco	IF panel Fixed effects& pooled OLS	TFP is a function of trade policy	Import penetration(+) Export shares (+)					
4. Haddad et al. (1996)	Morocco	IF panel fixed effects & pooled OLS	TFPG is a function of trade policy	Export (+)					
B. Studies from Asia									
5. Fouroton (1991)	Turkey	Inter-industry panel regression	TPFG is a function of change in trade	Import penetration private sector (+) Public sector (-*)					
6. Osada (1994)	Indonesia	Inter-plant cross-sectional regression	TFPG is a function of trade liberalization & FDI	Effective rate of protection (+)	FDI (+)				
7. Sjoholm (1999)	Indonesia	Inter-plant cross-sectional regression	Production function framework	Export (+) Import (mixed)					
8. Kim (1994)	Korea	Inter-industry cross sectional data	TFPG is a function trade& industrial structure	Nominal rate of protection (-)					
9. Wha-lee (1995)	Korea	Inter-industry panel regression (OLS).	TFPG is a function of government intervention.	Import coverage ratio (+)					

10. Fujita (1994)	India	Inter-industry cross-sectional data	TFPG is a function of trade liberalization	Trade liberalization (+)		
11. Norouz (2001)	India	Inter-industry cross-sectional data	TFPG is a function of exp. expansion	Trade regimes (*)		
12.Chad & Sen (2002)	India	Inter-industry panel regression	Production function approach	Trade reforms (+)		
13. Sharma et al. (2000)	Nepal	Inter-industry panel regression	TFPG is a function of trade	Trade liberalization (+*)		
14. Athukorola & Rajapatirana (2000)	Sri Lanka	Inter-industry panel data	TFPG is a function of trade policy & market structure	Trade policy (+)		
15. Okuda (1994)	Taiwan	Inter-industry panel data	TFPG is a function of investment, liberalization	Trade liberalization (+)		Investment (+)
16. Kajiwara (1994)	Philippines	Inter-industry cross-sectional data	TFPG is a function of trade & foreign investment policies	Effective rate of protection (+)		
17. Okamoto (1994)	Malaysia	Inter-industry cross-sectional data	TFPG is a function of trade protection.	Trade protection (+*)		
18. Urata & Yokota (1994)	Thailand	Inter-industry cross-sectional data	TFPG is a function of trade policies	Trade liberalization (+)		
C. Studies that incorporate measures of macroeconomic policies as variable						
19. Das (2001)	India	Inter industry panel fixed effect model	TFPG is a function of trade, industrial, & micro policies	Trade liberalization (+)		Inflation uncertainty (-*)
20. Goldar & Kumari (2002)	India	Inter-industry panel data fixed effects models	TFPG is a function of trade liberalization and investment	Trade liberalization (+)		Stock of capital investment (+)

Table 1 continues…

Table 1 continued

21. Cororation (2004)	Philippines	Annual aggregate data (1967-2000) OLS approach	TFPG is a function of several macro-variables	Export share over GDP (+) Export plus import over GDP (+)	FDI lagged one period (+)			Inflation (-) Manufacturing value-added over GDP (+)	R&D lagged (+)
22. Chandrachai et al. (2004)	Thailand	Annual aggregate data (1977-99) OLS approach	TFPG is a function of several macro-variables	Export over GDP (+)	FDI over capital flows (-) FDI over capital flows lagged (+)			Government over GDP (*) Growth of portfolio investment (*)	Labour growth non-agriculture (+*) R&D (+*)
23. Tinakorn (2001)	Thailand	Annual aggregate data. OLS approach	TFPG is a function of several macro-variables	Openness (+)	Capital stocks (+)				Share of employment in non-agriculture (+*)
24. Hercowitz et al. (1999)	Israel	Annual aggregate data (1960-96). OLS approach	Function of several macro-variables	Export over GDP (*)	Capital stock of road per unit of factor inputs (+)	Tax over GDP (-)		Inflation(-)	United States TFPG (+) Labour mobility (+)
25. Edwards (1998)	93 countries developed & developing	Panel data 1980-90	TFPG is a function trade and other macro-variables	Openness (+)		Inflation tax revenue over GDP (*)			Political instability (-) Human capital (+) Institutional property (-)
26. Miller & Upadhyay (2000)	83 countries developed & developing	Panel data 1960-89 fixed effect approach	TFPG is a function of openness Trade orientation & human capital	Export over GDP (+) TOT (+)			Local price deviation from PPP (-)	Inflation (-) Volatility of export over GDP (-) Volatility of inflation & TOT	Human capital (+)

Notes: [a] Symbols in parentheses denote a statistically significant positive effect (+); statistically significant negative effect (-) and (*) means no significant effect. IF means inter-firms; R&D is research and development, TOT is terms of trade.

2.2.3 Macroeconomic environment

The indicator of macroeconomic environment that have used frequently in empirical work of determinants of TFP is inflation. Many reasons have been hypothesized as to why inflation may be detrimental to economic efficiency (Fischer 1993; Levine and Renelt 1992; Briault 1995; Andres and Hernando 1997). One of the main arguments is that it is not inflation, per se, that generates uncertainty but that higher inflation is correlated with higher variation in inflation and it is this that places a drag on the economy.[5] Other arguments are that high inflation signals economic instability and possibly a lack of budget control. Economic uncertainty and price variability may induce excess capacity and hence reduce factor utilization (Fischer 1993). It may be accompanied by higher variability of relative prices thereby distorting the efficiency of the price mechanism and hence harm the allocation of factors of production.[6] Inflation may reduce the demand for real balances and if money serves as a factor of production reduces productivity. Lastly, it makes it necessary to use additional factors of production, such as financial management, to hedge against losses.

Relatively few empirical studies have been conducted the effects of inflation on TFP especially in SSA. Few studies that were focused on productivity–inflation nexus generally documented negative effect (Hercowitz et al. 1999; Englander and Gurney 1994). Edwards (1998) using inflation tax revenue as a percentage of GDP shows that inflation tax does not affect TFP significantly even though it has the anticipated negative sign.

