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The Growth-Poverty Convergence Agenda

Optimizing Social Expenditures to Maximize Their Impact on Agricultural Labor Productivity, Growth, and Poverty Reduction in Africa

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Contents

List of Tables

List of Figures

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ABSTRACT

The need to achieve the Millennium Development Goals (MDGs) has raised the profile of social sector investments in Africa and other developing countries. As a result, many African countries are pressured to emphasize short-term concerns related to the symptoms of poverty at the expense of the longer-term needs to raise productivity and incomes, and thereby tackle the real roots of poverty. Because of scarce budget resources, there is a major challenge for African governments in terms of ensuring the necessary consistency of policies and strategies to promote long-term economic growth, raise smallholder productivity, achieve food security, and reduce poverty, while providing the social services that respond to immediate welfare requirements. The main objective of the convergence agenda exposed in this paper is to identify strategies that would allow developing countries to improve the management of public expenditures so as to raise the chances of meeting the income growth and social needs of their populations under tight budget constraints. In this paper we have (1) discussed the terminology used in describing the problem being studied and formulated the assumptions and hypotheses underlying the research; (2) defined a typology of growth–poverty pathways; (3) developed metrics to measure the strength of the relationship between growth and poverty reduction; (4) laid out the theory for the measurement of the degree of convergence of public expenditures on social services, that is, the extent to which they are optimized with respect to their impact on labor productivity and growth; and (5) outlined models for (a) the quantification of social services availability at the local level using a single-score concept, (b) the evaluation of the quality and efficiency of public expenditures in social services sectors in rural areas, and (c) the optimization of public expenditures allocation to maximize the impact on growth and poverty reduction; as well as (6) provided initial evidence proving the validity of the theory of convergence.

Keywords: Poverty, expenditure, social services, convergence, agriculture, poverty overhang, growth deficit

1. INTRODUCTION

African countries have long struggled with the need to improve the agricultural sector development strategy formulation and implementation that the Comprehensive Africa Agriculture Development Programme (CAADP) agenda calls for. The international political economy and domestic macroeconomic policy trends of the last one and a half decades have only added to this challenge. Following the reform of interventionist policies and the disengagement of the public sector, many African governments are still searching for the right tools and approaches to enable them to play their role with respect to promoting agricultural growth and rural development. At the same time, the progressive shift in development assistance strategies toward budget support and sectorwide programs has given rise to a greater albeit new role of government and increased the burden on the public sector in terms of adequate strategy and policy planning and implementation. On the other hand, stronger attention paid by the global community to poverty and its symptoms, as reflected in the Millennium Development Goals (MDGs), has raised the profile of social sector investments in Africa and the rest of the developing world. Such developments create major difficulties for African governments in terms of ensuring the necessary consistency of policies and strategies to promote long-term economic growth, raise smallholder productivity, achieve food security, and reduce poverty, while providing the social services that respond to immediate welfare requirements. There are strong pressures to emphasize short-term concerns related to the symptoms of poverty at the expense of the longer-term needs to raise productivity and incomes, and thereby tackle the real roots of poverty and food and nutrition security. The related trade-offs and synergies are complicated and made even more complex by the sequencing and threshold issues that may be involved. Sequencing and thresholds refer to the conditions under which (i) social investments should lead or follow productive investments and (ii) minimum level of investments required on both sides for such synergies to take place.

From the point of view of African governments, the basic question resulting from the above challenge becomes one of allocating public resources efficiently and effectively to realize, in a sustainable way, a country's economic, social, and environmental goals. In particular, governments are constantly struggling with the determination of the share of government budgets that should be spent on social services, such as health, education, and social safety nets, and the share that should go to activities that aim more directly at improving productivity growth, such as adaptive research, information generation and dissemination, market development, and infrastructure.

The issue here is not just that factors determining the outcome may have little to do with economic efficiency and long-term growth and poverty reduction. It is also the lack of a good understanding of the synergies, trade-offs, sequencing, and threshold issues referred to earlier. It is, for instance, that lack of understanding and the pressure to address urgent social needs that tend to create the biases observed in the first generation of poverty reduction strategy papers and the related budget-based support programs. Such biases systematically tend to increase the provision of social services and decrease more immediate productivity-enhancing investments for the poor. The former are easier to measure and monitor and are expected to affect welfare with little delay, whereas the latter are less obvious, harder to measure, and have longer lead times. There is a particular risk that the above trade-offs will be amplified as external assistance is increasingly harmonized and aligned behind budget support directed at programs rather than projects. Governments often face overwhelming pressure to deal with poverty through transfers. This biases expenditures and programs toward social services provision since the activities involved are (1) more visible and easier for donor organizations and national governments to justify, and (2) predominantly public-sector driven and typically simpler to design and implement.

To imagine and expect a reversal of the bias, however, would be unrealistic and nonpragmatic. The social needs are real and have to be addressed. As long as countries have to operate under tight budget constraints, the only option that remains is to devise strategies that maximize the contribution of social services to labor productivity in agriculture and the rural economy. As argued later in this paper, the question being raised is not only with regard to the level of investment in social services and their

known long-term impact on productivity. It is also about maximizing their impact through optimal allocation of expenditures across subtypes of services within a given social sector, say health, education, or social safety nets.

Researchers and policy analysts can begin to address the above trade-offs and limit their eventual implications by (1) understanding the options available with respect to the exploitation of the synergies between social services and productive investments, (2) devising effective strategies to reflect such synergies and trade-offs in the allocation of public resources, and (3) providing insights as to how they might best be incorporated into policy formulation. Among other things, this will require an appreciation of how development strategies and the policies derived from them are influenced by differences in stakeholder interests and priorities.

