Understanding the Total Factor Productivity Shortfall in Sub-Saharan Africa

The Horn Economic and Social Policy Institute (HESPI)

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Understanding the Total Factor Productivity Shortfall in Sub-Saharan Africa

Abdurohman Ali Hussien[1]

Abstract:

Some argue that Sub-Saharan Africa (SSA) is unique and the fundamental policies and institutions that govern income or productivity variation across countries do not explain the total factor productivity (TFP) shortfall within SSA. This study puts this hypothesis in question and attempts to explain the TFP shortfall in SSA using institutional quality, restrictiveness of trade policy, geographical location and other controls. Using IV estimation to take care of potential endogeneity of the measures of institutional quality and trade policy, and including a SSA dummy and its interaction with TFP determinants in a cross-country regression, the study shows that the dismal TFP in SSA could broadly be understood in relation to its poor institutions, restrictive trade policy and most importantly, its tropical location and the meager domestic credit available to the private sector. Also, the marginal effect of institutions or trade policy on TFP in SSA is not found to be meaningfully different from their effect on TFP in the remaining sample. The findings imply that there is substantial room for improving SSA's TFP through better institutional quality, less restrictive trade policy, better access to finance for the private sector, and better connectivity of landlocked countries with their non-landlocked neighbors. Moreover, it also calls for emphasis in facilitating a structural shift towards less dependence in agriculture in the long run, while investing in research on drought resistance crops, tropical diseases, and irrigation infrastructure to mitigate the consequences of its tropical location in the short run.

Key Words: Sub Saharan Africa (SSA), Total Factor Productivity (TFP), Trade policy, Non-Tariff Barriers, Institutions, Geography.

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1. Introduction

Recent development accounting exercises have demonstrated that a greater portion of the per capita income variation across countries is explained by differences in Total Factor Productivity (see Hall and Jones, 1999; Klenow and Rodriguez-Clare, 1997). In order to understand the very low standard of living in Sub Saharan Africa (SSA), one thus needs to understand why the region has a dismal Total Factor Productivity (TFP) performance.

Among others, institutions, openness to international trade and geographical location are commonly considered to be deep determinants of TFP in a country. In general, human capital and domestic credit are also key determinants of TFP in a country. During the period under study, where complete data is available (2000-2003), SSA has performed the least in TFP compared to other regions of the world. Likewise, SSA has the lowest institutional quality, human capital and domestic credit. On average, a country in SSA is also closer to the equator than a country in any other region of the world. Can we thus understand the dismal TFP performance in SSA in relation to its poor institutions, restrictive trade policy, tropical location, low human capital or meager domestic credit? This is the main question for which we seek evidence in the current study.

Some argue that SSA has a unique economic structure, social set up, and geographical location that the fundamentals that drive economic development elsewhere don't work in SSA. However, those countries in SSA with higher institutional quality, human capital and domestic credit such as Botswana, South Africa, and Mauritius are also ranked among the highest in TFP within the region. This fact prompted us to ask whether the TFP determinants that govern TFP variation elsewhere in the world also explain the dismal TFP in SSA. As it turns out, our findings suggest that the TFP shortfall in SSA can broadly be explained by its poor institutions, restrictive trade policy and most importantly, its predominantly tropical location and very low domestic credit available to the private sector. Moreover, the poor institutions or restrictive trade policy in SSA doesn't have exceptionally squeezing effect on TFP compared to their effect in other regions.

Only few studies have tried to explain the TFP shortfall in SSA. Besides, the existing studies mostly focus on the role of trade/trade policy on SSA's TFP, ignoring the role played by the other fundamental factors i.e., institutions and geography. Also, the trade policy measures used by the existing studies such as trade share, average tariffs and weighted average tariffs have conceptual and technical drawbacks. The current study, however, uses recently constructed and theoretically sound trade restrictiveness indices to measure trade policy, thereby overcoming the drawbacks associated with the commonly used trade policy measures, such as simple average tariff and import weighted average tariff.

The study uses both descriptive and regression analysis to explain the TFP shortfall in SSA. The descriptive statistics gives preliminary information as to what factors explain the dismal TFP in SSA. Seeking more evidence, a TFP regression equation is estimated controlling for a SSA dummy and

interaction of the SSA dummy with the TFP determinants. 2SLS estimation is made as the study allows for endogeneity of non-tariff barriers and institutions.

The remaining sections of the study proceed as follows. Section two presents a brief review of the literature. Section three makes description of the potential TFP determinants, describes the data and makes descriptive analysis that allows comparison of SSA with other regions, comparison among countries within SSA in relation to their performance in TFP, institutional quality, trade policy, domestic credit, human capital, and their geographical location. Section four specifies the model, and presents the estimation techniques, while section five discusses the findings in relation to the hypothesis laid out. Section six concludes.

2. Brief review of the literature

Few studies attempted to explain GDP per capita growth, including a SSA/Africa dummy in their regressions. Using a cross country regressions some studies have shown that Africa's slow growth can be explained by similar set of circumstances that determine growth outside sub Saharan Africa such as human capital, financial deepening, etc. (for example , see Sachs and warner , 1997; Hoeffler , 2000). This argument means that there is no need to invoke additional explanation for the slow growth in Sub-Saharan Africa. Other studies such as Easterly and Levine (1997), have found a significantly negative SSA dummy in a cross country regression aimed at explaining real GDP per capita growth. Their finding means that, once accounting for a set of circumstances that explain GDP per capita growth in non-SSA countries, there remains to be a significant slow growth unexplained in SSA. Hence, there is a need for additional explanation for the remaining slow growth in SSA. Likewise, Authors such as Collier and Gunning (1999) argue that while factors such as its predominantly tropical nature uniquely slows down SSA's GDP growth, there is evidence that this can be more than offset by pro-growth macroeconomic policies.

In recent times, openness to international trade, institutional quality and geography emerge to be core fundamental determinants of GDP per capita or TFP. Studies that include these 'core' in a cross country regression, among others, include: Acemoglu, Jonson and Robinson (2001); Hall and Jones (1999); Sachs, 2003; and Rodrik, Subramanian and Trebi (2004).

Kilish et al (2013) have demonstrated that intuitional quality, and interaction of institutional quality with openness explain significant GDP growth within SSA using GMM estimation technique and data from 36 SSA countries for the period 1996-2010.

To see the possible productivity gain accruing to manufacturing firms in Cote d"Ivoire due to the trade reform in the second half of 1980s, Harrison (1994) estimated a TFP growth equation for 246 firms during 1979-1987. Using weighted average tariff and import penetration as a measure of trade policy, she found a positive significant role of the trade reform on TFPG.

To see how the firm level TFPG responds to South Africa's trade reform in the 1990s, Jonson and Subramanian (2002) estimate a TFPG equation using a pooled cross section for 1990-1994 and 1994-1998; and a time series method using data for 1971-1997. In both methods, the evidence suggests a significant TFP growth gain due to the trade reform.

With a central interest of testing whether exporting firms enjoy a productivity premium (a higher productivity gain relative to non-exporting firms), Mengistae and Patillo (2004) estimated a TFP equation using a panel of 599 firms in three SSA countries (Ethiopia, Ghana and Kenya) for 1992-1995. The TFP specification includes a dichotomous term that represents whether the firm is exporter or non-exporter in general; direct or indirect (through intermediary) exporter; export within or outside Africa. Estimating the coefficient of this binary variable was their main interest to identify the productivity premium for exporters relative to non-exporters, for direct relative to none direct and for those who export outside Africa relative to within Africa. They showed that direct exporters outside Africa have 41% productivity premium compared with 21% for direct to within Africa; and 9% indirect to within Africa. Estimating a TFPG equation also shows that exporters enjoy a 10% faster TFP growth than non-exporters. One may doubt the productivity premium may not necessarily reflect an exporting gain on the ground that productive firms may have selected themselves in the export market. The authors claim, however, that higher productivity premium for direct exporters and exporters to outside Africa are consistent with learning by exporting rather than self-selection of firms.

