Determinants of Total Factor Productivity: The case of Sub-Saharan African economies

by

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Abstract

Strengthening of international competitiveness is advocated to developing countries as a mean to expand trade participation and to enlarge the accrued gains. A major component of competitiveness is constituted by the enhancement of total factor productivity. We analyze factors that determine TFP in order to identify and suggest direct policy measures towards its improvement. Usual as well as rather innovative determinants are considered: (i) human capital stock, (ii) reallocation of production factors, (iii) economic diversification, (iv) agglomeration economies, (v) demographic age structure, (vi) infrastructure development, and (vii) black market premium. A panel causality test is carried out to investigate the pattern of the effects of those determinants in Sub-Saharan Africa. Most of those variables were found to be Granger-causing TFP. Also, for most cases no evidence of reverse causal relationship emerged; those factors can serve as primary policy measure for raising TFP and international competitiveness.

Key words: Total Factor Productivity, causality, Africa.

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I – Introduction:

Openness of developing countries to international trade and foreign investments has always been a topic of controversy for researchers as well as policy makers. However, from the 1980's, dissimilar development performances have arisen between developing countries that have pursued open-policy and those that have been reluctant to international openness. The former group, essentially constituted by Asian economies and some Latin American economies, has exhibited economic growth far larger than that of the latter group, including Sub-Saharan African economies. Consequently, for the last two decades, the debate of participation or non-participation in the phenomenon of globalization has been answered by the observed facts; and the focus has turned to the search for measures to deepen such participation and to enlarge the accruing gains.

Originally, from the Ricardian theory and the Heckscher – Ohlin theorem, increasing the participation in international has been thought of as being based on the country's comparative advantage. The concept of comparative advantage can be briefly explained as the fact that a country specializes in production of goods or services where it exhibits lower relative prices. The lower relative prices result from the possession of more advanced technology in the production of those goods and services, and/or from the intensive use of the relatively abundant factor endowments. Trade would lead each participant to look for and exploit its comparative advantage, hence will bring about better allocation of resources, and ultimately would increase welfare of each participant. Originally the theory was presented in a static setting, *i.e.* the analysis was conducted in

terms of the “existing” factor endowments.

Later on, the analysis has been extended to a dynamic setting, giving rise to the concept of “dynamic comparative advantage”. The idea is based on the fact that factor endowments can change along the participation of a country in international trade. For instance, international trade through its growth enhancing effects can positively influence the gross capital formation. Subsequently, the capital-labor ratio can be altered. Also, international trade can heighten the skilled/non-skilled labor ratio. And those transformations can differ from one country to another, resulting in changes of the pattern of comparative advantages across countries.

Nowadays, international trade studies have added to the framework of static and dynamic comparative advantage the concept of competitive advantage and competitiveness. As Porter (1990) pointed out, the concern about the country’s competitiveness has become a major focus of researchers and more importantly of policy makers. This concern stems from the fact that higher competitiveness in international trade lies at the core of intensifying participation in international trade, *i.e.* stronger competitiveness allows larger trade. International competitiveness can be briefly defined as the ability of the country to sell more products in the international market while maintaining and improving real income level, standard of living and welfare domestically (Scott and Lodge, 1985; Competitiveness Policy Council, 1994; Aiginger, 1998). Two policies are at the core of the strengthening of international competitiveness: short-run measures essentially the devaluation policy and long-run structural measures mainly productivity policies. On the one hand, devaluation might be ineffective in promoting a country’s competitiveness since the expected decline in

prices of exports[1] might be offset by the resulting domestic inflation. Moreover, devaluation might hamper real consumption, i.e. worsen domestic welfare, since it renders imported goods more expensive and leads to higher inflation. On the other hand, measures related to productivity improve the fundamentals of competitiveness and do not involve any trade-off in terms domestic welfare. Hence, we analyze direct policy measures that might be implemented in order to improve productivity in the Sub-Saharan economies.

II – Potential Determinants and Literature Review:

We attempt to investigate productivity determinants frequently cited in the literature as well as rather original ideas.

II – 1: Human capital stock

Effects of human capital on productivity can be understood through three models, as explained in Wolff (2000): human capital model, "catch-up" model, and "interaction with technical change" model.