However, many reasons suggest why inflation is likely to harmful in TFP. The continent has witnessed higher rate of inflation compared to regions. Also, several empirical studies have shown that high inflation encourages capital flight (Olopoenia 2000; Lensink et al. 1998; Dooley 1988). If inflation encourages capital flight and capital flight constrains investment, this would no doubt affect TFP in view of the linkage between investment and TFP. This is also an empirical issue.

2.2.4 Fiscal policy

Studies that focused specifically on the nexus of relationship and TFP are still scant. Most studies have been on fiscal policy and economic growth. However, government activities play a major role in setting the economic framework for enhanced efficiency. Fiscal policy setting can affect productivity through various ways. Where government deficits finance consumption or transfers, it could lead to crowding out of the private sector. In

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5 However, a mechanism through which inflation may positively influence economic performance, called the 'Tobin effect', exists. Tobin (1965) argues that as inflation increases the opportunity cost of holding money, the incentive to invest is enhanced. But as has been pointed out in the literature, the potential for such an effect is rather limited since money balances are only a small fraction of the capital stock and thus the effect could at best be marginal. As a matter of fact, Stockman (1981) argues that if cash has to be held for the purchase of capital goods then inflation may reduce incentive to invest.

6 Temple (2000) survey a number of mechanism including the diversion of human capital into financial management and more sophisticated monetary arguments such as, the effective shortening of contracts and difficulties in obtaining trade credits; and difficulties in company valuation and the evaluation of alternative investment projects.

addition, if fiscal policy is perceived as being at odds with monetary policy, the credibility of the latter could be undermined leading to risk premia on interest rates and exchange rates Moreover, supply side theories argue that taxes necessary to support government spending could distort incentives and thus reduce the efficient allocation of resources.

The endogenous growth theorist hypothesized the potentially long lasting effect of tax distortion and certain kinds of public consumption on efficiency and growth (Barro 1990; Mendoza et al. 1997). These studies classify elements of the government budget into different categories, distortionary and non-distortionary taxation; and productive and non productive expenditure. Generally, distortionary taxes could affect investment decision of economic agent with respect to level and composition of physical and human capital by creating tax wedges with adverse effect on efficiency. In addition, the composition of public expenditure is also important with a greater positive impact for productive investment, including expenditure on infrastructure and investment in education than for expenditures not directly related to growth including inefficient systems of subsidies and transfers. Moreover, distortionary tax policies that lower expected net returns to domestic investment will impair efficiency. Likewise, volatility of tax rate which results in higher investment risks and lower risk adjustment return to domestic investment will no doubt lead to higher capital flight, reduce domestic investment and impair efficiency.

Essentially, the main conclusion from the literature is that there may be a size effect of government intervention on efficiency. More often especially in the developing countries a large public sector deficit is accompanied by higher inflation tax in the long run, thus its effects are similar to those of inflation.[7] Empirical study by Hercowitz et al. (1999) finds a significant negative effect of public deficit on TFP.

2.2.5 Monetary and financial development

The role of financial intermediation on productivity consideration has been documented. The main channel through which financial system could affect TFP growth is efficiency in capital allocation. Many new growth theories have made a connection between finance and efficiency through hypotheses that are based on a Schumpeterian view of innovation; a well functioning financial system spurs technological innovation and hence productivity by identifying and finding entrepreneurs with the best chances of success. According to King and Levine (1993), financial system could encourage innovation through mobilizing resources to finance promising projects, evaluating prospective entrepreneurs and choosing the most promising projects, allowing investors to diversify the risks associated with uncertain innovative activities and revealing the potentials rewards to engage in innovation, relative to continuing to make existing products with available techniques. Studies by Greenwood and Jovanovic (1990), and Becivenga and Smith (1991) have shown how information acquisition and risk-pooling as well as fund allocation by financial intermediaries can encourage investment in high risk project with potential positive benefits on efficiency.

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7 Given the fact that in the long run deficit can be financed by the inflation tax, deficit as a percentage of GDP and inflation are likely to work in the same direction thus making it impossible to introduce the two variables together in our regression.

Several studies have shown that financial repression, characterized by artificially low domestic deposit rate and overvalued exchange rate impairs efficient capital allocation. In particular, empirical studies have shown that financial repression encourages capital flight.[8] Since capital flight has negative effect on investment then financial repression will likely have negative effect on TFP in view of the positive relationship between investment and TFP.

2.2.6 Knowledge investment policies

Specifically, emphasis has been placed on education and R&D. The endogenous growth models have emphasized the importance of R&D in the production of knowledge for understanding technological progress and productivity. This is exemplified in the work of Romer (1990). It is stressed that technology is essentially a non-rival, partially exclusive good. Thus, as non-rival goods, technology can be accumulated without bound on a capital basis, making it possible to envisage technology spillovers. R&D can boost productivity either directly through innovation it produces or more indirectly through the adoption of technologies developed elsewhere. Griliches (1980) identify two positive forms of spillovers namely rent spillovers and knowledge spillovers. These two forms of spillovers work to enhance productivity.[9] Empirical evidence mostly in the advanced countries indicates that R&D has positive and strong effect on productivity growth (Mohen 1990; Griliches 1992; Nadiri 1993; Cameron 1998). However, in order to create a supportive framework for R&D activity, an economy needs a well developed risk capital markets, a good system to protect intellectual property rights and good education and research support system.

Educational attainment is a key determinant of human capital which is an important driver of labour productivity. When a country's skill base is increased, structural change and technological improvements are engendered with positive impact on TFP. Education is required for technological improvement in an economy. It is also crucial in terms of attracting inward FDI. The literature on this issue in SSA is still scant; there is the need to explore this issue in the case of SSA. More importantly, the current argument on the impact of age structure on TFP needs to be verified in the case of SSA. It is argued that the value of human capital can be affected by the structure of the distribution of the population. In a country with young population, productivity will be better enhanced. This is based on the fact that youthful workforce are more dynamic, flexible, and innovative.

