FACTOR PRICE AND AGRICULTURAL PRODUCTION IN SUB-SAHARAN AFRICA

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Abstract

For the last four decades or so growth of agricultural output per worker has remained too slow or stagnant in Sub-Saharan Africa. This problem is analyzed by using a framework that reveals source of growth through relaxing the usual assumption of unfailing market condition. The analytic result suggests that the degree and direction of effects of factors of market failure make a difference in levels of output per worker as well as in its rate of growth. On this ground, the poor performance observed in agricultural sector of the region can be well attributed to lack of ability to manage and exploit factors of market failure. Moreover, the analytic result suggests that the existing trend could be well reversed by looking for the investment system that could optimize the gains from factors of market failure. The empirical evidence obtained from a panel of countries of the region supports strongly this argument.

Keywords: Sub-Saharan Africa, Factor price, Agricultural productivity, Market failure, Subsistence economy.

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1. INTRODUCTION

Almost for two and a half centuries, industrial expansion has been considered as an engine of economic growth, and favorable change in agricultural productivity has been regarded as the major factor determining the size and growth of industrial sector. James Steuart for example, in 1767, at the dawn of industrial revolution, argued that it is the productivity of the farmer that limits the size of the industrial sector. Following this line of thought, a century later, Toynbee (1884) described how productivity change in agriculture helped lowering the price of food for industry and lowers price of labor for industrial employment in eighteen-century England.

The indicated sequence of sectoral changes was repeated as industrial revolutions spread to France in the 1820s, Germany in the 1850s USA in 1860s (Bairoch, 1973). In Japan Ohkawa and Rosovsky (1964) observed the necessity of productivity gains in agriculture to support a heavy land tax that was invested in industrial sector in 1880s. Despite this all productivity changes in different regions of the world, we have not seen yet such similar labor productivity change in SSA agriculture. Rather the region's agriculture is characterized, exceptionally, with low and almost stagnant productivity, which is responsible for persistent food insecurity and wide spread rural poverty seen in the region.

According to World Bank (2002) data set, in the first half of the 1970s an average farmer living in SSA produces a produce worth of $1.61 per day on the average, which has only changed to $1.96 in the second half of 1990s. Comparing this indicator to that of Danish farmer, she produces $32.41 in the first half of the 1970s, which has grown to $135.0 in the second half of the 1990s. These figures indicate that during the covered period, while Danish farmer exhibit an annual productivity growth of 5.87%, a sub-Saharan Africa farmer indicated a productivity growth of only 0.78% per year. Putting it in different terms, in the early 1970s, an average farmer in Denmark can produce agricultural output of about 40 times that of an average farmer living in SSA. This ratio mounted up over 100 times in the second half of 1990s. The central question here at is then, what has gone wrong with SSA's agricultural productivity? Why has the region failed to see the productivity level and change observed in other regions of the world? What triggers productivity progress? This question will be the subjects of this paper. Section two will try to review some of the literature. Section three and four presents theoretical framework for productivity change and empirical evidence for the argument. The last section concludes the implications of the analysis.

2. THE LITERATURE

Even if history of industrialization up to mid 1950s provided ample and compelling evidences for the importance of change in agricultural productivity for industrialization process, there was no as such formalized mechanism that explains the process through which it plays the indicated role. But Lewis (1954) managed to provide formalization of the process through which cheap surplus labor or zero marginal productivity in agriculture influence the level of industrial wages through the operation of labor market. In this approach low nominal wages in industry in turn induce high rate of investment and growth as a result of industrial sector's excess profit over wages. Even if many economists considered this mechanism as elegant, to describe the link between the two sectors, some felt discomfort with the assumption employed by the model, particularly with that of surplus labor in agriculture.

Later on Jorgenson (1961) out ruled the assumption of surplus labor and managed to show the possibility of extracting labor from agriculture for industrial employment, while assuming full employment for the former sector. Shortly after this work, considering the assumption of surplus labor in agriculture and technical change, Fei and Ranis (1964) showed the possibility of reducing nominal wages for industry through reduced price of food available from agricultural sector.

Careful insight throughout these works and similar others reveal one common point. The fact that enhanced productivity in agriculture is a pre-requisite for industrial expansion and growth. Another implied but implicit point is that the need for industrial expansion for growth. But we do not find the basic and explicit source of productivity change in agricultural sector.