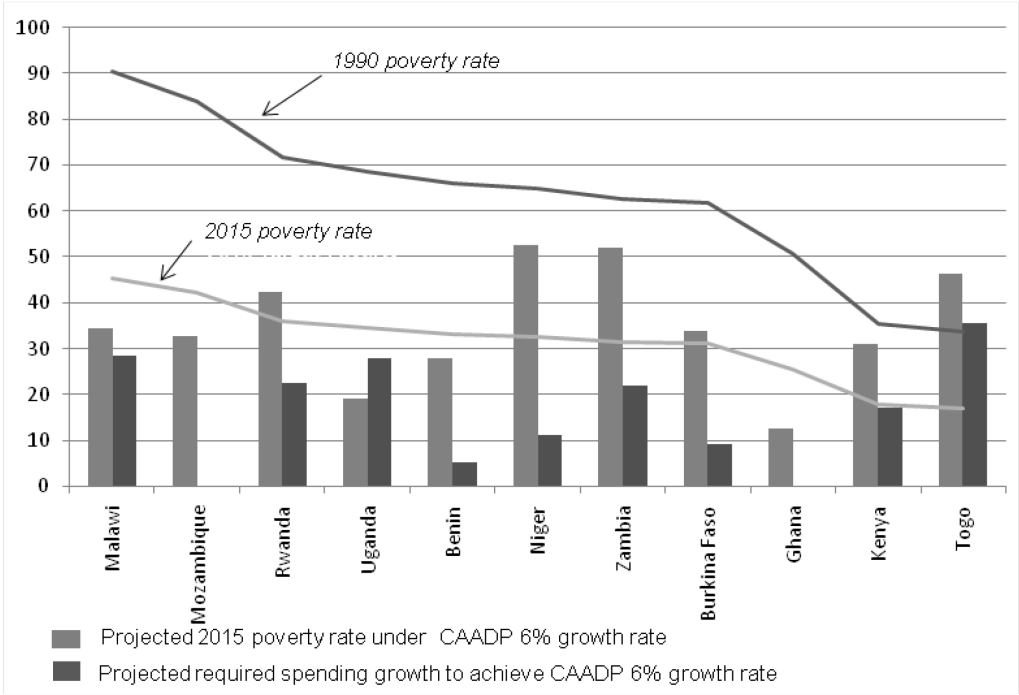
The overall objective of the present paper is therefore to identify strategies that would allow developing countries to improve the management of public expenditures so as to raise the chances of meeting the income growth and social needs of their populations under tight budget constraints. The related specific objectives are to find answers to the following, underlying strategic research questions: (a) how to maximize long-term growth while meeting the short-term social services needs to the maximum possible; (b) how to maximize the synergies between social services and direct productivity-enhancing investments in the short and long run; (c) how to fully exploit the growth externalities of investments in social services; and (d) how to improve the consideration of intersectoral growth synergies in budget planning and negotiations.

2. PUBLIC EXPENDITURE, CONVERGENCE, AND THE REALIZATION OF THE MILLENNIUM DEVELOPMENT GOALS

Trends toward the MDG Poverty Target: Progress and Prospects

As a consequence of more than two decades of economic stagnation starting in the early 1970s, the majority of African countries are still far behind the MDG 1 target poverty rates, despite the remarkable agricultural and overall economic growth of the last 10 years.[1] More important, for nearly all African countries, achieving the MDG target of halving poverty below the 1990 levels still leaves a significantly large number of poor and vulnerable (see Figure 2.1). That population lives primarily in rural areas but increasingly also in urban centers.

Figure 2.1. MDG poverty outcomes and CAADP growth targets



Source: Simulation of poverty and spending levels by the IFPRI CAADP team. Baseline poverty rates and MDG targets are based on World Bank's PovcalNet 2008, except for Malawi, Mozambique, Rwanda, and Togo, where diverging national baseline data are used.

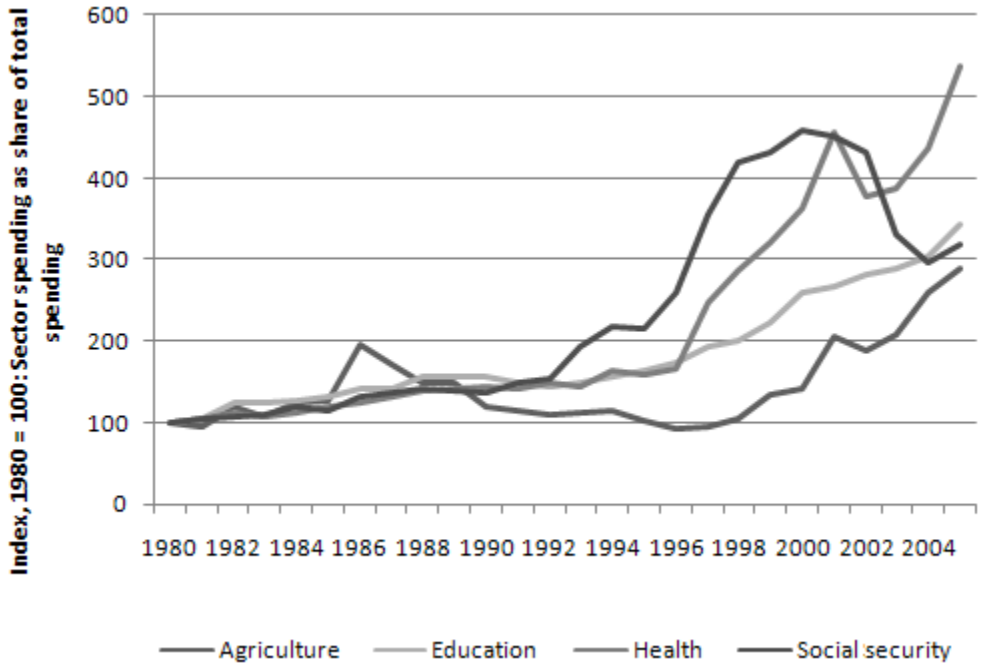
Furthermore, Figure 2.1 reports simulations by IFPRI's CAADP team that suggest that if all African countries were to meet the declared 6 percent agricultural growth rate under CAADP, several would make significant progress but still fail to achieve the MDG poverty target. The simulations also indicate that double-digit expenditure growth rates in the agricultural sector, in some cases more than 20 percent annually, would be required for a decade to achieve the above CAADP growth target. For African countries as a whole, Fan et al. (2008) estimate that an average agricultural growth rate of 7.5 percent would be required. The associated annual agricultural spending requirement is estimated at US$30–40 billion.[2]

[1] See Fan et al. 2008 and Badiane 2008.
[2] U.S. 2000 dollars.

Investing in Growth and Financing Growing Social Needs: Trends and Prospects

The strong economic and agricultural sector growth recovery over the last 10 years has not compensated for the long period of decline during most of the last two decades of the twentieth century. The majority of African countries, therefore, will find it impossible to achieve the hunger and poverty MDG by 2015. Some may not even get there within a decade past that deadline. The progress has been slow in many cases, and some countries have even experienced increasing hunger and poverty rates. As indicated earlier, African governments increasingly find themselves in the difficult situation of having to meet the rising costs of social services to mitigate the immediate impact of poverty and, at the same time, raise investments to boost and broaden growth so as to reduce the prevalence of poverty in the future. They try to achieve this, in many instances, under extremely tight budgetary conditions. As a consequence, and due to the strong pressures to address the acute social needs, governments are spending an ever-increasing share of their scarce resources on meeting such needs at the expense of investing in productive sectors such as agriculture. These trends are illustrated in Figure 2.2. After lagging for the entire decade of the nineties, agricultural spending has inched up a bit in the beginning of the new decade. It still makes up a fraction of combined expenditures in social sectors. These trends are untenable as they (a) reduce the pace of overall economic growth and thus perpetuate the prevalence of poverty, while (b) reducing the economy's capacity to generate the necessary resources to combat the impact of poverty on an increasing number of poor people.