2.2.7 Capital flows

The main finding in the growth literature is that debt overhang adversely affects growth. None of the empirical studies reviewed in this work examine the impact of external debt burden on TFP. Yet, in the case of SSA, this is the main feature of the continent. The external debt stock is not only high but the burden is quite excruciating. External debt

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8 Dooley (1988), for example, finds that financial repression, characterized by artificially low domestic deposit rates, is an important determinant of capital flight.

9 However, Jones and Williams (1998) have outlined several forms of negative spillovers that could negatively affect TFP. These are inter-temporal knowledge spillovers; congestion externalities, and creative destruction.

would no doubt affect TFP through its effects on investment and exports. Several studies have shown that debt overhang adversely affect investment while debt service tends to reduce exports. Through these channels TFP is likely to be adversely affected. As a matter of fact, various debt burden indicators could affect productivity through their impact on public sector expenditures. As economic conditions deteriorate, government find themselves with fewer resources and public expenditure cut would the level of production activity. Moreover, where debt overhang worsens the macroeconomic environment and lead to high capital flight, investment would be adversely affected and consequently, TFP.

Moreover, uncertainty about portion of the debt will actually be serviced with the country's own resources could adversely affect productivity. It may not be clear what terms debt will be rescheduled, whether there are will be additional lending, what changes in government policies the rescheduling will entail among others. These uncertainties could lower productivity through reduced level of investment and more speculatively, by distorting the efficiency of capital accumulation, as the investment that does take place may be poorly allocated to activities with quick returns rather than long-term irreversible investment.

However, it is possible for debt stock to increase TFP. This can happen in a situation where high debt is interpreted as evidence of creditworthiness, signaling higher expected availability of foreign exchange with positive effect on investment. In addition to debt flow, we examine the ratio of FDI to GDP as a determinant of TFP. FDI could be a very important driver of TFP in SSA through its spillover effects. Several macro and micro studies have demonstrated channels through which FDI could affect productivity in the middle and higher income countries. There is the need to examine this in the case of SSA countries.

3 Data

The present study examines the impact of macroeconomic factors on TFP in 34 SSA countries for the period 1980-2002. The 34 countries included are those for which necessary data for both dependent and independent variables are available. By using pooled time-series and cross-sectional data the number of observations increases and, thus the degrees of freedom compared to a single country study. The definitions of the variables used are presented in Table A1 in the Appendix.

3.1 Total factor productivity

A variety of techniques have been used to measure TFP in the literature (for details see Fried et al. 1993). However, to keep this analysis simple, we adopt as a first approximation the Cobb-Douglas production function.[10] Hence, the three production

[10] The literature to date is inconclusive on the best method to estimate TFP growth. Typically, no measure of TFP is necessary the best for all purpose (see Mehadevan 2003). As has been noted in the literature, the estimation of an aggregate production function confronts the researcher with various problems; including possible endogeneity of capital and labour. These might have impact on the elasticities estimates obtained and thus the values of TFP obtained. The reader needs to keep these potential biases in mind when interpreting the results.

functions, one excluding and one including the stock of human capital and the third adjusting for simultaneity between capital and labour by combining the two are expressed as:[11]

$$\ln Y = \ln A + \alpha \ln K + \beta \ln L \quad (1)$$

$$\ln Y = \ln A + \alpha \ln K + \beta \ln L + \gamma \ln H \quad (2)$$

and

$$\ln Y = \ln A + \beta(\alpha/\beta \ln K + \ln L) \quad (3)$$

where Y is the output (real GDP) of country j at time t, K, L, and H stand for physical capital, labour capital, and human capital respectively.[12] We equally assume constant return to scale. The estimated factor shares were used to construct yearly estimate of TFP. These estimates were used to construct a second set of TFP growth called TFPG, TFPGH, and ATFPG for production functions 1, 2, and 3 respectively. Over the last three decades, many researchers have improved the measurement of both capital and labour. For capital, they paid great attention to the service life of various types of capital and the corresponding deflators. For labour, researchers took into consideration working hours and the level of education. Unfortunately, statistical authorities in most African countries do not provide much information on labour and do not even provide capital stock estimates. This forces us to use total labour force as a measure for labour. We estimate historical capital stocks from historical investment flows.[13] Following the works of Englander and Gurney (1994), Hjerppe (1998), Mendoza et al. (1997) Markiv et al. (1992) and Narayan and Smyth (2005), we measure human capital as secondary enrolment rate.[14]

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11 The estimating equations emerge by adding random errors to equations (1) to (3) and when using panel data, we can further classify the omitted variables into three groups namely country-varying time invariant, time-varying country-invariant, and country-and time-varying variables (see Hsiao 2003).

In estimating equation (3) we assume capital share of 0.65 and labour share of 0.35 giving us capital-labour share ratio of 1.8571. Hence, our estimating equation for deriving elasticities of capital and labour takes the form of $\ln Y = \ln A + \beta(1.8571 \times \ln K + \ln L)$. The result of the estimation gives the sum of output elasticities with respect to labour and capital as 0.912.

12 The time and country subscripts are omitted for convenience.

13 The amount of capital stock existing at time t is generated from time series of investment. We use the perpetual inventory method as follows:

$$Kt = It + (1 - \Phi)Kt - 1$$

where Kt is the real capital, It is real investment, and Φ is the depreciation rate. However, to avoid the assumption that capital stock is 0 in the first year of the investment data, we aggregate the investment data over the past ten years and five years. However, we do not report the results with aggregate investment data over five years as they are not significantly different from those of ten years.