Two recent studies by Akino(2002) and Njikam, Binam and Tachi(2006) tested the impact of various macroeconomic factors including openness on TFP growth using country level panel data. Both studies share considerable similarities with regard to objective, methodology and data coverage. The methodology in both studies heavily draw from Miller and Upadyay (2000).

Akino estimated the TFPG equation using a panel of 34 SSA countries for the years 1980-2002. He Uses fixed effect (within differencing) estimation technique that allows the country specific term to correlate with other controls. The effect of various macro-economic factors is tested in different specification. Trade related variables include share of export in GDP, local price deviation from PPP and terms of trade. Export share was found to have a significant positive impact.

Njikam et al (2006) employed the Share of export and import in GDP to proxy openness. The TFP growth equation is estimated using fixed effect panel of 27 countries for 1965-2000; cross section of 36 year average and seemingly unrelated regression. They interpreted the negative coefficient on trade share as failure of SSA countries to support competitiveness of domestic producers. This interpretation sounds that the TFP growth decline following increased openness in SSA is due to higher imports. It is speculative in the sense that their openness measure does not differentiate between import and export. Besides, they did not account for a possible endogeneity of their openness measure.

The current study is different from the empirical studies discussed so far with respect to the following aspects: unlike most of the studies that employ an outcome measure (trade share) to link trade orientation with TFP, it employs a trade policy variable which measures more closely the impact of trade on TFP that can be ascribed to trade policy. Moreover, to overcome the aggregation bias associated with using average or weighted tariffs measures, the study employs trade restrictiveness indices (TRIs) that are estimated using imports and non-tariff brriers at the tariff line level. Also, import demand elasticities, measuring the economic importance of the good are used as weights while aggregating trade distortions from the tariff line level. Both features render the use of these trade restrictiveness indices to measure trade policy more theoretically sound. Finally, to account for a possible endogeneity in the measure of non-tariff barriers, the study uses instruments in line with the endogenous theory of trade policy.

3. Description of TFP determinants, Data and Descriptive Statistics
3.1. Description of TFP determinants

i. Trade policy

To measure the role of trade policy on TFP that could be channeled through the former's effect on import, I included two trade policy indices that measure the restrictiveness of a country's trade policy on its imports. The first index measures the restrictiveness of non-tariff barriers on countries imports. It measures the restrictiveness of a core NTB across a tariff line for which there is a core NTB in the country. It is named in the current study as the overall trade restrictiveness index based on Non-Tariff Barriers (OTRI_NTB)[2]. The core non-tariff barriers used in the computation of OTRI_NTB include quotas, technical regulations and other non-tariff barriers (Kee et al, 2008). The second index measure the restrictiveness of tariff barriers on a countries imports. It is named in the current study as overall trade restrictiveness index based on tariff (OTRI_TARIF)[3]

ii. Institutions

In the current study, institutions measure governance quality. Governance quality in a country pertains to the process by which governments assume power and are held accountable; government's capacity to formulate and implement sound policies; and the respect of the state and citizens for the social and economic institutions (Kauffman et al, 2009).

The governance indicator has six dimensions by which it reflects the aforementioned features: (1) voice and accountability; (2) political stability; (3) Government effectiveness; (4) Regulatory quality;

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[2] Appendix B shows a formal definition of the two trade policy variables, i.e. OTRI_NTB & OTRI_TARIF.

[3] The country level data on the three trade policy measures are aggregated using import and trade policy data at the tariff line level. This reduces the aggregation bias present in using average tariffs for example, for the later implicitly assumes equal restrictiveness of tariffs in different tariff lines.

(5) Rule of law; and (6) control of corruption. The measure of an institution used in the current study (INST) is a simple average of the above six indicators[4]

A difference in the quality of governance is believed to explain substantial TFP variation across countries, triggering differences in the return to economic activity (see also Hall and Jones, 1998; Acemoglu, Jhonson adn Robinson, 2001; Dollar and Kraary, 2002; Rodrik, Subramanian and Trebbi, 2004). They matter to TFP in a manner by which checks and balances for governments against expropriation are established; governments ensure an economic climate that could increase confidence among the private sector and increase (expected) return to economic activity. They are exclusively perception based data on governance in reflecting the views of households, firm survey respondents and experts working for the private sector, NGOs and the public sector. As the authors (Kauffman et al, 2009) argued such perception based measures are appropriate in thinking of economic development attributable to governance. This is because, such determinants of the former as decision of households to participate in the labor market or of firms to make investment depend on their perception of the governments performance and the investment climate. In fact, this measure of governance is highly correlated with the two widely used measures of institution in the literature i.e. Government Anti Diversion Policy (GADP) index by Hall and Jones (1999); and protection against expropriation risk by Acemoglu, Johnson and Robinson (2002). In the current data, the governance quality measure correlates with GADP and Protection against expropriation risk at 82% and 72% level respectively. Compared to the latter two, governance quality measures institutions from a broader perspective in the sense that it captures the variation in both political and economic institutions which matter for TFP.

iii. Geography

The fact that most poor countries (e.g about 90% of SSA) are located in the tropics and most of the prosperous nations lie in the temperate zones could be immediate observational evidence that geography matters for economic performance. The well-known explanations for such dichotomy often relates to agricultural productivity and disease prevalence. Crop productivity in the tropics is very low compared to the temperate regions. Maize productivity, for example, is about three times higher in the temperate than in the tropics (Gallup et al, 1999). Malaria prevalence is widespread in the tropics holding back labor productivity growth especially farmers productivity in many countries where agriculture is the mainstay of the economy. The favorable climate for infestation of crop pests and insects is an additional impediment to the already low productive agricultural sector in the tropical region. The current study employs a measure of distance from the equator (LATITUDE) as a proxy for variations in the above mentioned latitude related features whereby explain TFP variation across

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[4] Measuring institution as a simple average of the indicators implicitly assumes equal contribution to TFP from each indicator. This is used (though may not be appropriate) because, judging otherwise would be speculative. Other studies that use similar method of measuring institutions include Easterly and Levine (2003).

countries in the sample[5]. The second measure of geography relates to whether a country has access to the sea. Sea transport is the cheapest means to transport goods across countries. Thus, landlocked countries face higher transportation cost which would reduce the level of international trade and the associated productivity gains from trade, other things held constant.

The fact that geography enters significantly in different specifications for measures of economic performance implies that failure to control for this variable may cause omitted variable bias. Particularly, by omitting geography we may overstate the role of policies on economic growth (Gallup et al, 1999)[6].

iv. Human Capital and Domestic Credit to the Private sector

The rate of technology adoption tends to be faster in countries with higher human capital yielding higher TFP, other things held constant. Moreover, most of the technologies invented in developed countries are designed for high skilled man power to be operated in developed countries themselves. In such a situation, difference in human capital across nations explains a significant variation in TFP even if all countries have equal access to the newly designed technologies (Acemoglu and Zillbouti, 1999). Also, better credit availability, facilitating efficient allocation of resources is expected to increase TFP. Countries with higher gross capital formation are also expected to have higher TFP by reducing the transaction cost of doing business.