Figure 2.2. Trends in social expenditures in African countries



Source: Government spending: Global database on public spending, Development Strategy and Governance Division, IFPRI, 2009.

Accelerating Broad-Based Growth under Tight Budget Constraint and Large-Scale Poverty in Rural Areas

The analysis of growth, poverty, and funding trends and prospects in the preceding two sections can be summarized as follows:

1. Agriculture remains the strongest contributor to rapid and broad-based poverty reduction among African countries.
2. By meeting the CAADP annual growth rate of 6 percent for the agricultural sector, African countries would considerably raise their chances of achieving the MDG poverty target, or at least make significant strides in that direction.
3. The same countries would have to raise and sustain spending in the sector quite vigorously over a decade in order to achieve the above growth target.
4. The current and prospective budgetary conditions in most of these countries will make it extremely difficult, if not impossible, to meet the future funding requirement for faster agricultural growth and poverty reduction, while at the same time meeting the increasing short-term social needs of large groups of poor and vulnerable.

The following two fundamental conclusions can be drawn from the above analysis:

1. Continued attempts by African countries to pursue the growth and social goals separately, and thus manage public expenditures without sufficient consideration of the synergies involved, will fail to achieve either.
2. A more viable strategy to deal with the budget constraints and trade-offs implied above is to plan and execute, in the most efficient way, social services investments so as to maximize their impact on long-term growth.

The convention is to look at social services from an entitlement point of view, with a primary objective of meeting people's welfare needs. Part of that convention is to treat social services as homogeneous and think about the impact on growth only as a function of the level of spending and efficiency of delivery. A key hypothesis of the suggested research is that (1) social services are composite bundles of a variety of subservices, and (2) the composition of these services, because they affect labor productivity differently, is not growth-neutral. In other words, health, education, and social safety net services consist of various types of services with different impacts on long-term productivity. The proposition here is to approach the analysis of the nexus between social services and growth in a manner similar to what has been done for infrastructure. When analyzing the impact of infrastructure on growth, it is an established convention to treat the various types of infrastructure—highways, main roads, tracks, trails, and so forth—distinctly as well as to consider the implication of their complementarities and geographic location.

The contribution of the convergence agenda does not reside in the technicality of the proposed research but rather in the search for practical strategies for resource-constrained countries to optimize synergies between social services provision and productivity-enhancing investments in the agricultural sector so as to maximize the long-term poverty and growth outcomes of public expenditures in rural areas. Moreover, by identifying the above synergies, it becomes possible for governments to approach budget allocations between sectors from a win-win rather than a win-lose angle. For instance, the ministry of agriculture would no longer consider budgetary resources going to social ministries as lost to agriculture. In turn, the latter would be more conscientious about the specific contribution of their programs to agriculture beyond the broader social targets in rural areas.

The importance of the issues raised here and the relevance of the research questions and expected findings outlined above have been confirmed by participants at an international conference on the same topic that was organized by IFPRI and the African Centre for Food Security, University of KwaZulu

Natal in January 2008 and attended by scientists as well as policymakers from several African countries. It is worth noting that the research issues we raise in this paper speak directly not only to the hunger and poverty MDG, but also to the MDGs on child and maternal health, gender equality, and education, among others. All these objectives would greatly benefit from improved optimization of public expenditures in the social and productive sectors of the economy.

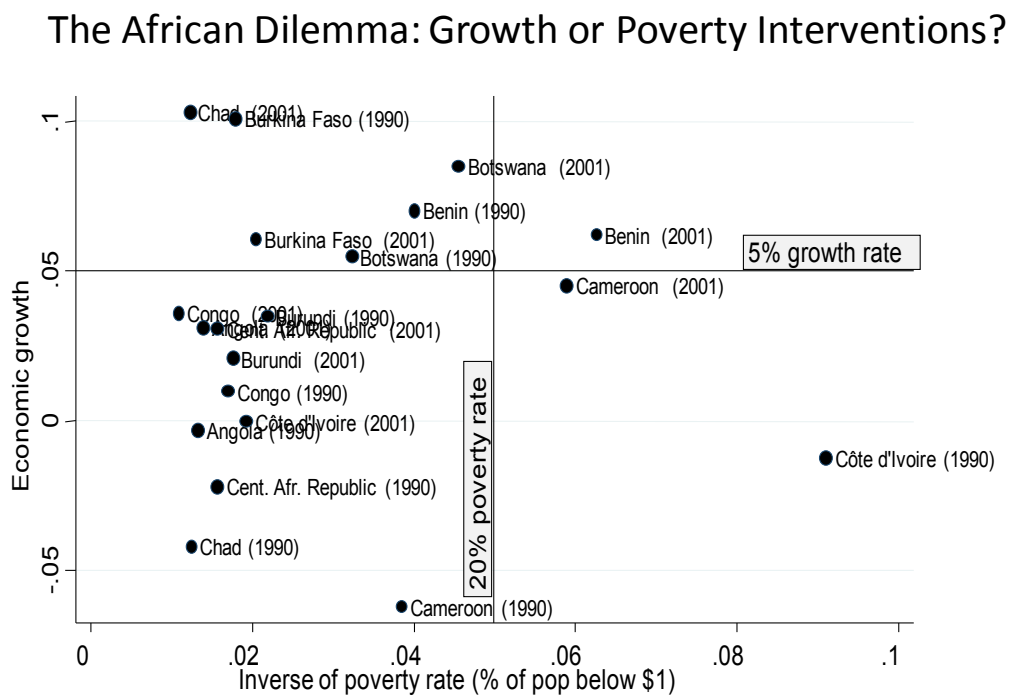
The issues are particularly relevant for countries that have "little money" and "little time" to effect the broad and rapid changes necessary to achieve the MDG goals. Such countries are characterized by (1) tight short- and medium-term budget constraints; (2) a sizable share of their population living in poverty; (3) a large share of low-skill, underemployed labor among the poor; (4) a low degree of decentralization and effectiveness of services provision; and (5) an urban-centered form of service delivery, both in terms of geographic focus and content.

