

ROLE OF AGRICULTURAL MODERNIZATION: ECONOMIC DEVELOPMENT

CĂTĂLIN ILIE¹, LIVIU SĂMBOTIN¹, ANA MARIA DINCU¹, CARMEN DUMITRESCU¹,
CLAUDIA LEPĂDATU², LIDIA GIURICIN²

¹ Faculty of Agricultural Management, Banat's University of Agricultural Sciences and
Veterinary Medicine Timișoara

² Agricultural Economics and Rural Development Institute București
tm9tma@yahoo.com

ABSTRACT - Role of agricultural modernization: Economic development

In earlier debates on economic development, the agricultural sector's role was somewhat controversial. While dualistic models highlighted the importance of agriculture the mainstream literature placed a greater emphasis on the creation of a modern industrial sector. Soon agriculture disappeared from the mainstream development literature to re-emerge recently with a variety of multiple-sector growth models emphasizing the key role of agriculture. This paper is an empirical cross-country analysis of agriculture's role in economic development. The focus is the importance of agricultural modernization as a precondition for convergence in postwar growth rates as well as an indicator for overall growth and wellbeing.

Keywords: agriculture, modernization, convergence, growth, well-being

Rolul modernizării agriculturii: dezvoltarea economic

În dezbaterile anterior cu privire la dezvoltarea economic, rolul sectorului agricol a fost oarecum controversat. În timp ce modelele dualiste au subliniat importanța agriculturii, literatura de specialitate a pus un accent mai mare pe crearea unui sector industrial modern. Astfel agricultura a dispărut din literature de specialitate cu privire la dezvoltare pentru a reapărea recent cu o varietate de modele de creștere cu sectoare multiple subliniind rolul cheie al agriculturii. Această lucrare este o analiză empirică transnațională a rolului agriculturii în dezvoltarea economic. Accentual este importanța modernizării agriculturii ca și o condiție pentru convergența ratelor de creștere ca și indicator al creșterii și bunăstării generale.

Cuvinte cheie: agricultură, modernizare, convergență, creștere, bunăstare

Initially development economics concentrated on questions concerning the industrialization process. The main questions had to do with how to modernize through overcoming the constraints of traditional society. The latter was often linked with agriculture and rural people, commonly called peasant agriculture. This sector was generally thought to act as a drag on the development process. Thus tradition and peasant farming were obstacles, systems which had to be reduced and eventually eliminated if modernization was to succeed.

Dualistic models also directly modeled traditional agriculture in the long-run growth process. In these models the conclusion often implied that the long-run growth process must be a balanced one with agricultural productivity a necessary condition for eventual industrial/manufacturing growth. In other words, if productivity in agriculture remained stagnant, the development of a modern manufacturing sector would be limited.

¹ Faculty of Agricultural Management, Banat's University of Agricultural Sciences and Veterinary Medicine Timișoara

² Agricultural Economics and Rural Development Institute București

Throughout much of the 1980s and 1990s much of the analysis of the role/contribution of agriculture was carried out by agricultural economists. Much of this work concentrated on technological innovation in agriculture, the institutional structure necessary to foster technical innovation, etc. However, in terms of long-run growth models, agriculture disappeared. This sector and its role were, for the most part, ignored in models of long-run growth emphasizing industrialization and manufacturing.

Recently, however, one finds a re-emergence of interest in agriculture. Agriculture has been increasingly incorporated into models of long-run growth. The argument in most of these models is that agriculture and the productivity of agriculture is the key to understanding the timing of the shift from an agrarian based to an industrially based society. In addition, some non-traditional roles have been attributed to agriculture in the development process.

Given the literature referred to above on the importance of agriculture in the development process, the hypothesis in this paper concerning agriculture is that high productivity in this sector is a necessary precondition for industrial growth. The implication of such a hypothesis would be that countries which did not have this precondition would not grow as fast as those that did. Therefore, economic convergence, when poorer countries grow faster than richer countries leading to a convergence in growth rates and standards of living, is not likely to occur for countries within which agricultural productivity is historically low. The existing convergence literature indicates very little support for the idea that unconditional convergence occurs. This paper begins by testing for unconditional convergence utilizing a postwar cross-section of countries. If such convergence is found not to exist, the next step is to test whether convergence requires a precondition of agricultural modernization which is presumed to imply high productivity. Once that proposition is established, an attempt is made to test how robust this connection between agricultural preconditions and long-term growth is. Finally, the non-traditional views of the role of agriculture in development, which indicate that agricultural productivity should be significant in determining levels of human development, are tested by utilizing the human development index, which incorporates measures of life span, education.