3.2. Data

Independent regression for SSA sample was practically impossible, because only 13 SSA countries have both average years of schooling data required to derive TFP, and trade policy data. Thus a SSA dummy is included while making the regression. The countries in the sample initially included 25 low income, 32 middle income and 9 high income countries with a total of 66 countries[7]. However it is only 52 counties for which both average year of schooling and trade policy data are available, which force the study to do most of the analysis using data for those 52 countries, which finally comprises of 16 low income (10 of which are in SSA), 27 middle income (of which 3 is in SSA) and 9 high income countries. All countries included in the sample are non-oil countries based on the classification in Mankiw, Romer and Weil (1992).

In the TFP specification, average values of TFP for the years 2001-2003 is used for two reasons:

a. The trade policy indices are estimated based on average import and export data for 2001- 2003; average tariff and NTBs data for 2000-2003. The trade policy indices used in the study are proxy for restrictiveness of trade policy measured by the response of import or export for which average data for the years 2001-2003 is used. Thus, it is appropriate to use the corresponding average

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[5] LATITUDE, though a good proxy for all climatic differences may not fully capture the variations in influences from climate related factors on TFP.

[6] This view is reflected in the data where LATITUDE has high correlation with the measure of institution and other variables such as human capital.

[7] The country classification is according to World Bank (2009). Table 2 in Appendix A reports the country list

figures for TFP in a specification where we estimate the impact of trade policy on TFP.

b. In a cross section setting, using average of TFP would reduce business cycle effects by smoothing out short run fluctuations. Average data for 2001-2003 is used for the remaining variables except explicitly stated otherwise. Population, investment share, real GDP per capita and real openness data are from Penn world table version 6.2. Real GDP and investment data are constructed using information on population, real GDP per capita and investment share data. Labor force data is available in world development indicators (2008) CD ROM. Recent data on average years of schooling for the year 2000 is obtained from Barro and Lee (2000). The parameter values for capital share is assumed to be one-third ($\alpha=1/3$) as in Hall and Jones (1999). Capital stock is estimated using perpetual inventory method. Before discussing the regression analysis, let's get preliminary picture of how TFP is associated with its determinants in SSA using information from the descriptive analysis presented below.

3.3. Descriptive Analysis

We use the descriptive statistics to get preliminary evidence as to what explains the meager TFP in SSA. Fig 1 in appendix A[8] indicates that SSA has the lowest average TFP compared to other regions. Moreover, SSA is also shown to have the lowest institutional quality, human capital, domestic credit for the private sector. On average a country in SSA is also closer to the equator than a country elsewhere.

Considering variations within SSA, Fig 2 also shows that better quality institutions, lower NTBs, high latitude, higher human capital and high domestic credit to the private sector are associated with higher TFP. In what follows, how each determinant is associated with TFP in SSA is discussed in a bit more detail.

A. Trade policy

Fig 1 show that SSA has the most restrictive non-tariff barriers (NTBs) of all the regions. On top of other factors that increase cost of trade, higher NTBs make import of the intermediate inputs and better technologies even costlier, forcing to use old technologies and discouraging private investment which all reduce TFP. However, the trade related policy hindrances in the region are well beyond NTBs and Tariffs. The inefficient services at the borders; the length of time to clear consignments; and the less transparent procedures ; and lack of motive on the side of policy makers to support an efficient practice makes trade less profitable if any, for the private sector (see also ECA, 2004). At this point we note the importance of policy complementarities. The fact that the private sector in many SSA countries do not have the institutional mechanism to held government accountable for the inefficient practices in regards to custom operations also highlight the interaction of bad policies with lack of better institutions. Furthermore, in many of the countries in the region where good

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[8] All tables and figures are presented in Appendix A.

governance is at a very low level, NTBs create attractive opportunity for government officials to divert resources for their private gain. On the other hand, the correlation between NTBs and TFP within SSA as shown by panel (a) of Fig 2 suggests that lower NTBs are associated with higher TFP in SSA.

B. Institutions

As panel (b) of Fig 2 shows, countries with better institutions within SSA have higher TFP. The three top ranking SSA countries in institutional quality, i.e., Botswana, Mauritius and South Africa in their order are also ranked among the top four countries in TFP. In fact, arguably the most distinguishing feature of Botswana and Mauritius' economic success lies in their underlying institutions that made possible a relatively efficient macroeconomic management. Unlike many countries in the region, rule of law and contracts are effectively enforced which together boost investors' confidence. Mauritius is ranked as the most competitive trade enabling environment and infrastructure in Africa during 1997-2001(ECA, 2004). Moreover, both countries held free and fair elections; have independent press that criticizes government action. Without those institutions, the huge revenue from diamond reserve perhaps would have led to domestic unrest in Botswana as in some other countries in SSA. Without those institutions, the export led growth by establishing an Export Processing Zone might not have been possible in Mauritius (see also Zafar 2011). The better quality institutions in both counties are believed to have caused the higher TFP in both countries by making possible effective implementation of growth enhancing policies, creating enabling environment for the private sector, mediating conflicts which are all missing or are at a very low level in many other countries in the region.

C. Geography

Even if most of the countries in SSA lie within the tropics, an increase in latitude within SSA is associated with higher TFP. The intensity of disease prevalence, differences in soil quality or rainfall volatility may still have significant variation within the tropics. It is noted in Sachs (2003) that Falciparum, the more dangerous type of malaria require warmer climate even within the tropics. Likewise, the climate related impediments to agricultural productivity growth may still vary within the tropics. As will be seen later, the empirical evidence suggests that being located closer to the equator has an even more TFP reducing effect within SSA than elsewhere in the sample, indicating the severity of the climatic and soil influences of Tropical location within SSA.

D. Human Capital and Domestic Credit

Panels (d) and (e) respectively of Fig 2 show that countries with better domestic credit to the private sector and better human capital have higher TFP. Except in Mauritius and South Africa, domestic credit is at a very low level in the region. Sacerdoti (2005) argue that the major problem associated with the low level of domestic credit is "absence of the institutional framework: legal, judiciary and regulatory framework governing enforceability of claims and property right...banks have the

resource to support expansion of credit." Public deficit also causes crowding out of resources when it is financed domestically. At this point, we also note the interaction of policies and institutions working simultaneously to influence TFP. For example, countries with better institutional framework that enforces contracts and prudent macroeconomic policies make possible better domestic credit available for the private sector. The Top four countries in human capital are also ranked among the first four with the highest TFP as can be seen from panel (e) of Fig 2.

The information in Fig 1 and panels (a)-(e) of Fig 2 suggests that the low TFP in SSA could well be understood in relation to its poor institutions, very low domestic credit, the fact that a relatively greater portion of the region lies within the tropics, low level of human capital, and to some extent in relation to SSA's restrictive NTBs. Seeking more evidence, the TFP specification is estimated controlling for the SSA dummy. The regression results are discussed in the following section.

4. Model Specification and Estimation
4.1. Model Specification

The TFP equation is specified as in equation (1) below where TFP depends on trade policy, institutions and geographic characteristics. For similar specifications in the literature, see Hall and jones (1999), Alcala and Ciccone (2004), and Chanda and Dalgaard (2008).

$$LogTFP = \beta_0 + \beta_1 \, INSTITUTIONS + \beta_2 \, TRADE \, POICY + \beta_3 GEOGRAPHY + \varepsilon_i \qquad (1)$$

where logTFP is the natural logarithm of Total Factor Productivity which is derived from a Cobb − Douglas production function as a residual, where real GDP per worker is disaggregated in to capital intensity and human capital per worker, following Hall and Jones (1999) (henceforth HJ) as shown below.