3. PUBLIC EXPENDITURE CONVERGENCE: CONCEPT AND CONTRIBUTION

Typology of Growth and Poverty Pathways

In the following sections, we will, in addition to examining the growth and poverty trends across African countries, propose a typology of growth–poverty pathways and define a set of metrics to describe the concept of convergence. We will also define more clearly the concept of convergence, in particular by contrasting it with the concepts of pro-poor growth, mainstreaming, and complementarity. Figures 3.1a and 3.1b depict growth and poverty trends among African countries and illustrate the trade-offs described above. The vertical axis represents the change in gross domestic product (GDP) growth rates between 1990 and 2001 and the horizontal axis the inverse of the poverty rate. The two lines that are added indicate growth and poverty rate thresholds of 5 percent and 20 percent, respectively, dividing the graphs into four quadrants. The southwest quadrant regroups countries that have experienced growth rates below 5 percent and poverty rates higher than 20 percent and includes the large majority of countries. Countries in this quadrant are the most exposed to the double challenge of investing in accelerating poverty reduction and responding to significant social needs in the short term. Going forward, these countries, and others that have experienced higher growth rates and lower poverty levels, face four distinct pathway scenarios, as indicated in figures 3.2a and 3.2b Pathway 1 would take a country into a higher growth level but with little or no further reduction in poverty. Pathway 2 would cut poverty further but with little progress on the growth front. Pathways 3 and 4 correspond to pathways 1 and 2 but are started from lower poverty and higher growth levels, respectively. The situation in these latter cases is less critical and the trade-off less acute, but the basic question of sustaining growth while further reducing poverty still remains.

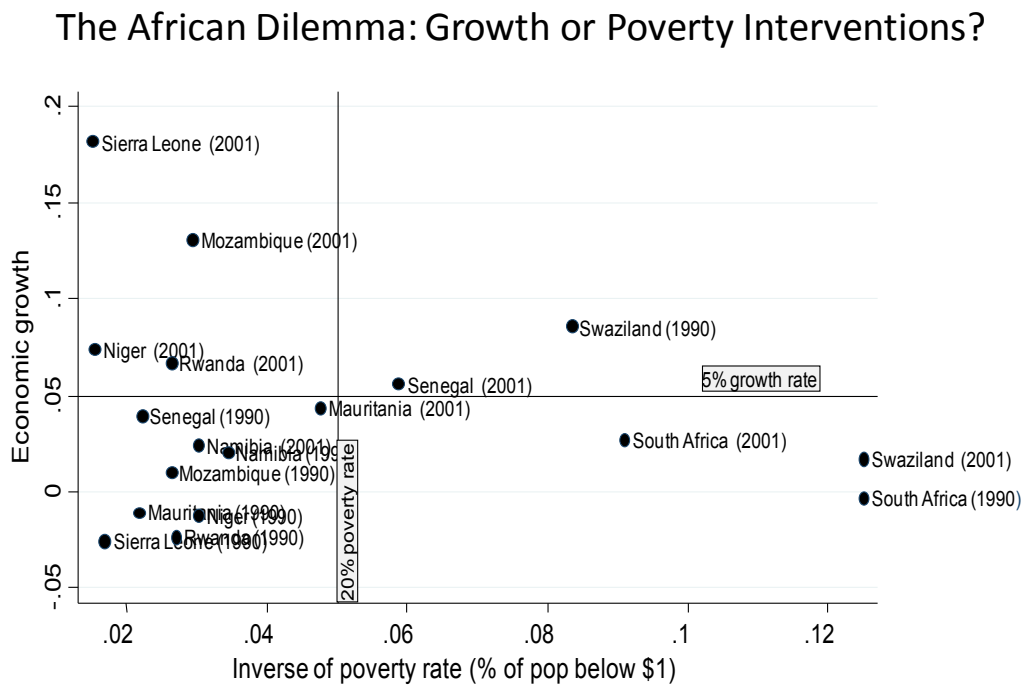
Figure 3.1a. Growth and poverty trends among African countries3



Source: Country Poverty Reduction Strategy Paper and 2007 World Development Indicators.

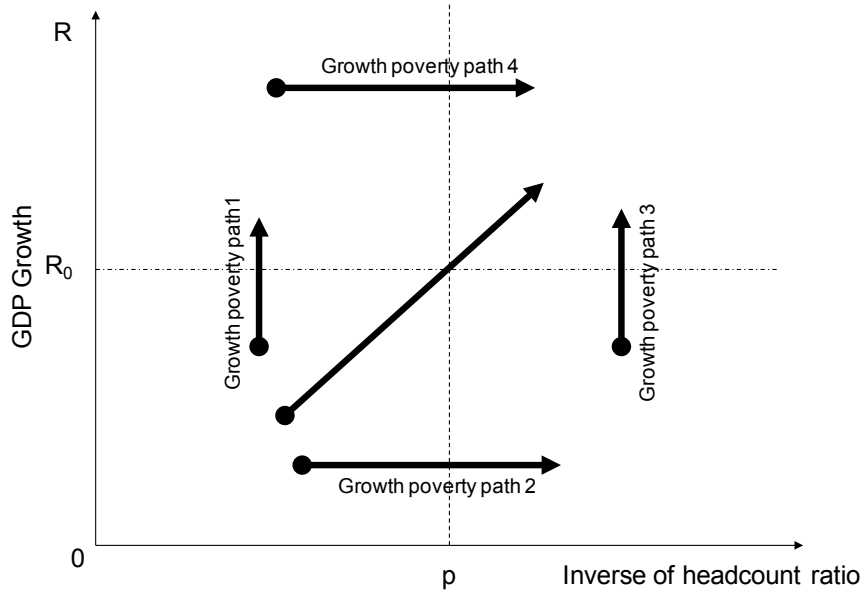
[3] Notes: Figures 3.1a and 3.1b regroup countries for which the data were available. *R* in the *y* axis denotes country GDP growth rates and *p* in the *x* axis the inverse of the poverty headcount ratio, that is, the share of population living below $1.00 a day.