Before going into the details of the paper it needs to be clarified that the importance of agricultural sector is not calculated as a traditional productivity measure by measuring units of agricultural output per unit of labor or land or based on some index of inputs. One reason for this is such measures of agricultural productivity are not available for a number of countries for the time period covered in this paper. Thus a different and unique perspective on agricultural productivity is introduced here. Here the importance of agriculture is measured by the amount of investment made on land to modernize it and thereby make it productive. Theoretically this may be more appropriate than the traditional measures. This is due to the fact that agricultural productivity could be high because a particular nation is well endowed with natural resources.

High productivity, in this situation, will likely decline with depletion of natural resources unless some steps are taken to maintain this productivity. On the other hand, it is being hypothesized here that countries which made some effort towards improving or maintaining their agricultural productivity by investing in it and modernizing the agricultural sector would most likely be the ones who would continue to reap the benefits from increased agricultural productivity. In other words, this paper measures *effort* or *investment* rather than *potential* for agricultural productivity. For the above reasons the focus in this paper is the importance of agricultural modernization for economic growth and well-being.

Much of the early thinking on economic development ignored agriculture altogether. For example, Rosenstein-Rodan's (1943) early work concentrated on manufacturing and industry. He argued that the piecemeal establishment of manufacturing in poor regions lacking infrastructure would not likely be successful. Instead, investment in industry and manufacturing had to be on a broad front such that various industries could create markets for each other's products.

Perhaps the best known of these early theories was that developed by Hirschman (1958). He argued that industries or production processes were characterized by backward and forward linkages depending upon whether production of the industry stimulated the expansion of suppliers of inputs or the processors of output. Some industries possessed strong backward and forward linkages and thus if established would likely stimulate strong growth around it. However, agriculture's linkages were mainly of the forward variety and not very strong. Thus the expansion of agriculture was not likely to stimulate further development.

There were a set of theories which, however, did see a role in the development process for agriculture. These were dualistic theories of development constructed by Lewis (1954), Ranis and Fei (1961), and Jorgenson (1961). These theories divided the less developed economy into the traditional and modern sector. The modern sector was driven by profit maximization and the accumulation of physical capital. The traditional sector was subsistence oriented and usually thought to be dominated by peasant agricultural production. This sector was characterized by output sharing mechanisms rather than profit maximization.

In many of these models it was presumed that the traditional sector was characterized by surplus labor. That is, there was so much labor in this sector that it could be withdrawn and put to productive work in the modern sector without any fall in output in the traditional sector. In effect, "free growth" was possible through mobilization of labor for modern production. However, once surplus labor was exhausted, then the expansion of the modern sector might very well be strangled. Continued withdrawal of labor would lead to falling output in the traditional sector leading to a rise in the relative price of the traditional sector output relative to that in the modern sector. If the traditional sector produces mainly food, the rising relative cost of food would push up wages to the modern sector, cutting into profits, reducing investment and the expansion of this sector. The growth process would likely grind to a halt. Thus overall growth was dependent upon a balanced expansion of both sectors with neither racing too far ahead of the other. This would keep the relative cost of food low, maintain profits in the modern sector, and spur modern sector investment.

Johnston and Mellor (1961) built upon these ideas in their analysis of the role of agriculture in overall economic development. They argued that agriculture supplied the labor necessary to man the modern sector firms as well as the food necessary to feed that labor. In addition, the agricultural sector was seen as serving as a market for the produce of the modern sector, a stimulus from the demand side. Finally, perhaps most importantly, agriculture was likely to serve as the main source of savings necessary to finance the expansion of the modern sector.