Production is assumed to take place using the technology:
$$Y_i = K_i^{\alpha}(A_i H_i)^{1-\alpha} \qquad (2)$$
where Y_i, K_i, A_i and H_i denote real GDP, physical capital stock, labor augmenting productivity (TFP) and human capital augmented labor respectively. Physical capital stock K_i is calculated using the perpetual inventory method[9]. Human capital in each country is given by:
$$H_i = e^{\emptyset(Ei)}L_i \qquad (3)$$
, where an average worker in each country is assumed to have Ei years of schooling. $\emptyset(Ei)$ is a functional form governing the impact of schooling on human capital, while L_i denote number of workers. Raising both sides of (2) by a power of $\frac{1}{1-\alpha}$ gives us:
$$Y_i^{\frac{1}{1-\alpha}} = K_i^{\frac{\alpha}{1-\alpha}}A_i H_i \qquad (4)$$

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[9] Perpetual inventory method computes capital stock using the formula $K_t = (1-\delta)K_{t-1}$. Initial capital stock is calculated using initial investment data as $K_0 = I_0/(g+\delta)$. Following HJ: δ is assumed to be 0.06; and g is computed as the geometric average of investment series for the first ten years. For most of the countries that have investment data from 1950, for example, g is the geometric average of investment rate for 1950-1960.

Dividing both sides of (4) by $L_i Y_i^{\frac{\alpha}{1-\alpha}}$, real GDP per worker can be decomposed in to capital intensity , human capital per worker and the TFP term as in (5) below.

$$y_i = \left(\frac{K_i}{Y_i}\right)^{\frac{\alpha}{1-\alpha}} h_i A_i \tag{5}$$

, where $y_i = \frac{Y_i}{L_i}$; $h_i = \frac{H_i}{L_i}$ are output per worker and human capital per worker respectively. Assuming $\emptyset(E_i)$ a piece wise linear from mincerian wage regression and using (3), human capital per worker can be given as:

$$h_i = exp(\emptyset_p s_p + \emptyset_s s_s + \emptyset_\tau s_\tau). \qquad {}^{[10]} \tag{6}$$

$\emptyset_p, \emptyset_s$ and $\emptyset_\tau$ denote Mincerian returns for an additional year of schooling in the primary, secondary and tertiary schooling levels. Using data for Y_i, L_i , K_i , available years of schooling ; and assuming values for the capital share parameter and Mincerian returns, it is possible to compute Total Factor Productivity (A_i). Following HJ, a value of one-third is assumed for the capital share parameter; and mincerian returns to schooling are assumed to be 13.4%, 10.1% and 6.8% for primary, secondary and tertiary schooling levels respectively.

To measure the role of trade policy on TFP that could be channeled through the former's effect on import, two TRADE POLICY indices that measure the restrictiveness of a country's trade policy on its imports-OTRI_NTB and OTRI_TARIF are included. The former measures the restrictiveness of non-tariff barriers on countries imports, while the latter measures the restrictiveness of tariff barriers on a country's imports[11]. As far as I know, no study so far has used this family of trade restrictiveness indices to identify the role of trade policy on TFP. Both two trade policy variables are expected to have a negative effect on TFP through their restrictive role on openness.

INSTITUTIONS proxy governance quality. The measure of institutions used in the current study (INST) is a simple average of six indicators noted in section 3.1[12]. INST, the proxy measuring institutional quality is expected to have a positive significant effect.

The core specification controls for the effect of GEOGRAPHY related measures such as distance from the equator (absolute latitude), and whether a country is landlocked or not. The current study employs a measure of distance from the equator (LATITUDE) as a proxy for variations in latitude related factors discussed in section 3.1[13]. The second measure of geography relates to whether a country has access to the sea. To account for the contribution of having access to the sea on TFP,

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[10] This specification is borrowed from Chanda and Dalgaard (2008).

[11] Appendix B shows a formal definition of the two trade policy variables, i.e. OTRI_NTB & OTRI_TARIF. The country level data on the two trade policy measures are aggregated using import, export and trade policy data at the tariff line level. This reduces the aggregation bias present in using average tariffs for example, for the later implicitly assumes equal restrictiveness of tariffs in different tariff lines.

[12] Measuring institution as a simple average of the indicators implicitly assumes equal contribution to TFP from each indicator. This is used (though may not be appropriate) because, judging otherwise would be speculative. Other studies that use similar method of measuring institutions include Easterly and Levine (2003).

[13] LATITUDE, though a good proxy for all climatic differences may not fully capture the variations in influences from climate related factors on TFP.

the study controls for a dummy (LANDLOCK) which takes a value of one if the country is landlocked and zero otherwise. Higher latitude and being landlocked respectively are expected to have a positive and negative effect on TFP.

To identify the effect of additional TFP determinants and as a way of robustness check to the results from estimating the 'core' TFP equation, an extended equation is also estimated. The extended equation includes human capital, and domestic credit to the private sector.

4.2.   Estimation

In the presence of possible feedback effect from TFP to the measure of Non-Tariff Barriers, OLS estimates might not speak of causality that runs from the later to TFP.   Likewise, TFP may affect institutions where the latter is included in the TFP equation. To account for the possible endogeneity of these variables, 2SLS estimation technique is employed.

Reverse causality is a main challenge plaguing identification of the effect from one of our variables of interest, i.e., OTRI_NTB[14]. The political economy literature underscores the fact that protection is endogenously determined through the influence of lobbying   groups on policy makers (Lee and Swagel, 1997; Trefler, 1993).

Among the various dimensions, trade patterns affect the nature of protection. Different arguments are made to support this claim. One view is that higher past imports may trigger various interest groups to lobby policy makers for a higher protection in which case NTBs on imports of an industry would rise in response to an increase in imports share of goods in the industry. Based on this argument, NTBs and past import shares would have a positive association. As this may induce retaliation by trading partners, policy makers may depend their decision on the importance of imports, measured by share of imports in domestic use; and the importance of exports ,measured by export share in the output of each industry (Lee and Swagel, 1997). The latter argument would imply a reduction in import restrictions as a result of increased export share of an industry implying a negative association between NTBs on imports of an industry and past export shares in the industry[15]. In line with the above arguments, the current study uses past import, past changes in import and past export (all as a share of GDP) to instrument Non-tariff barriers in dealing with the endogeneity of the later[16]. NTBs are shown to be associated with past export shares and the past import share significantly with a sign consistent with the theoretical arguments[17]. However, the study admits that the theoretical arguments made above are particularly true for industry level studies than country level studies such as the

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[14] No previous study has demonstrated how to deal with the endogeneity of Non-Tariff Barriers in a TFP equation.

[15] Rodrik (1995) also noted that the investment subsidies such as lifting import restriction to Taiwanese and Korean firms was in practice contingent on the firm's ability to compete in the world market.

[16] The theoretical justification to use export share of output in each industry normally require industry level data on NTB and export shares. Due to data availability, the study employs NTBs, export shares and import shares data aggregated at the country level.

[17] First stage regressions for NTBs are estimated but not reported for parsimonious reason

current one, in the sense that the link between NTBs and past trade shares that the theory outlines is better conceived at industry level. This is because according to the theoretical arguments, past trade share in different industries could potentially induce a change in trade policy in opposite directions making it difficult to claim a particular link between trade policy and past trade shares when country level data is considered[18].

