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Sectoral Productivity Growth and Poverty Reduction: National and Global Impacts

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Summary. — This paper examines the implications of productivity improvements in agriculture, industry, and services for global poverty. We find that, in poor countries, increases in agricultural productivity generally have a larger poverty-reduction effect than increases in industry or services. This differential declines as average incomes rise, partly because agriculture becomes smaller as a share of the economy, and partly because agricultural productivity growth becomes less effective in reducing poverty. The source of the poverty-reduction benefits from agricultural productivity growth changes as innovations are more widely adopted—moving from increases in producer returns to reductions in consumer prices.

Key words — total factor productivity, poverty, decomposition, sectoral growth, transformation

1. INTRODUCTION

A large body of research has demonstrated that the impacts of economic growth on poverty reduction depend heavily upon the sector in which the growth occurs. In particular, many studies (such as Ravallion & Datt, 1996) have found growth in rural areas to be associated with much more rapid reduction in poverty than economic growth in urban areas. This seems plausible given the generally much higher poverty rates in rural than in urban areas. However, if it is to be used as a basis for policy, it is important to understand the channels of effect so that policies can most effectively be targeted to promoting growth and poverty reduction.

Loayza and Raddatz (2010) make an important contribution by showing that the impact on poverty depends importantly upon the labor intensity of different sectors (e.g., agriculture, construction and services). In addition to this supply-side linkage, other studies have noted that widespread agricultural productivity growth may have important impacts by reducing the cost of food to poor consumers in closed economies or for the world as a whole (eg Dercon, 2009). On the other hand, Christiaensen, Demery, and Kuhl (2011) and Himanshu, Murgai, and Stern (2013) have concluded that the role of the non-agricultural sector in poverty reduction has increased, raising important questions about whether agriculture retains its traditionally central importance for poverty reduction.

Much of the available analysis of linkages between the sectoral composition of growth and poverty reduction outcomes has used econometric approaches. This has important advantages because it allows hypotheses to be tested against real-world data and confidence estimates to be assigned to parameter estimates. It also allows possible alternative channels of effect to be assessed and compared. Ravallion and Datt (1996), for example, found using econometric approaches that movement between sectors was less important for poverty reduction than growth rates within sectors.

Econometric approaches, however, face many challenges. The rate of output growth in each sector is clearly strongly endogenous, depending upon factors such as productivity growth rates, and yet it is common to use the output growth rate as an explanatory variable. While tests and potential solutions for endogeneity bias are widely used, the effectiveness of these approaches is uncertain given our inability to perform randomized control trials. It is also difficult to use econometric approaches to separate the direct impacts of productivity change through changes in producer incomes at a given commodity price, and those resulting from indirect impacts such as productivity-induced changes in wage rates and/or changes in commodity prices.

To complement the available econometric assessments and to allow assessments of global poverty impacts, we develop a framework that links a global Computable General Equilibrium (CGE) model with models for 315,000 households from 31 countries. This allows us to assess the poverty impacts of specific productivity shocks, and to take into account whether they apply just to one country or more broadly. This approach is based on rigorous use of economic theory and data on the structure of each economy and on patterns of international trade. For many of the questions that we consider—such as the impacts of changes in productivity—the key determinants of our results are actually the shares of income from different sources, and the shares of expenditure on different goods, rather than elasticity parameters. The key parameters used—such as the elasticities of substitution between factor inputs, elasticities of consumer demand, and Armington elasticities of substitution between domestic and imported goods from different sources—are based on the econometric literature.

While one must always be aware of the potential limitations of using a simulation approach when the true structure generating the outcomes of interest is unknown, we are reassured by Kehoe's (2005) conclusion that simulation models are better suited to modeling productivity shocks than shocks such as trade reforms whose primary impact operates through price changes. Where results are available from both econometric studies and simulation models, and are broadly comparable, we can increase our confidence in both types of model. In this case, the ability of the simulation framework to compare different scenarios, such as technical change in a single, small economy facing fixed prices relative to the same change in a large set of countries, provides valuable additional insights.

Where the results from simulation and econometric studies are not consistent, further analysis is needed to try to understand the differences.

Key questions addressed in this paper include: what is the relative effectiveness of productivity growth in agriculture, manufacturing and services in reducing poverty? In which countries do productivity increases have major impacts on global poverty? How are urban and rural poverty rates affected by productivity growth in different sectors? What are the sources of change in poverty rates? In the next section of this paper, we consider the specification of productivity changes, the impacts of productivity change on the prices of goods and factors, and the linkages between productivity growth and poverty. Then, in the third section, we consider the data and methodology used for the analysis. In the fourth section, we present and discuss key results. The final section presents conclusions.