After these developments, agriculture disappeared from general models aimed at analyzing economic growth and development. Instead, much of the literature concerned with agriculture concentrated on analyzing productivity growth in the traditional, agricultural sector. Perhaps the most interesting and innovative work in this area has been undertaken by Hayami and Ruttan (1985). They developed a theory of induced innovation. From this perspective, technology can be divided into two broad categories, mechanical and biochemical. Changes in the relative price of inputs induce farmers to search for



technologies that substitute for the increasingly scarce factor. Because biochemical technologies are subject to problems stemming from non-excludability of the benefits, a public institutional structure must be established to provide biochemical technologies. In regions where labor and fertilizer are relatively cheap and land is becoming relatively scarce, the public institutional structure will respond to the needs of farmers by developing techniques of production which are land saving (biochemical).

As one can see, this literature was not so much concerned with agriculture's role in the growth process, instead it was concerned with the process by which agricultural productivity increases. These ideas were indeed powerful, but the modeling of the growth process tended to neglect agriculture and thus obscure its role in the process of development.

Recently, multiple sector growth models have begun to be constructed with agricultural sectors. Matsuyama (1991) developed an endogenous, two sector growth model. In this model the engine of growth, the driving force, was learning by doing in the manufacturing sector. He compared and contrasted the implications of a closed and open economy model. In the closed economy case, an increase in agricultural productivity spurs overall economic growth since this eases the expansion of learning by doing via manufacturing. However, in the open economy case there is a negative link between agricultural productivity and overall growth. This occurs because the more productive the agricultural sector is, the more resources that are devoted to agriculture based on comparative advantage. This, of course, implies less manufacturing, less learning by doing, and less growth.

The results from Matsuyama's model are of course based on assuming that all learning by doing occurs in manufacturing, none in agriculture. However, learning by doing in manufacturing could enhance productivity in agriculture and perhaps vice versa. More generally, the model's results stem from the assumption that agriculture is, by nature, incapable of sustaining rapid productivity growth. Thus it is inevitable that higher initial productivity in agriculture (exogenously determined) would lower long-run growth.

This idea that productivity growth is slow in agriculture is actually contradicted by empirical analysis. Martin and Mitra (2001) utilize a panel data set for approximately 50 countries over the period 1967-1992 to analyze this issue. They found that at all levels of development technical progress appears to have been faster in agriculture than in manufacturing. In addition, "there is strong evidence of convergence in levels and growth rates of TFP in agriculture, suggesting relatively rapid international dissemination of innovation" (p.417). These results suggest that a large agricultural sector need not be a disadvantage in the overall growth process. It may likely be an advantage if productivity growth is rapid. Thus contrary to the assumption made by Matsuyama, the agricultural sector has significant prospects for rapid productivity growth.

Theorists have now begun to explicitly model the agricultural sector in multiple sector growth models. A recent example of this is provided by the work of Gollin, Parente, and Rogerson (2002). They extend the neoclassical model so as to incorporate an agricultural sector. They attempt to model the structural transformation that comes with development (agriculture shrinking, manufacturing expanding). The intuition of the model can be summarized as follows. Agricultural output per person must reach a certain level before modern technology will be applied to agricultural production and labor can flow out of agriculture and into industry. The rate at which labor can then flow out is determined by the rate of technological change in agriculture. Low agricultural productivity can thus substantially delay the onset of industrialization.

Another example of a long-run growth model that directly incorporates agriculture is the work of Olsson and Hibbs (forthcoming). They have constructed a stages growth

model within which societies progress through hunting and gathering, sedentary agriculture, and industrial production. The main focus of the model is that those regions that were initially well endowed biologically and geographically are those regions which progress through to the industrial stage the quickest. In this model, the intermediary stage is sedentary agriculture and it is productivity increases leading to surpluses in this sector that allow for the creation of new knowledge. When knowledge reaches a certain threshold level, the development of industry occurs, i.e., industrial revolution.