The first model views human capital in the context of growth accounting reasoning. The human capital is considered as a production factor as the physical capital. Human capital is introduced as an explanatory variable for the productivity growth and hence the output growth. Human capital is often regarded as the accumulation of education. Accordingly, the studies in this model have put forward that educational change influence markedly productivity and economic growth. Schooling is considered as an

[1] Denominated in foreign currency.

investment in skills, consequently as a mean to improve workers' productivity (Schultz, 1960, 1961, 1971; Becker, 1975). Griliches (1970) analyzes the case of the U.S. from 1940 to 1967 and suggests that accumulation of education for the U.S. labor force explains one-third of the productivity growth, measured with the Solow residual. Denison (1979), also investigating the case of the U.S., for the period 1948 – 1973, infers that heightening of educational attainment accounts for one-fifth of the growth of per-capita income. Jorgenson and Fraumeni (1993), still for the U.S from 1948 to 1986, find that improvement in human capital accounts for one-forth of economic growth. Maddison (1987), for the case of the OECD countries during 1913 – 1984, stresses the considerable role of human capital, i.e. education in his growth accounting analysis.

The second model carries out the analysis of human capital in the context of a "catch-up" or "convergence". The model takes as given that international competitive pressures lead to spreading of technology worldwide. And it can be argued that knowledge diffuses from developed countries to developing ones, since the former would not have much to learn from the latter. This "advantage of backwardness" induces technological "catch-up". The "convergence" stems from the fact that it is easier and cheaper to improve obsolete technologies than those at the edge[2], therefore developing countries would exhibit faster technological growth hence productivity growth than developed countries. However, for the technological diffusion to be realized, the recipient country is required to possess stock of knowledge, i.e. human capital sufficient for absorption.

The third model is based on the concept of "learning by doing", put forward by Arrow (1962). The concept states that workers assimilate gradually the existing

[2] It would be cheaper to change from type-writer to word-processor through imitation, than from word-processor to a full computer through innovation.

technologies or the newly introduced technologies, therefore their efficiency increases over time. The "learning" process occurs more rapidly for workers with higher level of education. In the Nelson–Phelps model, it is argued that a more educated workforce may make it easier for a firm to adopt and implement new technologies. Firms value workers with education because they are more able to evaluate and adapt innovations and to learn new functions and routines than less educated ones. Countries with better educated workforce would assimilate faster and better technologies, and would exhibit higher productivity growth.

II – 2: Reallocation of production factors:

The reallocation of production factors has been frequently introduced in growth theory. Chenery *et. al.* (1986) conducted a remarkable empirical work in the field. Young (1995) investigated the case of East Asia for two decades from the 1960s to early 1990s and found that the spectacular economic growth in Hong Kong, Singapore, South Korea and Taiwan originated in large part from the reallocation of production factors from the low productivity agricultural sector to the high productivity industrial sector. Those countries successfully expanded investment and employment in manufacturing sectors, the latter has enhanced at an average rate of 6% per year, twice the rate of growth of aggregate working population. Poirson (1998) also emphasize that reallocation of production factors is vastly witnessed in countries exhibiting rapid economic growth, reallocation from agricultural to non-agricultural sector. Reallocation has been essentially studied through that of labor more than capital because (i) effects of the former have been shown to be more substantial and (ii) measurement of capital reallocation is rather a daunting task (Dessus *et. al.*, 1995). Accordingly, Syrquin (1986)

suggests the following index:

$$\rho_t = (1-\alpha)\sum_{i=1,2} v_{i,t-1}\frac{l_{i,t}-l_{i,t-1}}{l_{i,t-1}}$$

where $i = 1(agriculture),2(non-agriculture)$, ρ_t is the TFP gain due to labor reallocation from agriculture to non-agriculture at time t, $l_{i,t}$ is sector i's share of total labor force and $v_{i,t}$ is the contribution to GDP by sector i.

II – 3: Economic Diversification

Larger economic diversification can be defined as the fact that a country is engaging in production of growing number of varieties of goods. Diversification has also been observed to be strongly associated with fast economic growth. The impact of diversification on income occurs mainly through two mechanisms: enhancement of factors productivity and spreading of investment risk.

The first channel considers that diversification enters the production function by increasing productivity, as in the model by Romer (1990). The model, of three sectors, explains that the first sector namely research sector uses human capital and common accumulated knowledge in order to produce new designs which it sells (or rents) to the second sector namely the producers of intermediate goods. The third sector, namely the producers of final goods, acquires intermediate goods in order to produce goods for consumption. Larger diversity of intermediate inputs is thought of as enhancing productivity in the final good sector. Feenstra *et al.* (1999) analyzes the aggregate effect of diversification on the economy.