14 Using school enrolment rate as a measure of human capital is controversial. Some have suggested the use average year of schooling as a better measure. We have adopted this measure to be able to retain many countries in our regression. Average year of schooling among ages 15–64 is not available for some of the countries covered in our work.

One could estimate the equations above using ordinary least square (OLS) approach. However, as emphasized in the literature, the use of OLS is inappropriate because capital and labour would no doubt be correlated with the residual. The other way to estimate our production equation is using instrumental variable (IV) estimation. The IV is difficult to implement because it is necessary to find IVs that are correlated with the regressors but not with productivity. In view of this, we restrict ourselves to fixed effect estimation.[15] Table A2 in the Appendix shows the average TFP growth rate (calculated form production functions 1-3) for the period 1981-2002. The average TFP growth rate was negative for 17 of the 34 countries included in the study. However, except for seven countries (namely Angola, Burkina Faso, Congo Democratic Republic, Cote d' Ivoire, Kenya, Rwanda, and Togo), all other countries' TFP rate was positive since the early 1990s. This possibly reflects the positive effects of the economic reforms implemented in late 1990s in many of the countries included in the study.

In general, the productivity residuals constructed by these three production functions are very highly correlated in the time series for each country (with pairwise R^2s all exceeding 0.98), and we therefore use TFP estimates generated from production function that excludes human capital.

3.2 Independent variables

3.2.1 Macroeconomic environment

As indicators of macroeconomic environment, we use inflation, inflation squared, share of government consumption to GDP, population size and product of population size, and openness.

3.2.2 Fiscal policy

As measures of fiscal policy we use the overall deficit as percentage of GDP and total tax revenue as a percentage of GDP.

3.2.3 Financial development and monetary policy

As indicators of financial development and monetary policy, we use ratio of total liquid liabilities (M2 or M3) to GDP. This measures the size of the financial system. We also use lending rate, deposit rate, and credit to the private sector as a percentage of GDP. The latter is used to measure availability of credit to the private sector in the domestic financial market.

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[15] We cannot use random effects estimation since it requires that the omitted variables are uncorrelated with the included right-hand-side variables. The data were, however, adjusted as deviations for the mean across countries.

3.2.4 Capital flows and stocks

As a measure of capital flows, we use annual change in total debt stock (adjusted for exchange rate fluctuations); stock of debt as a measure of debt overhang, debt service ratio and foreign direct investment inflows.

3.2.5 Knowledge investment policy

As measure of knowledge investment policy we use secondary enrolment rate and add youth dependency ratio as additional variable to allow depreciation of human capital.

3.2.6 Trade and trade orientation

We use ratio of export to GDP, and export plus import as a percentage of GDP as measures of openness, terms of trade and local price deviation from PPP. Other variables used in the study include the shares of manufacturing and agricultural value-added on GDP. We incorporate them to examine the externalities and possible spillover effects of production from these sectors to the rest of the economies.

4 Econometric analysis

4.1 Methodology

The existing theory does not provide a particular way of determining a priori which independent variables should be included in the empirical model of determinants of TFP for a particular sample of countries. Consequently, we follow a stepwise approach, adding explanatory variables one by one and retaining those that are statistically significant.

The estimating model takes the following form:

$$g_{jt} = \Omega_{jt} + \sum_{j=nk}^{mk} B_{ij}{}^{T} X_{it-j} + \mu_{it} \qquad (4)$$

where g_{jt} is the dependent variable and in our case TFP. Ω is the constant term, X is a (k×1)-dimensional vector representing the explanatory variables, B is a (k×1)-dimensional vector representing coefficients for the explanatory variables (with T representing the transpose of the vector), μ is the error term, k is the number of explanatory variables (excluding the constant terms), i represents the cross-sectional units in the case the countries), j represents the number of lags (where lag values are included). n_k and m_k represent the range of lags, and t represents the time period. The dependent variable in our case is the TFP. To allow for country specific effects, we mean difference all the time varying variables. We first run the regressions with annual panel data, an approach that helps to maximize the degrees of freedom.[16] As a check on

[16] In the regressions, we test and correct for serial correlation of the error term as needed, using the Ochrane-Orcutt transformation procedure (see Griffiths et al. 1993).

the robustness of our results, we then collapse the data into a single cross-section where each country has one observation, consisting of the means of the factors.

4.2 Results

The results of the regressions using pooled annual data are reported in Tables 2 and 3, and the results of the cross-sectional regressions are shown in Tables 4, 5, and 6.[17] When we used the independent variables simultaneously, six of them remained significant. These are human capital, openness measured as export–GDP ratio or export plus import–GDP ratio, debt stock, inflation rate, credit to private sector as percentage of GDP, and debt service ratio. We tagged this as our 'expanded model'. Human capital, export–GDP ratio, debt stock, and inflation rate remained significant when other explanatory variables are added to the equation one by one. In contrast, credit to private sector as a percentage of GDP and debt service ratio are not robust to addition of more variables. Hence, we called the regression with human capital, export–GDP ratio, and debt stock as well as inflation rate as 'base model'.

4.2.1 Effect of macroeconomic environment

Our results indicate that inflation has significant negative effect on TFP regardless of which additional determinants of TFP are included in the regression (see Table 3).[18] In the cross sectional regression, inflation variable has a negative sign though not significant. This means that high and unstable prices create a lot of economic uncertainties that discourage investors from investing in productivity-improving projects. This result is consistent with existing empirical findings (Fischer 1993; Bregman and Marom 1993; Miller and Upadhyay 2000). The negative relation between inflation and TFP may actually explain the observed negative relationship between inflation and growth documented in many empirical studies (Levine and Renelt 1992; Kormendi and Meguire 1985; Miller and Russek 1997). As shown in Table 3, the growth rate of population has significant negative effect on TFP.[19] The result is consistent with existing empirical finding (Kogel 2005; Bernanke and Gurkaynak 2001). Government consumption–GDP ratio has a positive sign in both pooled annual and cross sectional data; however, the coefficient is insignificant.