These are just a few examples of a developing literature seeking to incorporate agricultural sectors into growth models. Other research has examined new links between agriculture and the growth of the rest of the economy. One can think of these new links as representing non-traditional roles for agriculture. Timmer (1995) argues that agriculture plays a significant role in reducing poverty. The bulk of the poor reside in rural areas so an increase in growth in agriculture has a significant potential for reducing such poverty. In addition, agricultural growth stimulates the development of agribusiness activities as well as stimulating the demand for manufactured inputs. Stringer (2001) further argues that the agricultural sector performs important social welfare functions in developing nations. For example, during an economic downturn or an external income shock or financial crisis, agriculture can act "as a buffer, safety net, and as an economic stabilizer" (p.7). The flexibility of the production process allows for labor to be substituted for capital thus cushioning economic blows. Thus people frequently return to the farm during bad times.

Given the analysis above, several questions suggest themselves. First, does absolute economic convergence occur and, if not, is convergence conditional upon agricultural productivity? In other words, is increased agricultural productivity a condition for economic convergence? Second, if so, is the modernization of agriculture an important determinant of overall growth? Is this effect robust to the inclusion of other variables? Third, given the non-traditional roles for agriculture, does agricultural modernization have a significant impact on human development? Is this impact robust to the inclusion of other variables? The methodology and data that will be utilized to address these questions is discussed in the following section.

Most studies have found very little evidence in support of absolute convergence. However, there is a substantial literature that conditional convergence does occur. That is, once one accounts for specific variables that influence the long-run, steady state equilibrium, convergence may still be found (convergence to different equilibria). Another way to think of this is that there are certain preconditions that must occur before convergence takes place. It is hypothesized that productive agricultural sectors are a necessary precondition for economic convergence.

Another way of testing the same hypothesis is to divide the sample countries into two groups, those with above average and those with below average fertilizer intensity in 1965. One would hypothesize absolute convergence for those countries above the average for fertilizer intensity and divergence or no trend for those with below average fertilizer intensity.

The discussion of the previous section indicated that agriculture is likely to play an important role in terms of providing a safety net for a society lacking formal programs aimed at social welfare. Under such assumption one would expect that the level of human development would also be influenced by agricultural modernization.

That is, countries that were rich in 1960 grew relatively richer and countries that were poor in 1960 grew relatively poorer over time.

It was further hypothesized in the previous section that countries with better initial agricultural precondition are most likely to be the countries which grow faster. That is, one

should find convergence between countries that have the necessary agricultural precondition.

If agricultural precondition is found to be necessary for conditional convergence to take place it can be inferred that one can then expect to find absolute convergence between countries with high agricultural productivity but not so among those with low agricultural productivity. Accordingly the sample of countries is subdivided into those with above-average agricultural productivity (in this case above average fertilizer intensity in 1965) and those below. It is found that 16 countries fall in the above-average agricultural productivity group and the rest fall under.

The evidence so far points to affirmation of the hypothesis made in this paper, that is, agricultural preconditions are necessary for long-run economic growth.

REFERENCES

- Bockstette, V., Areendam Chanda, Louis Putterman, "States and Markets: The Advantage of an Early Start," *Journal of Economic Growth* 7 (December 2002), pp. 347-369.
- John and Gustav Rams, "a Theory of Economic Development," *American Economic Review* 51 (September 1961), pp. 533-565.
- Gollin, Douglas, Stephen Parente, Richard Rogerson, "The Role of Agriculture in Development," *American Economic Review* 92 (May 2002), pp. 160-164.
- Johnston, Bruce and John Mellor, "The Role of Agriculture in Economic Development," *American Economic Review* 51 (1961), pp. 566-593.
- Jorgenson, Dale, "The Development of a Dual Economy," *Economic Journal* (June 1961), pp. 209-334.
- Lewis, W. Arthur, "Economic Development with Unlimited Supplies of Labour," *The Manchester School* 22 (May 1954), pp. 139-191.
- Martin, Will - Devashish Mitra, "Productivity Growth and Convergence in Agriculture And Manufacturing," *Economic Development and Cultural Change* 49 (January 2001), pp. 403-422.
- Matsuyama, Kiminori, "Increasing Returns, Industrialization, and Indeterminacy of Equilibrium," *Quarterly Journal of Economics* 106 (May 1991), pp. 617-650.
- Olsson, Ola - Douglas Hibbs: "Biogeography and Long-Run Economic Development,"
- Sambotin Liviu Management Agrar Timisoara 2008