The additional instrument used is the share of NTBs in the tariff lines where a core-NTB is binding (share of tariff line for which ad-valorem equivalent of NTB is statistically different from zero at 5% level) (see Kee et al, 2008)[19]. The OTRI_NTB equation below is estimated in the first stage regression:

$$OTRI\_NTB = \gamma_0 + \gamma_1 EXP99_i + \gamma_2 IMP99_i + \gamma_3 dIMP00_i + \gamma_4 Sh\_NTB_i + X_i + u_i \qquad (7)$$

where EXP99, IMP99, dIMP00 and Sh_NTB denote export share of GDP in 1999, import share of GDP in 1999, change in import share of GDP in 2000 and the Share of NTBs respectively are the excluded instruments whereas X_i represents the included instruments. u_i is an error term.

Even if the study always relies on the overidentification test for inference, one may fairly expect that past trade shares may themselves influence TFP, other than their effect through NTBs.

The remaining trade policy measure is tariff barrier (OTRI_TARIF). Tariff is usually bound by bilateral or multilateral agreements (Lee and Swagel, 1993; Trefler, 1997). Examples of such agreements include GAAT, WTO, and the South African Customs Union (SACU), among others. Under such agreements Tariffs are determined externally[20]. For this reason, the current study also assumes the trade policy index based on tariffs (OTRI_TARIF) as exogenous[21].

Institutions, measuring governance quality is the other variable to which feedback effect may run from TFP. Countries with higher TFP may have the incentive and capacity to set up enabling economic environment that enhance the confidence of private investors and households, on which the measurement of institutions in the current study basically depends. To account for this feedback effect, the study employs the widely used language instruments from Hall and Jones (1999) i.e., proportion of the population speaking English at birth (EngFrac), and proportion of the population speaking one of the major European languages at birth (EurFrac). The INST equation below is estimated in the first stage regression:

---

[18] In an import equation, Kee et al (2008) instruments NTBs with a GDP weighted average of NTBs by the 5 closest neighboring countries, assuming cultural, legal and historical factors may cause neighbors to impose similar types of NTBs. The current study constructed similar instruments for all countries in the sample, but did not found it to be a strong predictor of NTBs.

[19] This variable has a considerable level of correlation with NTB by construction and is used to supplement the above mentioned instruments. The justification to use this instrument does not have theoretical foundation. It is believed, however, to fulfill the statistical requirement of being a source of exogenous variation for NTB (see Rodrik et al, 2004). Some criticize this way of argument for example on the ground that if one fails to tell about the theoretical link between the endogenous variable and the instrument, it is also difficult to tell whether the later can be excluded

[20] In fact, Lee and Swagel (1993) uses tariffs as part of their instruments to identify the impact of NTB on imports.

[21] Also, the endogeneity test where the null considers tariffs as exogenous is always accepted (not reported).

$$INST = \theta_0 + \theta_1 EngFrac_i + \theta_2 EurFrac_i + X_i + \mu_i \tag{8},$$

where INST is a proxy for institutional quality (government effectiveness), EngFrac and EurFrac are as defined above, while X_i denotes the included instruments. μ_i is an error term[22].

5. Discussion of the results

Table 1 reports the regression results of the TFP equation. In column (1), the 'core' TFP equation is estimated controlling for the SSA dummy. All enter with expected sign. To highlight the individual significance of the two endogenous variables, i.e., INST & OTRI_NTBs, the instruments need to be relevant. In other words, there must not be a concern for weak identification[23]. When there is weak identification, we cannot tell about the individual significance of INST or OTRI_NTBs. But, we can tell whether the endogenous variables together have a significant effect. For this purpose, we rely on the Andersen-Rubin test statistics.

Considering column (1), a Cragg-Donald Statstics of 5.07 means that INST & OTRI_NTBs are weakly identified. The corresponding critical values needed to reject a maximum size distortion of 20% for 2 endogenous variables and 5 excluded instruments should exceed 8.38 (See Stock and Yogo, 2005). The Andersen-Rubin test, however, rejects the null-hypothesis that INST & OTRI_NTB together have insignificant effect on TFP. As non-tariff barriers are often high in areas of poor institutional quality, the high correlation between the two may make it difficult to single out their individual effects when both enter in the TFP equation. Moreover, some of the instruments in the first stage regression strongly predict both INST & OTRI_NTB. In such a situation, considerable collinearity between the predicted value of INST and OTRI_NTB create difficulty to isolate the effect of INST or OTRI_NTB in the second stage regression (See also Dollar and Kray, 2003). For this reason, we estimate TFP by including one of them at a time as shown by columns (4), (6), (7), (8) and (9). In this case, the F-statistics from the first stage regression can be used to tell about individual significance of OTRI_NTB or INST.

Considering column (4), OTRI_NTB has a negative significant effect on TFP[24]. Other things being equal, a country with one more unit higher OTRI_NTB compared to another country would have a 13.8 % lower TFP. Similarly, in column (9), OTRI_NTB is shown to have a significant downward pressure on TFP. INST in column (7) is shown to have a significant upward push on TFP[25]. Other things being equal, a country with one more unit of institutional quality compared to another country would have a 17% higher TFP advantage. In the current data, LATITUDE and INST have a correlation coefficient of 0.62. This high correlation may have caused the effect of LATITUTDE to appear insignificant in columns (1)-(3). For instance, in column (4), where INST is dropped,

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[22] EurFrac is dropped later in the regression as it turns out to be insignificant predictor of institutions in the current data.

[23] The rule of thumb is that an F-statistics of less than 10% is a cause for concern (Staiger and Stock, 1997). However, when two or more endogenous variables enter together in the same equation, the F-statistics from the first stage regression is not informative of whether instruments are weak. In this case, we rely on an alternative method, i.e., a test statistic by Stock and Yogo (2005) which is based on Cragg-Donald (1993) F-statistics.

[24] The F-statistics for the first stage regression of OTRI_NTB is 32.06 (estimated but not reported for parsimony reason)

[25] The F-statistics for the first stage regression of INST is 11.97 (estimated but not reported for parsimony reason)

LATITUDE is shown to have a positive effect on TFP at a 5% level of significance. A country which is one degree latitude farther from the equator compared to another country would have a 51% higher TFP, other things held constant. Being a land locked country also has a 20% TFP disadvantage compared to a country with access to the sea, as column (1) shows. The effect of other TFP determinants i.e., tariffs (OTRI_TARIF) in column (4), domestic credit (LDCR) in columns (7) &(8), and human capital (Hcap) in column (9) is shown to be very little, once the 'core' TFP determinants are controlled.

The findings above show that the 'core' TFP determinants i.e., institutions, trade policy and geography, explain a significant variation in TFP across countries. Next, we seek answer to the major questions of the study i.e., whether we can use the same set of TFP determinants to understand the TFP shortfall in SSA; and whether the TFP determinants influence TFP in SSA exceptionally stronger than they do in the remaining sample.

Does SSA have exceptionally low TFP? This question basically relates to whether TFP in SSA remains low after we account for the effect from the 'core' TFP determinants used to explain the TFP variation in the broader data. In other words, it is a question of whether the low TFP in SSA could be understood in relation to the same set of factors used to explain TFP variation across the broader sample without a need to invoke additional explanation.