Surprisingly, although this general theory of development is supported by the historical experience of economic growth in the west, a couple of decades after Lewis work, its relevance to most contemporary developing countries has fallen under question. The basic reason was that the key assumption involved in the model-existence of surplus in agriculture, full employment in industry and competitive labor market in industrial labor market or absorptive capacity of industrial sector-by the model was found not to fit to the institutional and economic realities of the economies (Todaro 2000: p 87)

As a result of this unrealistic assumption some development specialists considered the approach to be irrelevant to the case of developing countries, (Jolly, 1970: p4), and started to look at rural urban migration as problem of developing countries rather than treating it as a beneficent process necessary for industrialization. As a result, the

Lewis two-sector model came to the level of serving no longer as a blue print for development as it was before. The experience of developing countries made the model more irrelevant and made the search for another appropriate tool essential.

The popular work that resolved this problem was Todaro's (1969) work that developed a theory of rural-urban migration to explain the apparently paradoxical relationship of accelerated rural urban migration in the context of rising urban unemployment. The central postulate of this work is that the migration proceeds in response to urban rural difference in expected income rather than actual earnings. As a result, the model suggests that members of labor force compare their expected incomes for a given time horizon in the urban sector, with prevailing average rural incomes and migrate if the former exceeds the latter. The process that leaves potential migrant to be indifferent between job locations was given as:

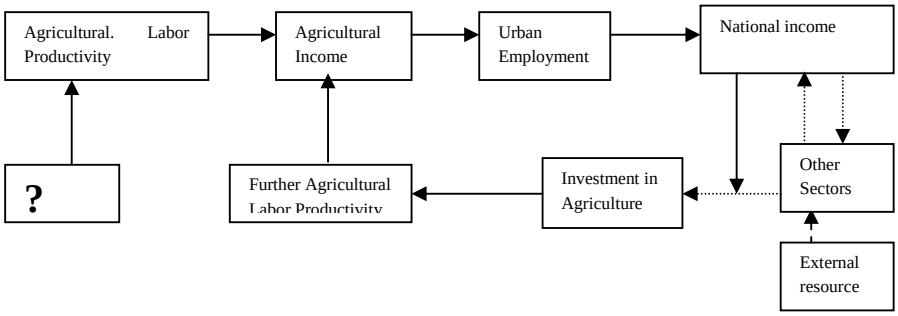
$$w_a = \frac{l_m w_u}{l_{us}} \qquad [1]$$

Where is w_u, w_a, l_m , l_{us} urban wage rate, rural wage rate and urban employment and urban labor force, respectively. From this expression we can find that

$$x = \frac{l_m (w_u - w_a)}{w_a} \qquad [2]$$

Where x represents urban unemployed labor force. From [2] it is possible to understand that Lewis two-sector model is a special case of Todaro migration model, the case being absence of urban unemployment. In this circumstance, the system tends to equalize rural income and urban income. Here it is worth noting that the integrated national development requires reducing or eliminating, if possible, urban unemployment, which requires according to this model, raising wages in agriculture. Moreover, from the model we observe that there is n adverse effect in attempting to raise urban employment on national development through its effect on urban unemployment. On the other hand, raising agricultural wage, which means raising agricultural productivity that influence favorably the national income by reducing urban unemployment. Once the national income is improved it is possible to acquire further agricultural labor productivity through investment made in the sector which may take place in the form of accumulation of physical and human capital, institutional changes and in extreme cases in innovation. This relationship is shown in chart 1.

Chart-1: Role of Agricultural labor Productivity



Considering this relation, the central question deserving due attention is what exactly brings the initial agricultural productivity? From historical perspective, What triggered improvement of labor productivity in agricultural sector in the western economies before industrial revolutions that led to higher income and higher investments?.

3. FRAMEWORK

In the literature Jorgenson (1961) indicated the fact that technological change in agriculture is required to raise productivity. Shortly after this work, Fei and Ranis (1964) also indicated the importance of technical change in altering agricultural labor productivity. Slight differently, Lele and Mellor (1981) also showed the fact that technological change in agriculture helps in reducing the price of food and the nominal wage for industrial employment. In these and other similar works, we find technological change to be considered as a prime factor of productivity change. But the problem is the essence and source of the technology is nearly unclear. One may consider agricultural machinery and improved inputs as a proxy for technological change. But from where do we get the resource for it initially? Todaro suggests the need for raising domestic demand for agricultural output through diversified non-agricultural labor-intensive rural development activities.