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17 In an attempt to address the issues of endogeneity, we equally estimated the equations using once-lagged values of the independent variables. The findings are essentially unchanged, although in few cases the level of significance drops.

18 The same result was obtained when we squared inflation rate. The coefficient of inflation squared was negative and statistically significant at the 1 per cent level.

19 We included total population as a measure of market size; however, the coefficient is not significant. This suggests that there is no particular efficiency gain in production due to country size. This simply means that increasing returns in production might not be present in this data set.

Table 2 Macroeconomic factors and TFP: fixed effects regressions with pooled annual data[a]

Explanatory variable	Base Model	Expanded Model	Base Model with Debt stock lagged	Base Model with Export+Import GDP ratio	Government consumption-GDP ratio	Terms of Trade	Local price deviation from PPP	Tax revenue-GDP
Human capital (HU)	0.0104	0.0106	0.0102	0.0100	0.0104	0.0104	0.0101	0.0105
	(7.72)	(8.28)	(7.33)	(7.28)	(7.72)	(7.71)	(7.52)	(7.76)
Export-GDP (OPE)	0.0107	0.0095	0.0111		0.0107	0.0107	0.0102	0.0111
	(8.49)	(7.71)	(8.70)		(8.48)	(8.47)	(8.16)	(8.24)
Export+Import-GDP (OPE)				0.0089				
				(6.22)				
Debt Stock (DBT)	-0.0068	-0.0052		-0.0062	-0.0067	-0.0068	-0.0072	-0.0072
	(-7.49)	(-5.96)		(-7.04)	(-7.54)	(-7.64)	(-8.2)	(-8.07)
Debt stock lagged (DBTL)			-0.0586					
			(-6.84)					
Inflation rate (INF) [b]	-0.0023	-0.0017	-0.0021	-0.0024	-0.0023	-0.0024	-0.0023	-0.0026
	(-6.23)	(-4.59)	(-5.52)	(-6.05)	(-6.03)	(-6.21)	(-6.12)	(-6.54)
Debt service ratio (DSR)		-0.0040						
		(-6.71)						
Credit to private sector (CRE)		0.0045						
		(5.38)						
Government consumption-GDP (GCN)					0.0013			
					(1.07)			
Terms of Trade (TOT)						0.0005		
						(0.06)		
Local price deviation from PPP (PPP)							-0.0013	
							(-3.16)	
Tax revenue-GDP (TAX)								0.0006
								(0.47)
Adjusted R2	0.94	0.95	0.95	0.94	0.94	0.94	0.94	0.94
F-tests	289.77	313.54	307.21	283.63	289.96	290.23	303.64	293.24
Observations	663	658	632	663	656	663	638	633

Notes: [a] The dependent variable is TFP. The t-statistics are given in parentheses. [b] Excludes Guinea for lack of data.

Table 3 Macroeconomic factors and TFP: fixed effects regressions with pooled annual data[a]

Explanatory variable	Liquid Liabilities (M3/GDP)	Liquid Liabilities (M2/GDP)	Lending rate [b]	Population Growth	Manufac Value-Added	Agric. Share	Foreign Direct Investment over GDP [c]	Youth Dependency ratio
Human capital(HU)	0.0105	0.0094	0.0093	0.0098	0.0117	0.007	0.0094	0.0104
	(7.81)	(7.28)	(6.85)	(7.03)	(8.41)	(5.27)	(6.61)	(7.72)
Export-GDP(OPE)	0.011	0.0111	0.0122	0.0106	0.0116	0.0075	0.009	0.0107
	(8.72)	(9.18)	(8.86)	(8.39)	(8.68)	(5.95)	(6.42)	(8.45)
Debt stock(DBT)	-0.0067	-0.0061	-0.0062	-0.0064	-0.0067	-0.0065	-0.0043	-0.0068
	(-7.69)	(-7.27)	(-6.35)	(-6.73)	(-7.06)	(-7.75)	(-4.2)	(-7.84)
Inflation rate(INF)	-0.0023	-0.0022	-0.0017	-0.0021	-0.0018	-0.0021	-0.0016	-0.0024
	(-5.93)	(-5.87)	(-4.15)	(-5.42)	(-4.23)	(-5.82)	(-3.57)	(-6.13)
Liquid Liabilities(M3/GDP)	0.0025							
	(1.78)							
Liquid Liabilities(M2/GDP)		0.0005						
		(0.36)						
Lending rate(LR)			-0.0022					
			(-2.45)					
Population growth(PG)				-0.0816				
				(-2.18)				
Manufacturing Value Added over GDP(MA/GDP)					0.0081			
					(5.27)			
Agriculture share over GDP(AG/GDP)						-0.0179		
						(-9.85)		
Foreign Direct Investment over GDP(FDI/GDP)							0.0007	
							(2.29)	
Youth Dependency Ratio(YD)								0.0009
								(0.76)
Adjusted R2	0.94	0.95	0.95	0.95	0.95	0.95	0.96	0.94
F-tests	293.68	319.03	299.02	299.25	297.7	340.28	323.7	290.1
Observations	659	652	600	632	620	654	493	663

Notes: [a] As in Table 2. [b] Excludes Angola, Mozambique, and Sudan for lack of data. [c] Excludes Central African Republic, Sudan, Congo Democratic Republic, Burkina Faso, Guinea, Madagascar, and Ethiopia (for lack of data). Mozambique, Uganda, Cameroon, Zambia, and Zimbabwe data run from 1980-95.