Column (1) in Table 1 shows the effect of the SSA dummy controlling for the 'core' determinants, while columns (2)-(10) show the effects of each interaction term. Column (1) shows only little evidence that Sub Saharan Africa has an exceptionally low TFP once the effect from institutions, non-tariff barriers , latitude and the landlocked dummy is accounted for. Likewise, the SSA dummy remains insignificant in columns (2), (3), (4), (9) & (10) where we control for additional variables or in specifications where institutions and non-tariff barriers enter one at a time. This finding implies that the dismal TFP in SSA could as well be understood in relation to the same set of determinants that govern TFP variation in the remaining sample. In columns (5), (6), (7) & (8), however, the SSA dummy appear to be significant. This is perhaps because the SSA dummy captures the SSA economies' heavy dependence on low productive agriculture. However, this does not overshadow the finding that SSA's TFP shortfall can broadly be understood in relation to its poor institutions, restrictive trade policy and predominantly tropical nature. Thus, there is a substantial room to improve TFP in SSA by improving its institutional quality, reducing its restrictive trade policy and mitigating the effect of its predominantly tropical nature and being landlocked. This finding is in line with Collier and Gunning (1997), which also argue that even if SSA remains unique in its predominantly tropical nature and being landlocked, the effect of geography can be more than offset by implementing pro-growth policies.

Does SSA have exceptionally poor institutions, restrictive trade policy or severe tropical nature? In other words, this question asks whether institutions or trade policy has a larger marginal effect on TFP in the SSA sample than in the remaining sample. In column (2), SSA_INST (the term which proxy interaction between the SSA dummy and INST) is shown to have insignificant effect. Likewise,

SSA_NTB, the term which proxy interaction between the SSA dummy and OTRI_NTB does not have significant effect as columns (3) and (4) show. This suggests that the level of institutions or NTBs in SSA does not have exceptionally squeezing effect on TFP. In columns (5) and (6), SSA_LAT, the term which proxy interaction between the SSA dummy and LATITUDE, however, has a significant effect on TFP. This result implies that the marginal effect of location as we go farther from the equator is higher within SSA than in the remaining sample, even after controlling for institutions. This result suggests that latitude, beyond its role in the choice of the types of institutions, proxies a number of factors which have a direct bearing for TFP. As the troubles associated with tropical location are worse in SSA, the current finding is intuitive.

In columns (7) & (8), SSA_LDCR, the term which proxy interaction between the SSA dummy and domestic credit to the private sector has a positive significant effect on TFP, indicating a stronger marginal effect of domestic credit within SSA compared to the remaining sample. SSA_H and SSA_LOCK, the terms representing interaction between the SSA dummy and Hcap; and between the SSA dummy and the LANDLOCK dummy enter in columns (9) & (10). There is no strong evidence suggesting that being landlocked have a unique disadvantage for TFP in SSA. Likewise, human capital does not have a different role on TFP within SSA as shown by the insignificant SSA_H term in column (9).

In relation to the questions posed in the study, two main findings stand out of the regression analysis: First, the SSA dummy is shown to be insignificant in most specifications. Second, while the other interaction terms are insignificant, SSA_LAT and SSA_LDCR are shown to be significant. Taken together, the findings imply that the TFP shortfall in SSA could as well be explained by its poor institutions, restrictive trade policy and most importantly, its predominantly tropical nature and dismal domestic credit available to the private sector.

6. Conclusion

During the period considered in the study, Sub Saharan Africa (SSA) performed the least in TFP, institutions (government effectiveness), level of human capital, and availability of domestic credit to the private sector while it imposed the highest NTBs on its imports compared to other regions. Moreover, on average, a Sub Saharan African country is also located closer to the equator than a country elsewhere in the sample. This fact raised the question of whether the TFP shortfall in SSA could be understood in relation to the TFP determinants that explained a significant TFP variation across the broader data. The evidence suggests that we could broadly explain the TFP shortfall in SSA in relation to its poor institutions, restrictive trade policy and most importantly, the very dismal domestic credit available to the private sector and its predominantly tropical nature. This also means that there is a room to substantially increase TFP in SSA by improving its institutional quality, reducing its restrictive trade policy and implementing policies to mitigate the impact of its being predominantly tropical nature and landlocked.

A higher domestic credit available to the private sector and location farther from the equator have

stronger TFP increasing role in SSA than elsewhere in the sample, indicating the very low level of domestic credit in the region and the severity of problems associated with its predominantly tropical nature.

As is the case in the broader sample, the SSA data suggests that countries with better institutional quality support better credit to their private sector, stressing once again the need to address the problem of good governance to improve the expansion of private credit in the region. Likewise, as the ultimate objective of extending credit is to promote private investment, the focus should primarily be on improving a business friendly environment for investment and not on extension of credit per se.

The fact that SSA is predominantly tropical, coupled with the reason that its economy heavily depends on agriculture, of which the productivity is very low due to the soil and climatic factors, explains the stronger downward pressure of tropical location on TFP in SSA. This clearly emphasizes the need for a structural shift towards less dependence in agriculture in the long run. On the other hand, in the short run, research on drought resistance crops and tropical diseases, infrastructure in irrigation need to be encouraged to mitigate the influences of its tropical location.

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8. Appendices:

Appendix A: Tables and Figures

Fig 1: TFP & Its Major Determinants Across Regions
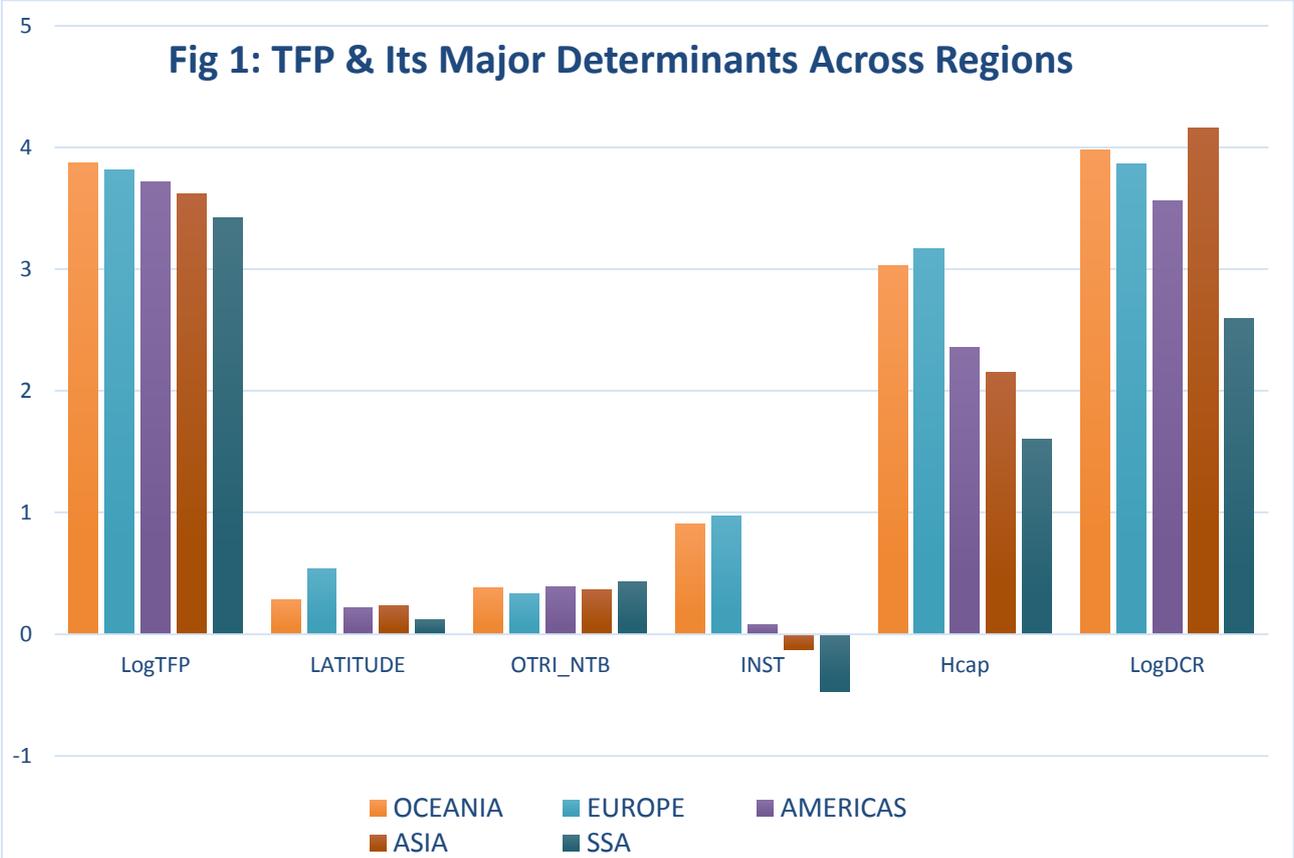
Fig 2: Simple correlation between TFP & its determinants within SSA.