From Macro perspective, Rostow (1960) and Harrod (1939, 19480) and Domar (1946, 1947) emphasize the need for physical capital accumulation, which means there is some income reserved for this purpose, be it from domestic savings or elsewhere. Haavelmo (1956), Uzawa (1965), Lucas (1988) stress the need to invest in human capital, which again implies there is some resource for the investment. Neo-Schumpeterians like Romer (1987, 1990), Grossman and Helpman (1991), Segerstrom, Anant and Dinopoulos (1990) and Aghion and Howitt (1992) prefer to look at the issue from innovation perspective that take place through research and

development, which again demands investment. In sober fact, these macro model explain the process pretty well once the agents are at the level of having enough income enabling to save and invest it in activities that enhance ‘technical progress’, which was made possible by earlier productivity gains. But the exact source of the initial productivity gain that put the agents at income level of saving and investing remains somewhat unclear.

Another challenge is that even though the agents are at the required position; say through the so called “big push” there is no clear and objective guide for weighting and sequencing investments made in the indicated areas, which exposes policymakers to committing policy mistakes. Regarding absence of objective guide, Hoff and Stiglitz (2001:pp.391) state, “We have had a wealth of experiments. There are clearly no surefire formulas for success; if there were, there would be more success. Some strategies seem to work in some countries and not in others.” The statement may imply a need for some objective, compressive and flexible explanation of process of productivity growth.

This paper adopts the framework in Gutema and Fayissa (2004) that helps to explain the initial source of productivity gain in an objective and comprehensive way.

The framework starts from an implicit production function Y=F(L,X) using labor (L) and Row vectors of other inputs (X) to produce aggregate net national income (Y), and introduces the problem of subsistence by assuming no saving that captures the behavior of indigent societies. Moreover, it introduces market incompleteness (both intertemporal and interpersonal externalities) and imperfection of market competition (both intertemporal and interpersonal wealth transfer), which are, here after, referred to as Factors of Market Failure (FMF). Finally it arrives at a growth determining equation as:

$$y=AL^{\beta} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots [3]$$

where y is per capita output, $\beta=(f_l-y)/y$ is a measure of relative effects of FMF (REFMF) and A stands for real wage rate per year under unfailing market condition.

From [3] it can be seen that an economy with larger β will have larger output per worker and vice versa. Moreover, it suggests that the rate of growth of productivity per worker is determined on one of its sides by the size of β. A careful look in to β

reveals that its level could be influenced by using a mechanism[1] that promotes gainful FMF while reducing unemployed labor. Thus if we find difference in changes of two economies' β overtime, the good candidate for the cause of the difference the degree of the efficiency of this mechanism. In other words, it suggests that poor economies could exhibit productivity growth, should they are in a position of managing and exploiting FMF. The productivity remains unchanged only if they fail to do so, or did it in a wrong way.

Furthermore, the framework gives some information on how productivity growth took place in agricultural sector of the currently developed nations, during the pre-industrial revolution period. It suggests that the currently developed nations have enhanced productivity, not by deferring the then current consumption and investing it in accumulation of physical capital, schooling and research, but through, be it knowingly or unknowingly, exploiting possible FMF.

This same argument will hold true in explaining the cause of absence of drastic changes in SSA agricultural productivity in the past. It suggest that either the economies have failed to generate sufficient unpaid factors in their productive activities due to improper incentive system, or they might have generated it, but it has been automatically nullified by unemployed but paid factors of production.

The next section attempt to provide evidence for the argument that exploiting unpaid factor derives initial productivity gains?

4. EMPIRICAL EVIDENCE

In this section, we need to see if an REFMF in sub-Saharan Africa agriculture is uniquely smaller from other poor countries of the world. To this effect, first poor countries of the world, countries earning an average GNP per capita less than 370[2], in the first half of 1970s (1970-1974) were taken. Second, from this set of countries SSA countries were sorted out and grouped under SSA subgroup, while the remaining poor countries were grouped under non-SSA subgroup. After forming such groupings, the proposed equation was estimated for both subgroups, separately, and estimates of parameter β in both subgroups were compared for their size, sign and

[1] The effects of factors of market failure are endogenous to the economy. An economy can influence the degree and directions of the effects through its social institution (laws, moral institutions and the market place itself). The institutions can promote (discourage) the gainful (adverse) factors by adopting appropriate incentive system

[2] for this demarcation, see World Bank [1990].

significance. The difference in the magnitude of the estimates will be used as empirical evidence for the argument.