Table 4 Macroeconomic factors and TFP: cross-sectional regressions[a]

Explanatory Variable	Base Model	Debt Stock	Openness Export+Import/GDP	Inflation	Inflation Squared	Credit to Private sector over GDP	Debt service ratio
Intercept	2.54	2.5409	2.5408	2.5497	2.5497	2.54	2.5309
	(91.29)	(65.21)	(65.22)	(86.82)	(86.81)	(80.38)	(62.53)
Human Capital (HU)	0.0191	0.0189	0.0189	0.0176	0.0176	0.0192	0.019
	(2.18)	(1.74)	(1.74)	(1.91)	(1.91)	(2.02)	(2.08)
Debt Stock (DBT)		0.0016					
		(0.46)					
Export+Import/GDP (OPE)			0.0004				
			(0.04)				
Inflation rate (INF)				-0.0007			
				(-0.17)			
Inflation Squared (INFS)					-0.0004		
					(-0.17)		
Credit to Private sector over GDP (CRE)						-0.0004	
						(-0.051)	
Debt Service ratio (DSR)							0.0034
							(0.38)
Adjusted R2	0.12	0.13	0.12	0.11	0.11	0.12	0.12
F-tests	4.31	2.33	2.09	1.82	1.82	2.1	2.17
Observations [b]	34	34	34	33	33	34	34

Notes: [a] The dependent variable is the country's average TFP over the relevant period. t-statistics are in parenthesis. [b] For excluded countries in some regressions see note (b) in Table 2.

Table 5 Macroeconomic factors and TFP: cross-sectional regressions[a]

Explanatory variable	Government Consumption over GDP	Terms of trade	Local Price Deviation from PPP	Tax Revenue	Liquid Liabilities	Lending Rate	Population Growth	Manufacturing Value-Added/GDP
Intercept	2.5138	2.5889	2.5253	2.521	2.52	2.5321	2.46	2.5528
	(52.57)	(62.14)	(58.64)	(60.75)	(62.12)	(69.87)	(52.61)	(69.13)
Human Capital(HU)	0.0179	0.0221	0.0199	0.0179	0.0173	0.0178	0.0223	0.0198
	(1.93)	(2.40)	(2.05)	(1.92)	(1.74)	(1.81)	(2.42)	(2.10)
Government Consumption/GDP (GCN)	0.012							
	(0.73)							
Terms of Trade (TOT)		-0.0124						
		(-1.50)						
Local deviation from PPP (PPP)			0.0028					
			(0.45)					
Tax Revenue/GDP(TAX)				0.0109				
				(0.87)				
Liquid Liabilities/GDP (MM2)					0.0063			
					(0.49)			
Leding Rate (LR)						0.0061		
						(0.54)		
Population Growth (PG)							0.0045	
							(0.87)	
Manufacturin Value-Added/GDP (MAN)								-0.0058
								(-0.46)
Adjusted R2	0.13	0.18	0.13	0.14	0.12	0.13	0.14	0.12
F-tests	2.38	3.36	2.21	2.52	2.23	2.31	2.52	2.21
Observations [b]	34	34	34	34	34	31	34	34

Notes: [a] as in Table 4. [b] For excluded countries in some regressions see note (b) in Table 3.

Table 6 Macroeconomic factors and TFP: cross-sectional regressions[a]

Explanatory variable	Agiculture Value-Added/GDP	Foreing Direct Investment/GDP	Youth Dependency ratio	Overall Deficit/GDP
Intercept	2.468	2.56	2.55	2.56
	(34.27)	(80.81)	(90.51)	(73.37)
Human Capital (HU)	0.0276	0.014	0.0183	0.02
	(2.31)	(1.31)	(1.99)	(2.15)
Agiculture Value-Added/GDP (AGR)	0.0147			
	(1.11)			
Foreign Direct Investment/GDP (FDI)		0.0051		
		(0.88)		
Youth Dependency Ratio (YDR)			0.0127	
			(0.99)	
Overall Deficit/GDP (DEF)				-0.0103
				(-0.62)
Adjusted R2	0.15	0.14	0.15	0.13
F-tests	2.79	2.38	2.65	2.3
Observations [b]	34	27	34	34

Notes: [a] as in Table 4. [b] For excluded countries in some regressions, see note (c) in Table 3

4.2.2 Effect of fiscal policy

Our indicator of fiscal policy—overall total tax revenue as percentage of GDP—has a positive sign but in none of either pooled annual time series or cross sectional regression is the coefficient significant. Hence, firm inference cannot be drawn from the result.[20] The ratio of overall deficit to GDP in the cross-sectional regression shows statistically insignificant negative effect (see Table 6).[21]

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20 As has been pointed out in many previous studies, fiscal data for SSA are not well documented. This could affect the result obtained in this respect.

21 The inclusion of budget deficit in the equation reduces the significance of inflation. This possibly suggests a long-term collinearity between inflation and government deficit (see Dahan and Strawczynksi 1997).

4.2.3 Effect of monetary and financial deepening

We find that credit to private sector as a percentage of GDP has significant positive effect in the pooled regression (Table 2). The cross-sectional regression, however, yields a negative and statistically insignificant coefficient in the credit to private sector–GDP ratio. The result suggests that increased credit to the private sector will lead to increased efficiency. Apart from the direct effect increased credit to the private sector could have on TFP, financial deepening can help to reduce capital flight by increasing opportunities for domestic portfolio diversification which could impact positively on efficiency.

Our result as shown in Table 3 shows that liquid liabilities measured as M3/GDP has significant positive effect on TFP. The coefficient of M2/GDP ratio though positive is not significant in both pooled and cross sectional regressions. In Table 3 the coefficient of lending rate in the panel regression is negative and statistically significant. This indicates that higher lending rate reduces efficiency or TFP. The cross sectional regression shows insignificant positive effect.[22]

4.2.4 Effect of capital flows

Our results show that debt stock has negative and statistically significant effect, regardless of which additional determinants of TFP are included in the regression (see Tables 2 and 3). In the cross sectional regressions shown in Tables 4, 5, and 6, the coefficient of debt stock was positive but not significant. We further used debt stock lagged one period to ascertain the impact of debt overhang on TFP. The coefficient as shown in Table 2 is significant at the 1 per cent level. The result supports the view that debt overhang reduces TFP. The debt service ratio variable has a statistically significant negative effect on TFP. That debt overhang associates with lower TFP may explain the observed empirical regularity between debt overhang and lower economic growth through its effect on TFP.[23] Table 3 shows that the FDI–GDP ratio has a statistically significant positive effect on TFP in the pooled annual regression. The coefficient is, however, small possibly reflecting the limited amount of FDI flow to the sub-region. The cross-sectional regression also indicates positive effect of FDI though the coefficient is not significant (Table 6). The result shows that FDI is another major vehicle for transferring foreign technology with positive impact on TFP.