Panel (a) : Correlation b/n TFP & OTRI_NTB in SSA

Panel (b) : Correlation b/n TFP & INST in SSA

Panel (c) : Correlation b/n TFP & LATITUDE in SSA

Panel (d) : Correlation b/n TFP & LDCR in SSA

Panel (e) : Correlation b/n TFP & Hcap in SSA
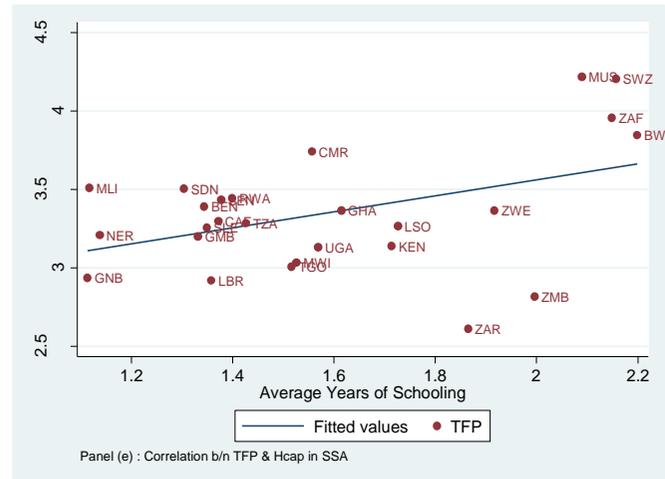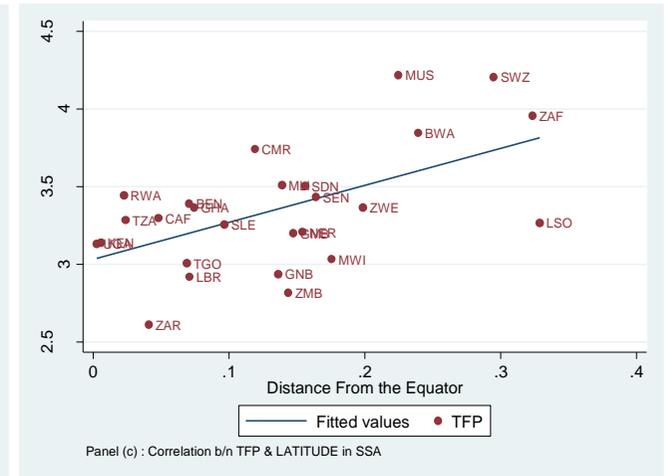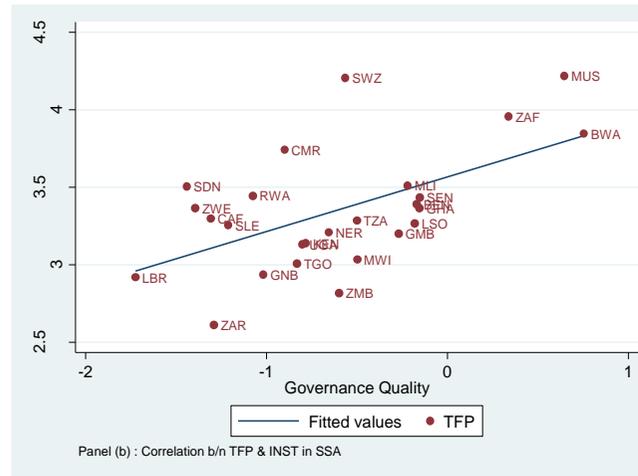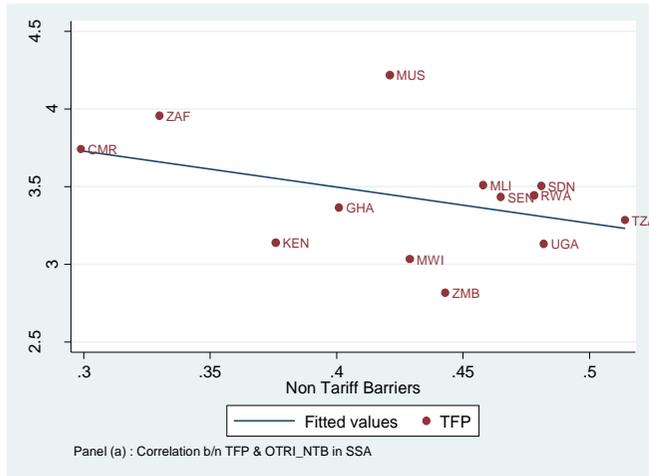
Table 1: Estimating the effect of the SSA dummy and its interaction with other TFP determinants (2SLS)