The statistical data used for this purpose was taken from World Bank (2002). The data set contains total agricultural value added and agricultural value added per worker, which enables one to calculate productivity per workers in the sector. From this data set, a total of 22 countries, earning an annual average GNP per capita below 370 in the first half of 1970s were selected on the ground of data completeness, fifteen[3] of them from SSA - while seven[4] of them are from non-SSA. A brief description of the performances of the two subgroups is given in Table 1.

Table 1: Agricultural Productivity of Sample Countries

Indicator	Group	1970-1974	1975-1979	1980-1984	1985-1989	1990-1994	1995-1999
Productivity*	SSA	288.1	292.4	269.3	278.6	281.5	295.1
	Non-SSA	321.5	330.2	368.1	397.4	432.1	465.2
	India	267.8	276.6	293.1	314.6	354.0	388.0
	Denmark	11830.0	15513.8	22146.2	26826.0	35095.2	49583.8
Productivity Ratio**	Non-SSA	1.1	1.1	1.4	1.4	1.5	1.6
	India	0.9	0.9	1.1	1.1	1.3	1.3
	Denmark	41.1	53.1	82.2	96.3	124.7	168.0

*- Agricultural value added per worker; **- Agricultural value added per worker in indicated country to SSA group

Table 1 reports the status of agricultural labor productivity in both SSA poor and non-SSA poor economies. It indicates that in the first half of 1970s, an average farmer in SSA produces an agricultural output having value close to that of an average farmer in non-SSA poor economies. But in the second half of 1990s, roughly, it requires three of SSA average farmer to produce what two of non-Africa poor farmers produce. Thus the aim here at is to see if these discrepancies could be explained in terms of REFMF argument or not.

Using the data set used for this description, the parameter β in [3] is estimated for both subgroups by setting agricultural value added per worker as dependent variable, and agricultural labor as the independent variable. For the econometric analysis

[3] SSA Subgroup includes Malawi, Burundi, Burkina Faso, Guinea-Bissau, Chad, Mali, Nigeria, Rwanda, Kenya, Sierra Leone, Gambia, Niger, Benin, Lesotho, Dem. Rep. of Congo

[4] Non-African Subgroup includes China, Nepal, India, Bangladesh, Pakistan, Indonesia, Sri Lanka

panel data approach is employed. In forming the panel, the time series data of each country was averaged over three consecutive years and a total of ten periods were formed for each country in both subgroups. In the analysis, after taking natural logarism of [3], it was specified as One-Way Error Component Regression Model. Moreover, the superior estimate from the restricted or OLS (RM), the Fixed effect (FE), and Random Effect or GLS (RE) estimators was chosen based on appropriate statistical tests. The results for SSA subgroup were given in Table 2.

Table 2: Parameter 'β' Estimation for SSA Group
One-Way Error Component Regression Model

Estimators	Parameters	Estimate of the parameter	St. error of the parameter	T-ratio	p-value
Restricted Model OLS	*LnA*	7.1919	0.4478	16.061	0.0000
	β	-0.1137	0.0307	-3.7050	0.0003
Fixed Effect Model	*LnA*				
	β	-0.0968	0.0743	-1.303	0.1945
Random Effect Model	*LnA*	-0.1031	0.8686	-1.743	0.0814
	β	-0.1032	0.05920	8.103	0.0000
Lagrange Multiplier test of RM vs. FE/RE $\chi_{(2)}^2$**=497.48,** ***p*****=0.0000**					
Hausman test of FE vs. RE; $\chi_{(2)}^2$**=0.020,** ***p*****=0.8884**					

To choose from the given estimators, first pullability hypothesis, i.e. the appropriateness of constrained model or OLS estimator has to be tested. In other words, the hypothesis of absence of country specific effects has to be examined. With N=15 T= 10 and k = 2, a Lagrange-multiplier test for significance of country specific effects yields a χ^2-value of ***497.48, p=0.0000***. This is distributed as $\chi_{(2)}^2$ under the null hypothesis of zero country specific effects. The null is soundly rejected, and the within or the random effect model is preferred to OLS estimator. That is, the test does not support the pullability of the data set, as there are strong country specific effects.