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22 In the regression not reported here we tested for the effects of domestic deposit rate, though the coefficient was negative, it was not significant in both pooled annual and cross-sectional regressions.

23 Several empirical studies have shown the negative effect of debt overhang on investment and economic growth rate (see, among others: Serven and Solimano 1993; Oshikoya 1994; Deshpande 1997).

4.2.5 Effect of knowledge investment policies

Our indicator of knowledge investment policy-human capital, as shown in Tables 3, 4, 5, and 6, has a significant positive effect on TFP, regardless of which additional determinants of TFP are included in the regression.24 The result is also robust in the cross sectional specification. The estimated coefficient of human capital reported in Table 2 and 3 range from approximately 0.007 to 0.0117, with an average value of 0.094. The result brings to fore the importance of human capital development in the SSA region.

4.2.6 Effect of trade and trade orientation

In sum, the trade variables tell a consistent story. As shown in Tables 2 and 3, the export–GDP ratio has a significant positive effect at the 1 per cent level. The coefficient remains significant irrespective of the other explanatory variables included in the regression in the pooled annual data. The same result holds when we use sum of export and import as percentage of GDP. This means that a more economy other things being equal, will lead to higher TFP. The local price deviation from PPP has a significant negative effect at the 1 per cent level. An increase in local price deviation from PPP implies that the countries' currency becomes less undervalued (more overvalued). Trade policies that lower (raise) the real exchange rate towards or below (above) its PPP would lead to higher TFP. What this means is that real exchange rate changes that stimulate export would enhance TFP. This result is consistent with existing empirical finding by Miller and Upadhyay (2000). Terms of trade variable have positive effects, but the coefficient is not significant. However, in the cross sectional regressions, terms of trade show negative sign but it is only significant at the 20 per cent level.25

4.2.7 Effects of other factors

We examine the effect of share of manufacturing value added to GDP to capture the externalities and spillover effect of production technology to the rest of the economy. As shown in Table 3, the coefficient in the pooled annual data is positive and significant at the 1 per cent level. The cross sectional regression shows negative, however, the coefficient is not significant. This suggests that development of the manufacturing is an important factor affecting TFP. Table 3 shows that the coefficient of the share of agriculture value-added as a percentage of GDP is negative and significant at the 1 per cent level. Although the cross-sectional regression for share of agriculture value-added to GDP shows a positive effect on TFP, the coefficient is not significant. This simply means suggest agriculture is a drain on the domestic economy. The effect of age structure measured as youth dependency ratio (the population below working age divided by population of working age) is positive in both pooled annual and cross sectional regressions, but the coefficient is not significant.

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24 However, when we introduced the interaction of human capital and export GDP ratio, the coefficient of the interaction term was positive and significant at the 1 per cent level; however, the coefficient of human capital turns negative suggesting that the effects of openness is leveraged by the human capital variable implying more human capital leads to higher effect of openness on TFP.

We could not test for the effect of R&D for lack of data on related investment for all the countries included in our study.

25 Miller and Upadhyay (2000) find positive effect of terms of trade on TFP while Bleany and Greenaway (2001) report positive effect of terms of trade on growth but negative effect of lagged value.

5 Concluding remarks

The effect of macroeconomic factors on TFP has been explored in this paper. The results suggest that human capital, export-GDP ratio, credit to the private sector, manufacturing development, and FDI have significant positive effect on TFP. However, inflation rate, lending rate population growth, debt overhang and local price deviation from PPP, share of agricultural value-added–GDP ratio have negative effects on TFP. The question, then, is what are the policy implications of these findings for SSA countries? These results have a lot of implications on policy formulation in SSA. One, the result shows that TFP would be enhanced if the continent open up the more. We find that greater openness generally benefits TFP. This by implication means that governments in SSA need to implement measures that aim at increasing the export volume, improving terms of trade, and lowering the real value of domestic currency. Increasing export volume would not only bring about economies of scale but also expose local producers to international best practices in production.

How is this best achieved? This is best achieved by allowing greater private (domestic and foreign) participation in the SSA economies. This, therefore, suggests greater private participation in the region. As an illustration, foreign investors participation in debt conversion exercises being undertaken in some SSA countries could be encouraged to direct their investment to projects that significantly increased production capacity, incorporate new technologies in export sector, and improve the countries' infrastructure.

However, governments in SSA need to provide the enabling environment by levelling the legal and administrative playing ground for foreign and domestic investors, promote macroeconomic environment, curb the de facto privatization of public assets (that leaves the corresponding liabilities in public hands), and fight corruption. More importantly, there is need for governments in SSA to provide adequate security, ensure good governance, and develop moribund public infrastructures if the needed private (foreign and domestic) participated is to be achieved. This will help to reduce the cost of key inputs (transports, telecommunications, and so on) with positive impact on trade and welfare in general.

In the sub-region, initiatives to strengthen private and public institutions that support export and trade need to be evolved and pursued vigorously. However, such initiatives must be pursued in the context of an overall national strategic framework that identifies where the payoff of reform and public investment is optimal.