The second mechanism through which diversification can increase income is by

expanding the possibilities to spread investment risks over a wider portfolio. In other words, greater diversification will enhance average capital productivity in the long run by providing better investment opportunities at lower risk. Acemoglu and Zilibotti (1997) demonstrate a model where lack of diversification leads economic agents to invest in low return, safe traditional projects, rather than in riskier projects with higher growth potential. The absence of possibilities to spread risks by investing in a diversified high-growth portfolio, will hamper capital productivity in the short run and capital accumulation in the long run.

Given the complexity to capture the extent of diversification for the entire economy, an index of diversification can be drawn from the components of exports as follows:[3]

$$Div = \frac{1}{\sum_{i=1}^{N}\left(\frac{x_{i,t}}{X_t}\right)^2}$$

where $x_{i,t}$ is exports of product i (at a three-digit level) in year t, and X_t is total exports in year t. The inverse of Div takes on a maximum value of 1, when the entire amount of exports is constituted by one single product and it tends toward 0 when there is an infinite number of equally weighted products for exports. In other words, Div takes the value of unity for the completely specialized case when a country concentrates all its exports to one product, and is increasing with the degree of diversification.

II – 4: Agglomeration economies

The concept of agglomeration economies is very rarely considered in studies on

[3] It is noted that the index fails to capture the extent of diversification in the non-tradable sector.

productivity, despite its potential valuable effects. Only recently, over the last decade, considerable interests have arisen in analyzing the effects of location and geographic concentration on aggregate economic growth. Agglomeration economies can be classified in three groups, namely (i) at the firm level from improved access to market centers, (ii) at the industry level from intra-industry localization economies, and (iii) at the regional level from inter-industry urbanization economies (Lall *et al.*, 2004). Most researches in this area draw upon the original work in regional science and location theory of Weber (1909), Losch (1940), Hotelling (1929), Isard (1956), Greenhut and Greenhut (1975). The recent researches examining the economics of agglomeration have been made possible by progress in mathematical modeling and by an improved understanding of three factors which determine the spatial concentration of population and economic activity: (1) increasing returns to scale (Dixit and Stiglitz, 1977; Krugman, 1991; Abdel-Rahman and Fujita, 1990; Fujita *et al.*, 1999), (2) technological and/or non-pecuniary externalities (Fujita, 1989), and (3) imperfect/spatial competition (Dixit and Stiglitz, 1977; Fujita *et al.*, 1999).

Krugman (1991) has particularly stressed on the increasing returns to scale. As Fujita and Thisse (1996) state, under non-increasing returns and uniform distribution of resources, each individual would only produce for personal consumption and each location would be the base of an autarkic economy where goods are produced on an arbitrarily small scale. However, if average production costs decline as scale of production increases at either the firm, industry, or regional level, then it will be beneficial to concentrate production in particular locations. At the firm level, for example, if a plant is located in a region with good access to markets, the entrepreneur has an incentive to increase production to meet increasing demand. The increasing scale

of production enables a restructuring of the production process through the use of specialized labor and investment in cost reducing technologies, consequently ameliorates productivity.

The technological and/or pecuniary externalities can be explained as follows. A firm located in close proximity to other firms in the same industry can take advantage of localization economies. The intra-industry benefits include access to specialized know-how (i.e., knowledge diffusion), the presence of buyer–supplier networks, and opportunities for efficient subcontracting. Employees with industry-specific skills will be attracted to such clusters giving firms access to a larger specialized labor pool. Externalities can also accrue from being located in close proximity to firms in other industries, called “urbanization economies”. These inter-industry benefits include easier access to complementary services (publishing, advertising, banking etc.), availability of a large labor pool with multiple specialization, inter-industry information transfers, and the availability of less costly general infrastructure. The origins of these ideas can be traced back at least to the works of Marshall (1890), who stated that the geographical concentration of economic activities can result in a snowball effect, where new entrants tend to agglomerate to benefit from higher diversity and specialization in production processes. Workers would also benefit from being in an agglomeration as they can expect higher wages and have access to a larger choice set of employers. Those factors are qualified as centripetal forces (Henderson, 1974, 1988; Carlino, 1978; Selting et al., 1994).