Figure 3.1b. Growth and poverty trends among African countries (cont'd)[4]



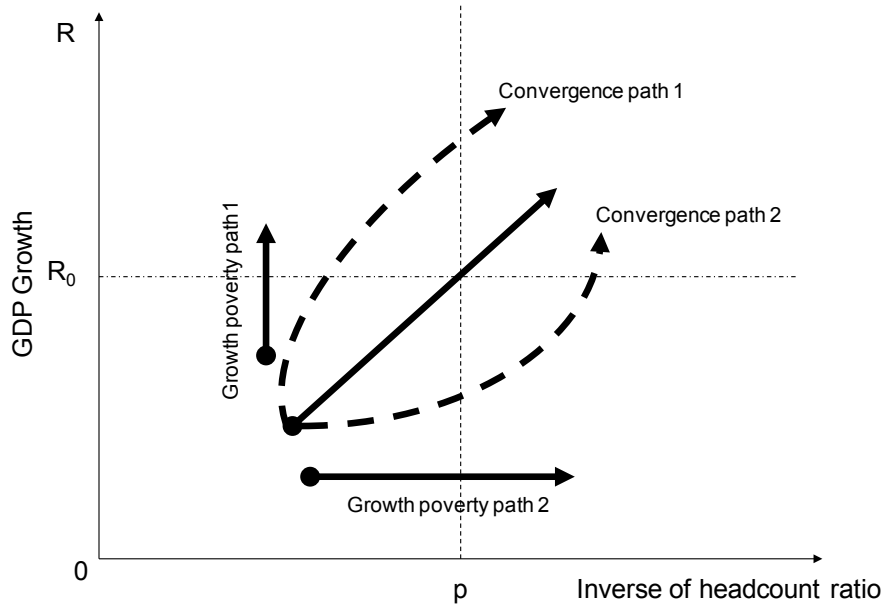
Source: Country Poverty Reduction Strategy Paper and 2007 World Development Indicators.

Figure 3.2a. Growth–poverty paths



[4] Notes: Figures 3.1a and 3.1b regroup countries for which the data were available. *R* in the *y* axis denotes country GDP growth rates and *p* in the *x* axis the inverse of the poverty headcount ratio, that is, the share of population living below $1.00 a day.

Figure 3.2b Growth–poverty paths



The trends in figures 3.1a and 3.1b show the actual pathways followed by individual countries. Sierra Leone, Mozambique, Chad, and, to a lesser extent, Central African Republic and Congo have followed pathway 1 between 1990 and 2001. Benin, Botswana, and, somewhat, Senegal followed pathway 4. There are no countries on pathways 2 and 3, as illustrated in the near emptiness of the southeast and northeast quadrants of figures 3.1a and 3.1b. The few countries that are in this space have instead experienced a deterioration, not an improvement, of growth or poverty conditions. Cote d'Ivoire, for instance, witnessed a sharp increase in poverty rates. South Africa has also experienced a rise in poverty rates, accompanied by higher growth rates. Swaziland, on the other hand, experienced both a decline in the rate of growth and an increase in the poverty rate.

Convergence, Pro-poor Growth, and the Growth Impact of Social Services

Because the concept of convergence can easily be confounded with that of pro-poor growth, its focus with that of public expenditure review and analysis, and its practical policy implications with those of complementarity and mainstreaming, the differences between these notions are worth highlighting. We start with a review of the literature in the following areas:

- Pro-poor growth and poverty reduction strategies
- Impact of public expenditures on agricultural growth
- Public expenditures in social sectors, income distribution, and poverty
- Health and agricultural productivity
- Education and agricultural productivity
- Social safety nets and agricultural productivity

The outcome of the review for each of the above areas is discussed in the sections below. Tables 3.1 and 3.2 show some of the key differences between the issues driving the convergence agenda and those underlying the other areas. In summary, the review brings to light the following gaps and value addition by the proposed research project:

1. While the first two areas focus on the trade-off between growth and poverty effects, including distributional aspects of macroeconomic policies, the proposed research focuses on the optimization of public expenditures to maximize the growth impact of social services. It is driven more by the search for policy solutions than the evaluation of policy outcomes.
2. The research on health and education tends to treat these as homogeneous services and thus does not look into the implications of changes in their composition. The proposed research, in contrast, treats health and education as composites of subtypes of services, whose combination can be optimized to maximize their growth impact through the related effects on labor productivity.
3. The research on social safety nets in many cases emphasizes the needs and vulnerability aspects more than the growth dimension; and where it looks at the latter, it tends to focus more on long-run outcomes. The proposed research, in contrast, emphasizes the growth and sustainability dimensions as well as the need and scope to exploit the short-term as much as the long-term growth externalities of safety net services.

Table 3.1. Convergence, pro-poor growth, and public expenditure review

Defining issues	Convergence	vs.	Pro-poor growth	vs.	Public expenditure review
Public expenditure quality and efficiency	M		M		M
Growth and poverty nexus	M		M		L
Distribution and equity	indirect		direct		
Services and growth synergies	M		L		
Services optimization	M				

Table 3.2. Convergence versus mainstreaming and complementarity

Defining issues	Convergence	vs.	Complementarity	vs.	Mainstreaming
Degree of externalities	M		H		L
Separability of objective	M		L		M
Search for optimization	M		M		
Resource trade-off	M				

Note: letters refer to different level of importance: H (high), M(medium), and L(low).

Pro-poor Growth and Poverty Reduction Strategies

There is broad consensus in the literature that economic growth is a necessary condition for poverty reduction. For instance, Kraay (2006) found that roughly 70 and 97 percent of changes in poverty headcounts in developing countries in the short and long run, respectively, can be explained by growth in

average incomes. A cross-country study by Ravallion (2004) finds that a 1 percent increase in income level results in a poverty reduction of between 0.6 and 4.3 percent, depending on the initial level of inequality, with lower reduction levels observed in countries with higher rates of inequality. Similar results are reported in World Bank (1990, 2000), Ravallion (1995), Ravallion and Chen (1997), and Fields (2001). Still, the policy implications of a call for pro-poor growth are not always clear (Klasen 2004). The questions raised in the above and similar work are these: What policies support growth but do little for poverty alleviation? What combination of macroeconomic and sector policies boost growth and reduce poverty? What policy actions can compensate for the initial (and often adverse) distribution of assets? And what policies mitigate short-term symptoms but fail to address the root causes of chronic poverty? Such questions are critical to understanding the nexus between growth and poverty, particularly the link between growth and inequality. However, they tend to skim over the strategic questions that arise from the pressure policymakers face in resource-poor countries seeking to mitigate the symptoms of poverty and trying to meet the short-term social needs of the poor and vulnerable while at the same time fostering long-term productivity growth. Although both the convergence issues at the center of the proposed project and the pro-poor growth agenda deal with the growth and poverty nexus, the pro-poor agenda speaks to the distribution and equity aspects much more directly. The convergence agenda, on the other hand, addresses the services and growth synergies much more explicitly. Furthermore, it zeroes in on the optimization of services delivery to boost growth and meet short-term social needs, a fact that is not being addressed in the pro-poor analysis.