Specifically, the results of our study suggest that interest rate subsidies and credit availability to promote export as very good policy choices to enhance TFP in SSA. However, such direct export expansion policies raises administrative problems and often requires significant budgetary resources. Like any other selective intervention, it may encourage rent seeking. More importantly, the risk of World Trade Organization disputes and countervailing duties in importing countries has made direct export promotion increasingly unattractive. In view of this, good policy option in addition to creating appropriate enabling environment would be for governments to increase their level of saving, that is, to reduce their level of deficit. This will help to achieve many objectives. It will enhance the rate of private saving and thus the level of domestic investment. It will help in reducing the rate of domestic inflation. Moreover, such measures will help to increase the level of financial deepening and moderate the lending rate which will no doubt impact positively on the TFP growth rate.

The results show that human capital has positive effect on TFP. The finding on human capital points to the need for increase human investment in SSA region. However, this could be produce counterproductive effects if the continent does not increase its level of openness. This actually re-emphasizes the need to open up the economy through increased export.

The results provide additional reasons for annulment of debts for SSA. For African countries to experience higher TFP, the huge debt problem needs to be solved. This is where the highly indebted poor countries (HIPC) initiative is highly commendable. However, based on the magnitude of the debt problem in SSA in relation to the resource base of many of the SSA countries and the magnitude of the resources required to achieve the Millennium Development Goals in the region, the best policy option for creditor countries is outright cancellation of SSA debts as it is being canvassed in the 2005 Blair Commission for Africa Report.

Finally, the result suggests the need to reduce the rate of population growth. The Millennium Development Goals of universal primary education for both young boys and girls, and gender mainstreaming and empowerment, are important policies in this direction. The achievements of these goals among others would no doubt impact positively on population growth rate and TFP in SSA.

Taken together, the result shows that policies that lead to lower population growth rate and debt; facilitate greater openness, sound macroeconomic fundamentals, price stability, financial deepening, and greater private participation; would lead to higher total factor productivity in the sub-Saharan region.

Appendix 1

Table A1

Variables: definitions and sources*

Variables	Definitions	Source
TFPG	Total factor productivity	Residuals from Cobb-Douglas
HU	Human capital(secondary schl. enrollment rate)	World Bank(2004a)
OPE	Export/ GDP; export+import/GDP	World Bank(2004a)
DBT	Total external debt as % of GDP	World Bank(2004a &b)
INF	Inflation rate	World Bank(2004a)
DSR	Debt service ratio	World Bank(2004a)
CRE	Credit to private sector as % of GDP	World Bank(2004a)
GCN	Government consumption as % of GDP	World Bank(2004a)
TOT	Terms of trade	IMF(a), UNCTAD, World Bank(2004c)
PPP	Local price deviation from Purchasing power parity	Penn World Table 6.1 (Heston et al 2002),
TAX	Tax revenue as % of GDP	World Bank(2004a)
M3\GDP	Liquid liabilities over GDP	World Bank(2004a)
M2\GDP	Liquid liabilities over GDP	World Bank(2004a)
LR	Lending rate	World Bank(2004a) IMF(2004b)
PG	Population growth	World bank(2004a)
MA\GDP	Manufacturing value-added as % of GDP	World Bank(2004a)
AG\GDP	Agricultural value-added as % of GDP	World Bank(2004a)
FDI\GDP	Foreign direct investment as % of GDP	World Bank(2004a)
YD	Youth dependency (pop.<14\pop.between 14-64)	World Bank(2004a)
K	Capital (domestic capital formation)	IMF(a), World Bank(2004a)
L	Labour force	World Bank(2004a)
PO	Total population	World Bank(2004a)
Y	Gross domestic product	World Bank(2004a)

Note: * To fill in some missing data for a few of the countries covered, we use African Development Bank (2004), selected statistics, and individual country's data sources.

Appendix 2

Table A2

Average Total factor Prodductivity growth rate(TFPG) (1981-2002)

Country	TFPGH	ATFPG	TFPG
Angola	-0.0243	-0.0243	-0.0286
Benin	0.0056	0.0065	0.0047
Botswana	0.0339	0.0392	0.0374
Burkina Faso	0.0044	0.0101	0.0083
Burundi	-0.0132	-0.0081	-0.0089
Cameroon	0.0026	0.0031	0.0024
Central African Republic	-0.0052	-0.0077	-0.0087
Congo, Dem. Republic	-0.0297	-0.0325	-0.0318
Congo Republic	0.0074	0.0039	0.0031
Cote d'Ivoire	-0.0055	-0.0064	-0.0062
Eithopia	0.0039	0.0059	0.0045
Gabon	0.0008	0.0025	0.0025
Gambia	-0.0176	-0.0127	-0.0156
Ghana	0.0033	0.0021	0.0006
Guinea	0.0006	0.0001	-0.0033
Kenya	0.0009	0.0022	0.0019
Lesotho	0.0038	0.0072	0.0045
Madagascar	-0.0120	-0.0160	-0.0166
Malawi	-0.0027	0.0056	0.0052
Mali	-0.0039	-0.0018	-0.0034
Mauritania	0.0044	0.0068	0.0058
Mauritius	-0.0188	-0.0131	-0.0178
Mozambique	0.0225	0.0246	0.0225
Niger	0.0015	0.0017	0.0020
Nigeria	-0.0016	-0.0053	-0.0050
Rwanda	-0.0171	-0.0109	-0.0124
Senegal	0.0033	0.0049	0.0035
Sierra Leone	-0.0267	-0.0253	-0.0253
Sudan	0.0166	0.0184	0.0179
Swaziland	0.0162	0.0159	0.0150
Togo	-0.0062	-0.0070	-0.0072
Uganda	0.0179	0.0219	0.0202
Zambia	-0.0029	-0.0027	-0.0021
Zimbabwe	-0.0095	-0.0031	-0.0036

Notes: TFPGH is the total factor productivity growth with human capital in the production function. ATFPG is total factor productivity growth adjusted for capital-labour simultaneity. TFPG is total factor productivity without human capital in the production function

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