On the other hand, there exist factors that might act against agglomeration qualified as centrifugal forces. These include increased costs resulting from higher wages driven by competition among firms for skilled labor, higher rents due to

increased demand for housing and commercial land, and negative externalities such as congestion. These costs offset some or all of the benefits of being located in an agglomeration. The net benefit from agglomeration depends on the ability of the firm to fully capture and make extensive use of the advantages in order to cover the potential disadvantages. Theoretical and empirical studies show that benefits accruing to firm from agglomeration is a positive function of the intensity of technology and innovation of the firm (Henderson et al., 2001). The underlying reasoning states that the benefits of knowledge sharing (ideas) and access to producer services (e.g., venture capital) are considerably higher in higher technology sectors than in low-end manufacturing that employs standardized production processes. Consequently, innovative sectors can afford the high wages and rents in dense urban locations and industry clusters. In this framework low-end industry producing standardized products can be expected to move to smaller urban centers with lower costs.

II – 5: Demographic age structure

The effects of demographic age structure are also very rarely investigated in studies of productivity. Two channels can be put forward. First, there is an "accounting" effect because a rising ratio of the working age population to the total population increases the ratio of producers to consumers in an economy. This contributes positively to growth of output per capita. Second, there might be "behavioral" effects on growth of output per worker. Bloom and Williamson stress that, on the one hand, a rising labor force leads to capital dilution, i.e., a reduction of the capital–labor ratio. On the other hand, a rising ratio of the working age population to the total population implies a falling dependency ratio (the population below and above working age divided by the

population of working age). In turn, a falling dependency ratio allows the working age population to save a larger percentage of their incomes. This will offset or even reverse the negative effect of labor force growth on the capital–labor ratio.

From a worldwide, cross-country regression analysis, Bloom and Williamson (1998) find support for their hypothesis concerning the effect of age structure on economic growth. These estimations showed a negative and significant effect on growth of output per capita due to growth of the total population, and an opposite, positive and significant effect from the growth of the working age population.

Kogel (2005) found that structural change from higher growth rate of total population compared to growth rate of working population, to lower growth rate of total population compared to growth rate of working population influences positively the total factor productivity; such effect has been observed in Asia. Since the mid-1970s, the growth rate of the total population has become lower than the growth rate of the working age population, which Bloom and Williamson (1998) qualify as “demographic gift” phase. Interestingly, this phase coincides with the rise in economic growth throughout East Asia and is thought of as a major contributing factor to the East Asian economic growth miracle. They estimate that one third of the economic growth rate in those countries can be explainable with the change in age structure.

II – 6: Infrastructure development

Infrastructure is frequently pointed out in the literature as a crucial factor underlying Total Factor Productivity. Extended infrastructure reduces direct and indirect cost of production. Infrastructure is included among the seven factors considered as “drivers of industrial competitiveness” (UNIDO, 2002). Availability of infrastructure

conditions the development of the industrial sector in a given country. As explained in the Global Competitiveness Report (GCR, 2003), expansion of industries requires two main favorable environments: microeconomic or business environment including regulations among other factors, and macroeconomic environment including infrastructure.

Although infrastructure is mostly mentioned when referring to industrialization, Hazell and Fan (2002) stresses its importance for the agricultural sector in developing countries. They warn against the policies of government in developing countries and that of multilateral cooperation agencies, which tend to reduce public investment (infrastructure) in rural areas in recent years, for instance as part of the Structural Adjustment Policy. They proved that public investments in rural areas are playing a role of engine for agricultural productivity and that they are continuing to provide substantial returns for economic growth. A research conducted at the International Food Policy Research Institute (2002) delved into the agricultural aggregate productivity of selected developing countries and found infrastructure as significant determinants along with other factors such as traditional farm inputs (fertilizers, machinery, draft animals), technology and agricultural terms of trade. Infrastructure can be measured either in monetary or in physical form, depending on the availability of data and on the purpose of the analysis. When conducting analysis at the national level or when carrying out cross-country analysis, both measures can be used: for instance the level of public expenditures on infrastructure (or the share in total expenditures, or as share of GDP) and density of paved road or telephone lines. However, when focusing on disaggregated level *i.e.* regions in a country, only physical measures would be available and insightful. Fan *et al.* (2000) found that infrastructure influence markedly productivity in rural areas

of India; among the considered factors, rural roads appear to be the second most important determinant. Fan and Zhang (2000) also discovers the high importance of rural roads in productivity of rural areas of China. Hazell and Fan (2002) emphasize that if the density of infrastructure in India or in China is taken as the required level for rapid agricultural growth, then massive investments in rural infrastructure would be needed for in Africa to initiate an agricultural revolution.