Impact of Public Expenditures on Agricultural Growth

As Fan and Rosegrant (2008) point out, public agricultural investment is the most direct and effective way for African countries to promote the required agricultural growth to achieve MDG 1. IFPRI researchers have established significant linkages between public expenditure, agricultural growth, and poverty. For example, Fan, Hazell, and Thorat (2000), Zhang and Fan (2004), and Fan, Zhang, and Zhang (2002) examine the sources of growth in rural and agricultural GDP and decreases in rural poverty in India and China. Similar studies have been done on the link between agricultural growth and agricultural development expenditure in Rwanda, Zambia, and Africa as a whole (Diao et al. 2007; Thurlow et al. 2008; Fan and Rao 2003), and between agricultural growth and agricultural research in Uganda (Fan, Zhang, and Rao 2004). It is also worth mentioning that IFPRI is providing analytical support to the implementation of CAADP. Under IFPRI leadership, in collaboration with local experts, reviews of agriculture sector performance including agricultural public expenditure are performed and growth–poverty as well as growth–expenditure elasticities are estimated in countries such as Ghana, Uganda, Malawi, Zambia, Niger, Senegal, Togo, Benin, Burkina Faso, and Niger.

Public Expenditures in Social Sectors, Income Distribution, and Poverty

In contrast to the growth–poverty nexus, there is little consensus regarding the quantitative impact of government spending on poverty reduction. While there is agreement that public expenditure policies in most developed countries have both contributed to poverty reduction and made the distribution of wealth and income more even (Afonso, Schuknecht, and Tanzi 2008), that may not be the case in middle-income, and especially poor, countries. Compared with the large body of literature on the linkages between fiscal policy and economic growth (i.e., Agenor and Neanidis 2006; Persson and Tabellini 1994; Alesina and Rodrik 1994; Barro 1990), the literature on the impact of fiscal policy on income distribution is much scarcer. The latter often focuses on the estimation of changes in single measures of income distribution, such as the Gini coefficient. Most studies consider the aggregate effect on income distribution of public expenditures in specific sectors, such as health and education (Ross and Wu 1995; Gylafson and Zoega 2003), government transfers (Bassett, Burkett, and Putterman 1999), and other social policies (Van der Ploeg 2003). To our knowledge, there is no serious analysis of the effect of disaggregated public expenditures (by subtypes of services) on different segments of the population or income groups among African countries, as proposed under the current project.

A major part of the literature on public expenditure deals with the quality and efficiency of expenditures at the overall or sectoral levels. In many instances, the literature deals with the distribution of spending within a given sector, such as, for instance, between personnel and operational costs. In others, it focuses on the execution of budgets within ministries. While all such questions are relevant, they are at the heart of the convergence agenda. The latter does not investigate the overall quality and efficiency of public spending as such, but rather focuses on the scope for better growth and poverty outcomes that can be achieved by allocating spending across subcategories of a given social service, say health, in line with their marginal impact on labor productivity. The efficiency of service delivery and allocation of spending between health and other sectors can be treated as given. The improvement in outcomes derives solely from the fact that subservices with higher marginal impact on labor productivity receive more funding and are supplied in greater quantity than others with less. The fact that the quality of public expenditure and service delivery may be suboptimal and thus can be improved upon in certain cases does not change this outcome.

Furthermore, the convergence agenda does not deal with the efficiency issues of reallocating expenditures across major sectors, such as from infrastructure to health, or from education to agriculture. Although such questions may be important, the political economy reality is that most governments facing serious budget constraints do not approach them from the efficiency angle. Moreover, as indicated above, there is little likelihood that African governments and others having to deal with large-scale poverty under limited budget resources can be moved to reallocate resources away from social sectors into productive ones such as agriculture or infrastructure. The situation today is that most governments, rather than contemplating a reallocation of budget resources to agriculture or infrastructure from health or education, tend to look at resources going to the latter sectors as "lost" to the former. The option behind the convergence agenda, which seeks to maximize the contribution of expenditures in the social sectors to the objectives in the productive sectors, therefore seems to be more realistic. It does not imply further competition between ministries regarding the *level* of budgetary resources but calls for cooperation with respect to the *utilization* of such resources. The ministry of agriculture, for instance, would not argue with the ministry of health about the size of its budget but rather the choice of health programs that the latter would finance so as to make the maximum contribution to agricultural growth and poverty reduction in rural areas. This is without question a much more productive debate.

Health and Agricultural Productivity

The importance of the role of health services in promoting economic development has been highlighted by Sachs et al. (2001). In particular, there is strong evidence that growth in early industrialized countries was associated with significant increases in caloric intake and therefore greater height and body mass index (Fogel 1994, 2004). Healthiness is also shown to be positively related to schooling outcomes (Bhargava et al. 2001; Miguel and Kremer 2004; Jayachandran and Lleras-Muney 2009). Furthermore, Hawkes and Ruel (2006a) show that in agricultural communities, poor health reduces income and productivity. The IFPRI Briefs Series edited by Hawkes and Ruel (2006b) provides a historical context to the links between agriculture and health and examines the challenges to linking agriculture and health in policy. Ajani and Ugwu (2008) found that a 1 percent improvement in farmers' health condition in north-central Nigeria leads to a 31 percent increase in efficiency. In Sierra-Leone, Strauss (1986) estimated an output elasticity of calories of 0.34 at the sample mean of average calorie intake, 0.49 at an average daily energy intake of 1,500 kilocalories, and 0.12 at a daily energy intake of 4,500 kilocalories. Audibert and Etard (2003) observed a 26 percent increase in labor productivity from control of schistosomiasis in rice-growing areas of Mali. In Kenya, Fox et al. (2004) found that HIV-positive workers plucked between 4.11 and 7.93 kilograms per day less tea leaves, used significantly more sick leave and other leave days, and spent many more days doing less strenuous tasks. Gillespie (2006) provides further evidence on the interaction between HIV/AIDS and agricultural productivity. Most of the studies in this area fail to account for the cost of investments (public and private) in achieving the required level of health

conditions for sustainable agricultural productivity. Furthermore, they do not link the productivity to changes in the mix of health services. The proposed project will look into both of those aspects.