Next, for a choice between random effects (GLS estimator) and within effect estimator a Hausman-test is performed. In fact, some writers (see for example, Aboagye and Gunjal, 2000) argue that simply fixed effect model has to be used since the sample of the countries are not random. However, the Hausman test is performed to check the validity of such argument. The basic assumption associated with random effect estimator is that there is no correlation between the regressor and country specific effects. If such assumption is violated, then the GLS estimator will be biased and inconsistent. The test gave a χ^2 value equal to ***0.020 p=0.8884***. This is distributed as $\chi_{(1)}^2$ under the null hypothesis of absence of the indicated correlation. The test

accepted strongly the null hypothesis of no correlation between the country specific effect and the regressor, which in turn imply that the GLS estimator in this case is unbiased and consistent. As a result, the preferable estimate of the parameter β for the SSA subgroup becomes β***=-0.1032***. Fixed effect estimator also gives very close estimate, which is β***=-0.0968***. Both estimators suggest that the SSA farmers have been exploiting nearly no or slightly negative FMF in the process of their production.

By the same hand, lets try to estimate the parameter, β, for Non-African subgroup. Applying the same procedure followed for SSA subgroup to the data set of the non-SSA subgroup, the results obtained are given in Table 3. In the non-SSA subgroup, like that of the SSA subgroup, One-Way Error Component Regression Model specification was employed and fixed effect estimator was found to give preferable estimate of the parameter β, which estimates the parameter to β***=0.8719***, its random effect counterpart is β***=0.6031***.

Table 3: Parameter 'β' Estimation for Non- SSA Group
One-Way Error Component Regression Model

Estimators	Parameters	Estimate of the parameter	St. error of the parameter	T-ratio	p-value
Restricted Model OLS	*LnA*	7.6699	0.6261	12.25	0.0000
	β	-0.1063	0.0359	-2.958	0.0043
Fixed Effect Model	*LnA*				
	β	0.8719	0.0765	11.402	0.0000
Random Effect Model	*LnA*	-4.6342	1.1492	-4.033	0.0001
	β	0.6031	0.0652	9.247	0.0000
Lagrange Multiplier test of RM vs. FE/RE $\chi^2_{(2)}$***=237.63, p=0.0000***					
Hausman test of FE vs. RE; $\chi^2_{(1)}$***=45.32, p=0.0000***					

Unlike the SSA this subgroup's estimate of β is significant at standard levels, ***p=0.0000***, suggesting that the productivity of the farmers in the non-SSA has been stimulated by the gains from FMF.

Next, lets try to see what is implied by the two sets of estimation. As indicated above, both subgroup were poor and were at similar stage in first half of 1970s. However, they followed different techniques of production during subsequent periods. From the econometric analysis, we understand that SSA farmers have not generated and exploited much of FMF, or, probably, managed to generate it but it was drained by some other adverse factors that nullified it, whereas in the later group the farmers were extracting much gain from FMF that has propelled labor productivity. This, confirms the hypothesis that gains from FMF was smaller or absent in the SSA

subgroup, while in the non-SSA subgroup, be it intentionally or not, has benefited significant gain from FMF that has acted as an invisible engine of productivity progress.

5 CONCLUDING REMARKS

The cause of meagerness and stagnancy of agricultural productivity in SSA, and hence delay of industrial revolution, was examined by using a somewhat different spectacle. The framework used to analyze the productivity progress was designed by taking in to consideration the problem faced by poor agents in saving part of their income, rather than assuming it away. Moreover, the framework has tried to relax the common assumption of competitive equilibrium and focused on factors of market failure. The framework suggests that poor economies can exhibit productivity progress to the extent they are able to manage and exploit FMF. They remain poor only if they lack such ability.

On this ground, the poor agricultural productivity in SSA can be well attributed to poor capacity in managing and exploiting the indicated factors. In prospect, the analytic result suggests the possibility of changing this trend, so far as the implied necessary conditions are met. Managing and exploiting factors of market failure may require developing a mechanism that encourages activities with good REFMF, and discourages those with adverse effects.

Moreover, care has to be taken so that measures taken with the objective of promoting gainful FMF will not fuel up labor unemployment. If not, possible gains from employment of unpaid factors could be counter acted or in the extreme case, outweighed by losses from paid factor unemployment. In other words, sufficient emphasis has to be given in differentiating and selecting good just “technology” from just a good “technology”.

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