II – 7: Black market premium

Black market premium in the exchange rate market reflects the degree of distortions in domestic prices. Market distortions can be expected to impede efficient allocations of resources, and thereby hamper productivity. Governments in developing countries frequently tend to alter structure of prices in order to create favorable conditions for specific sector in the economy or specific group in the society. The pattern of relative prices is sometimes modified to promote import substitution sector. Under the export-based policy, governments influence through different measures the structure of price to create incentives to export sector. Rushing to openness to the international market, relative prices are often biased voluntarily in favor of tradable goods and at the expense of non-tradable goods. Finally, due to political motives or policy objectives, relative prices between rural agricultural and urban industrial goods are frequently altered in favor of the latter in order to secure support from the politically strong urban population. However changing the relative price in the opposite direction would also be harmful; the naturally arising relative price would bring about optimal allocation of resources.

III – Empirical Analysis

III – 1: Definitions of Variables

We analyze the relationship between the above-mentioned factors and TFP growth in twenty eight economies in Sub-Saharan Africa. The sample is constituted by annual data spanning the period 1965 to 1999. TFP is the measured by the Solow residuals. The variables used as proxy for TFP determinants are explained as follows.[4]

Human capital stock is measured with the illiteracy rate among population over fifteen years old. Discussion related to the functional ability of "just" literate workers might arise, leading to the controversy on the effectiveness of illiteracy reduction in influencing productivity. Indeed, other measures such as secondary or higher education level might be more preferable, however, such data are not available for the entire period covered in the present analysis, and therefore we resort to the illiteracy rate. Furthermore, increase in the secondary or higher schooling reflects the importance that the government is giving to education, and would be expected to be highly correlated with the illiteracy rate.

Reallocation of production factors is measured with the share of manufacturing value added in total GDP. Although straightforward measures of capital and labor use in each of the sectors of the economy would give more accurate insights, such data are not available. Since the share of production factors employed in each sector determine the share in the total production , it can be defended that share of manufacturing value added in total GDP can rightly reflects the pattern of reallocation.

Agglomeration economies are proxied with the share of the urban population in

[4] All data were taken from the World Bank Africa Database (2001)

total population. Direct measure of agglomeration of industries such as number of existing clusters or the density of industries (number of industries in specific areas) would be preferable. Such data are not available for the countries of our study. We follow the reasoning in Krugman (1991), Fujita *et al.* (1999) and Lall *et al.* (2004), and consider that industries concentrate in location that allow easy access to and low transport cost for inputs such as labor. Therefore, it can be argued that higher concentration of labor, such as the increase in the share of urban population stimulates more intense concentration of industries in that given area.

Demographic age structure is measured with the age dependency ratio or the ratio of dependent (under fifteen and over sixty) to working (between fifteen and sixty) age population.

The level of development of infrastructure is captured with the number of main line telephones per thousand people. Other measures such as kilometers of roads paved or electricity supply could also be suggested, however they could not cover the entire sample period.

Black market premium is measured with the ratio of parallel to official exchange rate

III – 2: Methodology and Results

We employ Panel Granger Causality test suggested by Hurlin and Venet (2001) to examine the relationship between the TFP growth in SSA economies and the potential determinants. Prior to the causality test, Panel Unit Root Test is carried out for each of the variable, following Levin *et al.* (2002). Results are given in Table 1. The following variables are found to be stationary in level form: TFP growth, share of manufacturing

value added in total GDP, ratio of parallel to official exchange rate, age dependency ratio, illiteracy rate, and ratio of urban to total population. The number of phone lines per thousand people is found to include one unit root. Hence, except for the infrastructure variable that is used in first difference, all variables are introduced in the causality test in level form.[5] Results of the test on the causality from the potential determinants to TFP growth are displayed in Table 2.

First, it is shown that enhancing manufacturing industries influences aggregate productivity. Reallocation of production factors brings about restructuring of the economy and pulls up productivity through two channels: direct channel, manufacturing sector intrinsically possesses higher productivity than agriculture and service; and indirect channel, manufacturing sector spreads externality effects on the productivity of other sectors in the economy.

Second, agglomeration economies measured with the ratio of urban to total population affects TFP growth. Concentration of production factors (here measured with labor) stimulates concentration of industries, which creates and widens the scope for productivity growth. Locating a firm in an area where there exists a concentration of labor is beneficial for both parties; for instance, transport costs are lower for both firms and workers, and firms would be given larger choice of workers. Such incentives would pull more firms into the area and subsequently there would be larger choices of firms for the workers too. The overall scenario would result in better efficiency and higher productivity for the entire area and consequently for the entire economy, if such agglomerations emerge in various parts of the country. A policy to promote such

[5] Since the age dependency ratio and the illiteracy rate are stationary in level form only under the "none" specification, we also verified the causality test using first difference form of those two variables. The thrust of the results has not been altered.

concentration of production factors and concentration of industries is highly suggested for the SSA countries. Such policy can include the creation of industrial zone through development of specific infrastructure, or creation of Tax Free Zone using specific tax treatment.