Education and Agricultural Productivity

Improvements in education are largely seen as influencing how an individual acquires, assimilates, and applies information and technology. Education, particularly formal education acquired during primary and secondary schooling, has been shown to result in higher incomes and improved overall economic development and growth (Becker 1964). Works by Krueger and Lindahl (2001), Gemmell (1996), Mincer (1974), and Topel (1999) all suggest that both the change and initial level of education are positively correlated with economic growth. With regard to agricultural productivity growth, early studies by Griliches (1963, 1964) showed education of the labor force to have a positive and significant effect on U.S. agricultural production. Lockheed, Jamison, and Lau (1980) reviewed some of the early evidence from developing regions on the effects of farmer education on agricultural production and concluded that education had a positive and significant impact on productivity. Philips (1994) also found that four years of schooling raises labor productivity, with the impact stronger in Asia than in Latin America. In the case of Africa, earlier reviews by Appleton and Balihuta (1996) and Appleton (2000) concluded that the effect of education on agricultural productivity was at best mixed. Apart from challenges of establishing causality, the lack of significance of education in some of the African studies has been attributed to small sample sizes and measurement error in agricultural production. Others have argued that the lack of significance is due more to assuming homogeneous technology use by farmers and the failure to account for the fact that education plays a greater role in modern environments than traditional environments. This is because more-educated farmers are more likely to respond and adjust to technological disequilibria than those who are less educated. Therefore, Alene and Manyong (2006) examined the effects of schooling and extension on cowpea production under both traditional and modern/improved technology in northern Nigeria. Their study established that farmer education had a positive and significant effect on adopters of improved cowpea varieties as opposed to nonadopters or traditional cowpea farmers. In another study, Weir (1999) found that household heads and other adults having some upper primary education has a positive and significant effect on cereal production in rural Ethiopia. Although the conclusions about the relationship between education and agricultural productivity growth vary, there appears to be some consensus that the relationship is positive, particularly where differences between traditional and modern agriculture are taken into account. In many if not all of the aforementioned studies, authors are looking at the impact of general education, as opposed to targeted vocational training and workforce development in the rural areas, the focus of the proposed research, which should yield much greater short- and long-term productivity impacts.

Social Safety Nets and Agricultural Productivity

Although deemed important, the impact of social safety nets on agricultural productivity has not yet been extensively researched in the literature. According to Holmes et al. (2008), social safety nets in the agricultural sectors are designed to address (1) actual and perceived risks to investing in more remunerative agricultural technologies and activities, (2) vulnerability to shocks and stresses and limited ability to mitigate or cope with them, (3) temporal lack of access to capital and labor, and (4) limited access to information and voice to address exclusion. Devereux et al. (2008) and Devereux (2007) identify a number of synergies and conflicts between agricultural and social protection policies toward smallholders in Africa. In terms of synergies, investments in agriculture should promote growth in rural incomes, with two beneficial implications for social protection. First, economic growth increases public resources available to finance social protection. In turn, availability of social protection should encourage farmers to invest in more lucrative but also more risky new technologies; if they are poor and lack social protection, they will favor risk-averse low-return activities. Second, pro-poor growth in incomes reduces social protection needs. In terms of conflicts, agricultural and social protection policies typically compete for limited financial resources and political influence, since governments and donors tend to regard them

as distinct rather than complementary, and their implementation is often uncoordinated and internally contradictory. Hoddinott (2005) and Devereux (2008) found strong impact of productive safety net interventions, in particular linked to easing access to improved seeds and fertilizers. Assessing the impact of Ethiopia's Productive Safety Nets Programme (PSNP), the second-largest social protection program in Sub-Saharan Africa after South Africa, Gilligan, Hoddinott, and Taffesse (2008) conclude that the program had little impact on participants, due in part to transfer levels that fell far below program targets. In contrast, households with access to both PSNP transfers and agricultural support packages were more likely to be food secure, borrow for productive purposes, use improved agricultural technologies, and operate their own nonfarm business activities.

Safety net programs targeting agriculture often seek to lower the cost of and facilitate access to modern agricultural inputs. They usually have direct and strong impact but are plagued by sustainability problems related to their cost and/or the negative effect on the private sector. At least conditional cash transfer programs lend themselves to targeting education and health outcomes to boost labor productivity. As noted by Fiszbein and Schady (2009), conditional cash transfer programs generate full synergies between social assistance and human capital development only where the supply of health and education services is extensive and of reasonable quality. The proposed project will focus on the impact on labor productivity and incomes of linking safety net transfers to different subtypes of health and education services.

4. PUBLIC EXPENDITURE CONVERGENCE: THEORY AND RESEARCH METHODOLOGY

Definitions, Hypotheses, and Assumptions

Social services are defined here as including health, education, and the various types of social safety nets. Productivity-enhancing investments are primarily designated to refer to research and technology, infrastructure, and institutions that directly affect the productivity of agricultural land and labor. It also needs to be emphasized that the convergence agenda as defined here is not seeking to highlight the broad complementarity between social services and productivity or the importance of productivity increases for access to such social services. Those issues have been amply researched. The question at hand focuses more on the narrow issue of optimizing the mix of (subcategories of) social services based on the relative immediacy and size of their growth externality or spillover impact on agricultural and rural labor productivity. In other words, the strategic question is how to maximize the growth externalities of social services—that is, the level of induced productivity growth of one dollar's worth of public expenditure on social service. This analysis would have to unbundle the different types of services, say education, into its possible subcategories, say vocational training as opposed to formal training, and weigh their respective contributions. The final outcome is to understand how a country can spend the same dollars to provide the same composite unit of social services, while achieving a greater and more direct impact on productivity growth. The hope is to increase cooperation between agriculture and social services ministries, reduce the tension around budget negotiations, raise the efficiency of public expenditures in the agricultural and rural sector, improve the effectiveness of the delivery of public goods and services in rural areas, and achieve better growth and poverty reduction outcomes.

The following assumptions and hypotheses are behind the conference and associated research activities:

- The most effective, long-term strategy to reduce poverty is to raise the productivity of the assets upon which poor people depend for their livelihoods. Though the assets of the poor comprise primarily their labor (part of human capital) and land (an element of physical capital), their overall productivity and potential for raising it are influenced by their access to and use of all available assets, including human, physical, financial, natural, social, organizational, and institutional assets.
- Limited access to social services reflects the combined outcome of low household productivity, deficient fiscal resources at central and local government levels, poor planning and implementation of service delivery, and/or adverse incentive effects that impede participation by the poor.
- Because of the general scarcity of resources, governments face trade-offs when deciding on the priority between social service delivery and investment in activities that raise productivity more immediately. The challenge is to balance the pressure for services that address the immediate needs of the poor against the needs for productivity-enhancing activities that will enable the poor to generate the future incomes and resources to raise and sustain their welfare.
- Although it is true that for many of the poor, social safety nets may be the only hope of a life free from chronic poverty, malnutrition, and disease, it needs to be recognized that social services are not growth-neutral. Some combinations of social services raise the productivity of the poor more than others. Expanding such services (e.g., preventive and other health programs targeting seasonal labor bottlenecks in the farming sector, or the mainstreaming of education programs that upgrade and modernize skills in the same sector) would more rapidly reduce poverty than health and education programs that lack such focus. They are also more likely to hasten the time when primary reliance on external assistance to deal with the symptoms of extreme poverty can be phased out.