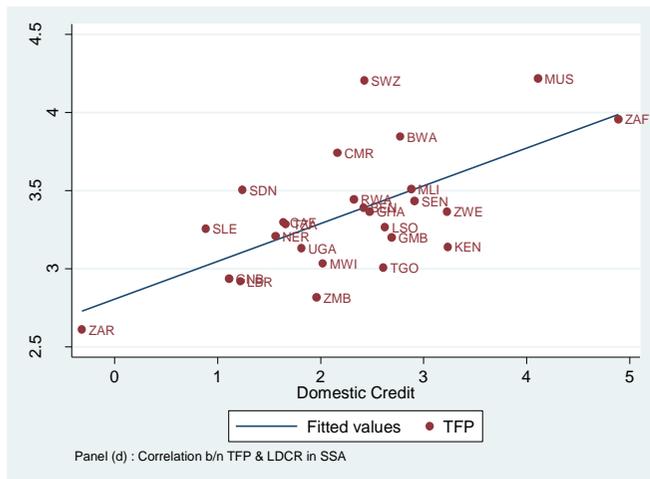| VARIABLES	1	2	3	4	5	6	7	8	9	10
OTRI_NTB	-0.41	-0.41	-0.24	-1.38*	-0.21	-1.18*	- 0.27	-0.75	-1.41**	-0.16
	(-0.564)	(-0.563)	(-0.198)	(-1.864)	(-0.272)	(-1.872)	(-0.34)	(-1.04)	-2.11)	(-0.21)
INST	0.16***	0.15***	0.15**		0.15***		0.17*			0.18***
	(2.664)	(2.587)	(2.037)		(2.588)		(2.55)			(2.83)
LATITUDE	0.04	0.04	0.05	0.51**	-0.05	0.34*	-0.03	0.29	0.48**	-0.06
	(0.151)	(0.148)	(0.175)	(2.48)	(-0.183)	(1.815)	(-0.09)	(1.61)	(2.07)	(-0.21)
LANDLOCK	-0.20*	-0.17*	-0.17*	-0.18*	-0.16	-0.16	-0.14	-0.14*	-0.19*	-0.04
	(-1.942)	(-1.772)	(-1.725)	(-1.89)	(-1.591)	(-1.573)	(-1.50)	(-1.72)	(-1.88)	(-0.43)
SSA	-0.12	-0.07	0.37	-0.16	-0.36***	-0.33***	-0.33***	-0.22**	-0.22	-0.08
	(-1.191)	(-0.641)	(0.557)	(-0.32)	(-3.168)	(-3.08)	(-2.57)	(-2.04)	(-0.39)	(-0.70)
OTRI_TARIF				-0.11						
				(-0.245)						
LnDCR							-0.03	0.05		
							(-0.263)	(1.30)		
Hcap									-0.009	
									(-0.19)	
SSA_INST		0.16								
		(0.947)								
SSA_NTB			-1.19	0.06						
			(-0.736)	(0.05)						
SSA_TARIF				0.70						
				(0.459)						
SSA_LAT					1.53**	1.42*				
					(2.247)	(1.841)				
SSA_LDCR							0.005**	0.004*		
							(2.54)	(1.95)		
SSA_H									0.06	
									(0.167)	
SSA_LOCK										-0.30
										(-1.611)
P-H(p-value)	0.99	0.99	0.99	0.98	0.99	0.94	0.91	0.99	0.93	0.99
C-D statistic	5.07	4.93	4.32	-	5.007	-	4.03	-	-	4.75
Hansen J-Statistic	0.57	0.51	0.49	0.42	0.47	0.43	0.36	0.47	0.34	0.66
A-R(p-value)	0.008	0.007	0.014	0.029	0.0105	0.024	0.17	0.22	0.009	0.006
N	52	52	52	51	52	52	52	52	52	52
R^2	0.407	0.436	0.422	0.40	0.458	0.439	0.462	0.475	0.39	0.422

Notes: logTFP is the dependent variable;*,**&*** denote significance of coefficient estimates at 10%, 5% & 1% level respectively; t-statistics based on robust standard errors in parenthesis; P-H and C-D refer to Pagan-Hall and Crag-Donald statistics; Hansen J-statistic tests whether the instruments fulfill the over identifying restrictions; and A-R is the Andersen-Rubin test of 'weak instrument robust inference'.

Table 2: List of Countries by Income category

Low Income countries	High Income Countries	Middle Income Countries	Sub-Saharan African Countries[26]
Bangladesh	Algeria	Australia	Benin
India	Argentina	Canada	Cameroon
Indonesia	Brazil	Hong Kong	Ghana
Jordan	Chile	Hungary	Kenya
Malaysia	China	Japan	Malawi
	Colombia	New Zealand	Mali
	Costa Rica	Norway	Mauritius
	Egypt	Trinidad and Tobago	Rwanda
	El Salvador	United States	Senegal
	Guatemala		South Africa
	Honduras		Tanzania
	Mexico		Uganda
	Morocco		Zambia
	Nicaragua		
	Papua New Guinea		
	Paraguay		
	Peru		
	Philippines		
	Poland		
	Sri Lanka		
	Sudan		
	Switzerland		
	Thailand		
	Tunisia		
	Turkey		
	Uruguay		
	Venezuela		

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[26] Except Mauritius and South Africa which belong to the middle income category, the remaining countries belong to the low income category.

Appendix B: Formal Derivation of Trade Policy Variables

i. Trade Policy Variables

OTRI_AVE: Ad-valorem equivalent of NTBs.

It is a price equivalent of NTBs. The ad-valorem equivalent of NTBs is constructed by transforming the quantity impact of NTBs in to price equivalents. An ad-valorem equivalent is defined as, $ave = \frac{dlog(P^d)}{dNTB}$, where P^d is domestic price[27]. It is derived by making use of import demand elasticity and the quantitative impact of NTB in an import demand function as shown below:[28]

The quantity impact of NTB can be given by:

$$\frac{dlog(q_{n,c})}{dCore_{n,c}} = \frac{dlogq_{n,c}}{(dlogP^d_{n,c})} \frac{dlog(P^d_{n,c})}{dCore_{n,c}} = \varepsilon_{n,c} ave^{Core}_{n,c} \qquad (9)$$

,where $q_{n,c}$ are import quantities $(m_{n,c} = P^w_n q_{n,c})$; $Core_{n,c}$ is a binary dummy variable that indicates the presence of a core NTB. P^w_n is the exogenous world price of imports, here assumed to be unity; and $ave_{n,c,k}$ is the ad-valorem equivalent of NTB of type k imposed on good n in country c.

Solving (9) for $ave_{n,c}$s yields:

$$ave^{Core}_{n,c} = \frac{1}{\varepsilon_{n,c}} \frac{dlogq_{n,c}}{dCore_{n,c}} = \frac{e^{\beta^{Core}_{n,c}} - 1}{dCore_{n,c}} \qquad (10)$$

,where $\beta^{Core}_{n,c}$ is a parameter in an import demand equation and measures the impact on the import of good n in country c of a core NTB(see Kee et al, 2006 pp6).

Once $ave^{Core}_{n,c}$ is obtained, it can be used together with ad-valorem tariff to compute OTRI.

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[27] Perfect competition is assumed.
[28] For detailed derivation, see Kee et al (2008).

Define $T_{n,c} = ave_{n,c} + t_{n,c}$ as the overall protection a counry imposes on its imports; where $ave_{n,c}$ is the ad-valorem equivalent of NTB and $t_{n,c}$ is the ad-valorem tariff. Overall trade restrictiveness index in country c is defined as:

$$\text{OTRI} = \frac{\sum_n \left(\frac{dm_{n,c}}{dp_{n,c}}\right) T_{n,c}}{\sum_n \left(\frac{dm_{n,c}}{dp_{n,c}}\right)} = \frac{\sum_n m_{n,c} \varepsilon_{n,c} T_{n,c}}{\sum_n m_{n,c} \varepsilon_{n,c}} \tag{11}$$

Here, OTRIc is defined as the weighted sum of protection levels. Weights in the first equality are the slope of import demand function while in the second equality they are given by import levels and elasticity of import demand. The definition after the first equality solves the downward bias in restrictiveness of trade policy associated with the use of import weighted average Tariffs in the presence of prohibitive tariffs. The bias can be seen in the definition after the second equality.

OTRI_NTB is the ad valorem equivalent of NTBs computed using (10).

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13/1	March/2013	Ali I. Abdi (Ph.D) and Emerta A.Aragie (M.Sc)	Financial Sector Development in the IGAD Region
12/3	December/20 12	Ali I. Abdi (Ph.D) and Emerta A.Aragie (M.Sc)	Economic Growth in the Horn of Africa: Identifying Principal Drivers and Determinants
10/3	May/2011	Ali I. Abdi (Ph.D) and Emerta A.Aragie (M.Sc)	Access to Finance in Africa and the Role of Development Banks

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