Third, we could find causality relationship from the availability of infrastructure to aggregate productivity. It is important to note that the sole availability of infrastructure might not accurately reflects the requirement for higher productivity, the functionality of the existing infrastructure is equally or even more pertinently necessary. For instance, the possibility to use on full time basis (twenty four hours a day, and seven days a week) the existing phone line needs to be considered. One other example, the number of electricity break down in one week might be as important as the number of villages covered by electricity. Hence, government ought to pay attention to both construction of new and maintenance of existing infrastructure.

Forth, black market premium measured with the ratio of parallel to official exchange rate impacts on aggregate productivity. Distortions arising from factors that underlie larger black market premium impede optimal allocation of resources and hinder productivity growth.

Finally, we did not find any causal relationships from age dependency ratio and illiteracy rate. We plan to investigate further such relationships in future research.

We also analyze the reverse causal relationship from TFP growth to each of the factors mentioned above. Results are given in Table 3. We find that except for the infrastructure variable (phone line), no reverse causal relationship is depicted. The results support our assessment that factors raised here can indeed serve as primary tools that the government can employ in order to enhance the aggregate productivity of the

economy.

IV – Conclusion

From the 1980s, the observed facts have given answer to the debate on "participation or non-participation" in international trade; open countries have performed better than closed ones. Subsequently, the focus of researchers and policy makers has moved to the search for measures allowing to expand such participation and to enhance the accrued gains. The strengthening of international competitiveness has been considered as a major component of such measures, and has been constantly advocated to developing countries. A core of competitiveness policy is constituted by the improvement of total factor productivity. The latter would allow to expand trade participation while maintaining and ameliorating domestic real income and welfare.

We analyzed factors that determine TFP and explained the channels of relationship in order to identify and suggest direct policy measures that might lead to TFP enhancement. Frequently cited as well as rather innovative determinants are investigated: (i) human capital stock, (ii) reallocation of production factors, (iii) economic diversification, (iv) agglomeration economies, (v) demographic age structure, (vi) infrastructure development, and (vii) black market premium.

A panel causality test is performed to study the pattern of relationship between those factors and TFP in the Sub-Saharan African economies. The following determinants were found to Granger-cause productivity: reallocation of resources from agricultural to non-agricultural sectors, deepening agglomeration economies measured as the ratio of urban to total population, availability of infrastructure, and decreasing

black market premium reflecting price distortions. No evidence of reverse causality emerged for most of the factors, implying that they can be employed by the government as primary policy measures to enhance TFP and strengthen international competitiveness.

References:

To be completed

Table 1: Productivity Determinants, Unit Root Test
(Levin, Lin and Chu Test)

Variables	Constant & Trend	Constant	None
TFP growth	-18.378***	-25.241***	-47.563***
Manuf. Val. Ad.	-0.650	-2.492***	-0.358
Black Mark. Prem.	-97.056***	-67.29***	-0.850
Age Depend. Ratio	-0.527	-1.135	-1.955**
Illiteracy Rate	3.660	10.103	-9.207***
Urban Pop. Ratio	-5.476***	-2.304***	1.910
Phone Line	9.324	18.015	13.405
Phone Line (first difference)	-3.864***	-0.786	-3.007***

Note: ***(**) indicate significance level at 1%(5%)

Table 2: Productivity Determinants, Causality Test

Dependent Variable: TFP growth

Excluded Variables	F-statistic	p-value
Manuf. Val. Ad.	3.305	0.011
Black Mark. Prem.	2.578	0.037
Age Depend. Ratio	0.386	0.819
Illiteracy Rate	0.441	0.779
Urban Pop. Ratio	8.326	0.001
Phone Line	8.942	0.001

Table 3: Productivity Determinants, Reverse Causality

Excluded Variable: TFP growth

Dependent Variables	F-statistic	p-value
Manuf. Val. Ad.	1.218	0.302
Black Mark. Prem.	1.054	0.379
Age Depend. Ratio	0.621	0.648
Illiteracy Rate	0.651	0.626
Urban Pop. Ratio	1.263	0.283
Phone Line	2.201	0.068