2. SPECIFYING PRODUCTIVITY CHANGE

The first step in the causal chain from productivity to poverty is to identify the nature of the productivity growth under consideration. Uniform productivity growth [1] in all sectors is a special case and we consider scenarios in which productivity grows only in agriculture, in industry, or in services. Many different types of productivity growth might be considered, including productivity growth that augments different factors to different extents; [2] productivity growth that saves on intermediate inputs as well as on factors. Productivity growth may also be specific to particular geographical areas (this is frequently especially obvious in agriculture) or to particular types of firms. In this initial analysis, we focus on changes that augment all factors equally in production of a particular commodity. This lets us identify differences in poverty impacts that result from the two channels of effect identified in the literature—those resulting from differences in impacts on the earnings of the poor and on their cost of living.

Changes in productivity affect low-income households in three basic ways: (i) through changes in the productivity of the factors they employ in businesses, such as farms or service enterprises, that they operate; (ii) through changes in the prices of goods and services that they consume; and (iii) through changes in the factor returns (and particularly wages) that they receive from factors they sell outside their family-owned businesses.

Because of our concern about impacts on prices of goods and factors, we need a specification of productivity growth that takes into account all of the channels through which changes in productivity growth influence output. Obviously, improvements in productivity increase output directly by increasing the amount of output from any given level of inputs. However, another important channel of influence on output is through induced increases in profitability, for given input and output prices, that draw additional resources from competing activities. One way to capture both of these impacts of technological change is with the distinction between actual and effective units used in macroeconomics (Obstfeld & Rogoff, 1996, p431), in computable general equilibrium modeling (Dixon, 1982) and in the analysis of agricultural productivity growth (Martin & Alston, 1997). As we will see, this approach has the advantage of allowing a simple, graphical interpretation of the impacts of productivity change, as well as allowing a rigorous accounting for the full effects of productivity changes in technologies with multiple inputs and outputs.

With this approach, production can be represented using an unchanging profit function expressed in effective units of output and prices. From the point of view of the firm, quantity q^* of effective output now translates into a larger quantity, q, of output, where $q = q^*\tau$. The improvement in productivity also results in an increase in the effective price of output at any actual price, where the effective price is defined as $p^* = p\tau$. A quadratic profit function in effective prices provides a second-order approximation to any underlying technology and helps explain the impacts of this type of technical change:

$$\Pi = \alpha_0 + \alpha' p^* + \frac{1}{2} p^{*\prime} A p^* \qquad (1)$$

where Π is the potential net return at current factor prices, p^* is as defined above and the α and A terms are coefficients.

Differentiating (1) with respect to the effective price yields a supply curve for the effective output of a particular sector.

$$q_i^* = \alpha_i + \sum_{ij} A_{ij} p_j^* \qquad (2)$$

or

$$q_i = \tau_i \left(\alpha_i + \sum_{ij} A_{ij} p_j \tau_j \right) \qquad (3)$$

Eqn. (3) can be depicted in actual price and quantity space as in Figure 1. As shown in this figure, productivity change has two effects on output at any given actual price. The first effect is an increase in output at any given input level associated with the τ_i term outside the parentheses in Eqn. (3). It increases output in the positive quadrant, and corresponds to the move from S_1 to S_2 in Figure 1. The second effect arises from the increase in profitability created by higher productivity, and is associated with the τ_i term within the parentheses on the right side of Eqn. (3). It changes the output (or input demand at points to the left of the vertical axis) at all prices above zero, and hence corresponds to the move from S_0 to S_1 in Figure 1. Note that this effect lowers the cutoff price at which positive quantities of output will be produced. As is clear from Eqn. (3), the move from S_1 to S_2 is a proportional change in output (from e to g in Figure 1) that is independent of the slope of the supply curve. By contrast, the increase in output associated with the rise in effective price (from f to e in Figure 1) depends upon the slope of the supply curve as well as the size of the technological change.

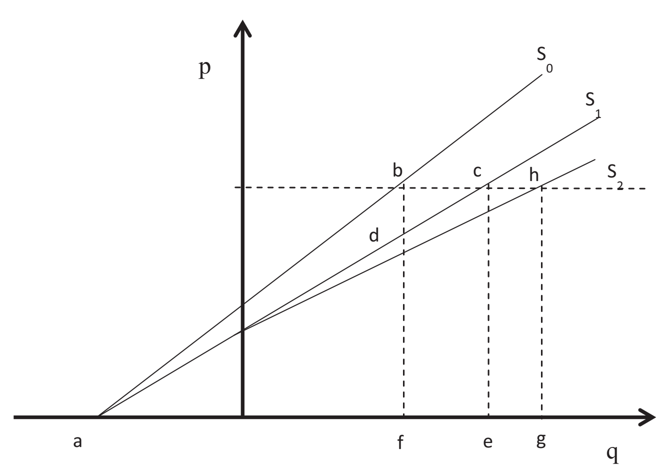

Figure 1. *Impacts on output of an increase in productivity.*

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