The research approach consists in gathering the necessary primary and secondary data, including through detailed household surveys and applying econometric models to examine the relationship between individual subtypes of the social services and changes in labor productivity. This part of the analysis can be disaggregated by social categories, making it possible, for instance, to highlight differences across gender, ethnicity, or other socioeconomic characteristics. The parameters from this analysis would then be input into a structural economy-wide model to simulate the long-term growth and poverty impact of changes in the composition of health, education, and social safety services. The model would then be applied to define service-provision strategies that would help meet social needs while maximizing and sustaining the contribution of public expenditures to growth and poverty reduction in rural areas.

Growth–Poverty Convergence Indicators and Measurement

In line with the growth-poverty pathways described in Figure 3.2 it is possible to derive a measure of the extent to which growth translates to a fall in poverty, that is, the extent to which a movement upward along the *y* axis in Figure 4.1 is related to a movement toward the origin on the *x* axis. Alternatively, it is possible to derive a measure indicating the extent to which a reduction in poverty levels is associated or not with a sufficient concomitant increase in the growth rate to ensure that the pace of poverty reduction can be sustained—that is, how far a movement toward the origin on the *x* axis is associated with a movement upward on the *y* axis. In both cases, PE_0 represents an initial level of public expenditures and PE_1 and PE_2 represent alternative public expenditure scenarios with corresponding growth–poverty outcomes, (R_1, p_1) and (R_2, p_2). In the first case, the increase in the rate of growth from R_0 to R_1 translates to a poverty rate of p_1. As shown in figures 3.2a and 3.2b, the most efficient growth–poverty combination can be assumed to follow the 45-degree line.

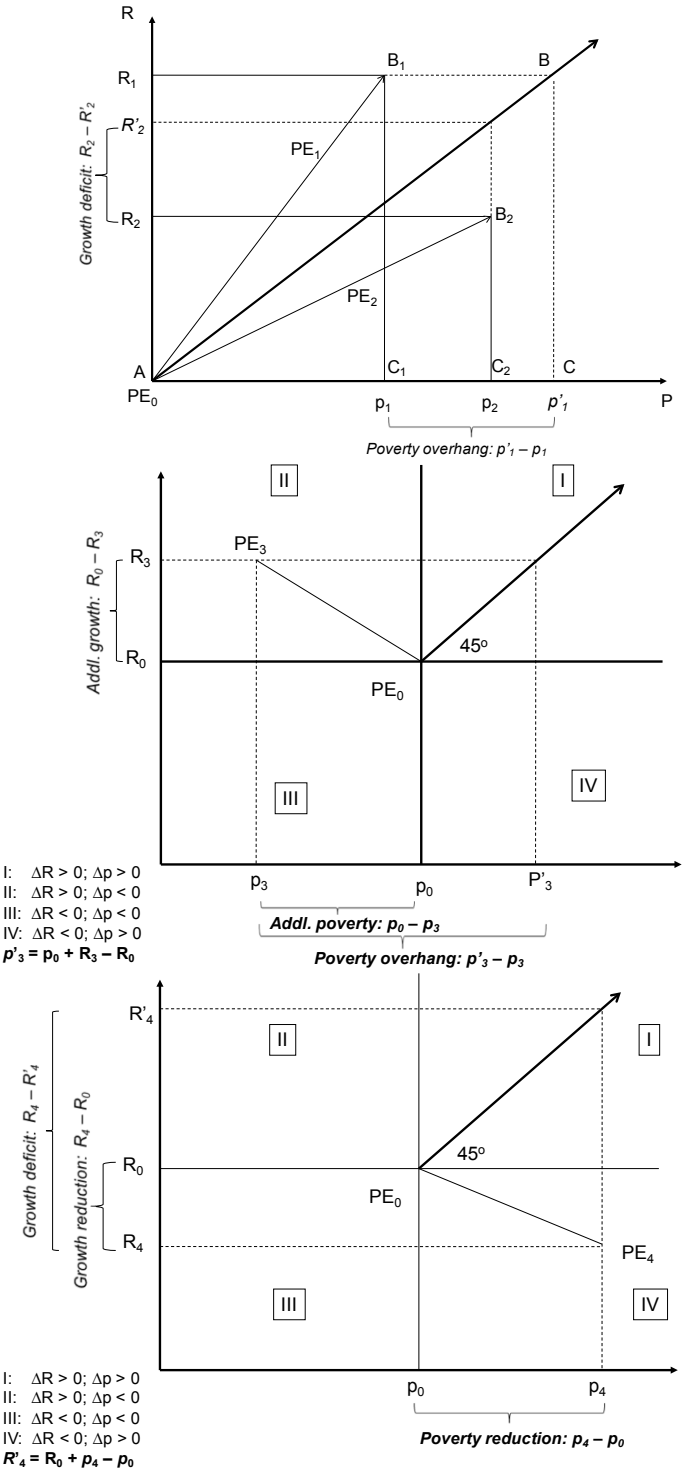
The assumption of a 1-to-1 ratio is in line with the large number of empirical estimates of growth–poverty elasticities reviewed by Fan et al. (2008), which hover around 1.[5] The (R_1, p_1) combination is therefore associated with a poverty overhang ($P'_1 - P_1$), where P is the actual poverty rate[6]which can be interpreted as indicative of a lower level of effectiveness to fully translate the increased growth that has resulted from the public investments (PE_1) into a reduction in the level of poverty all the way to p'_1. In other words, the poverty overhang can be used as an indicator of a growth–poverty efficiency(GPE) gap. Similarly, the (R_2, p_2) combination is associated with a growth deficit ($R_2 - R'_2$), which also can be interpreted as indicative of the failure of public investments to generate sufficient growth at R'_2 to sustain a poverty rate of p_2, and hence be used as an indicator of a growth–poverty sustainability (GPS) gap. The estimations of the GPE and GPS gaps are presented in Figures 4.2a and 4.2b.

The GPE and GPS gaps can be equally derived in situations where an increase in the rate of growth is associated with an increase in the rate of poverty or a decrease in the growth rate with a reduction in the rate of poverty. The two cases are illustrated in the bottom two graphs of Figure 4.1. The first graph corresponds to a growth–poverty combination in the second quadrant and the second to a combination in the fourth quadrant. For ease of illustration, the initial level of public expenditure, PE_0, is located away from the origin and associated with an initial growth–poverty combination of (R_0, p_0), with R_0 and p_0 both greater than zero. Next, a change in public expenditures leads to a new outcome, (R_3, p_3), where an increase in the rate of growth from R_0 to R_3 is associated with an increase in the rate of poverty from p_0 to p_3. The new outcome results in a poverty overhang that comprises two components.
The first corresponds to the failure of the increase in the rate of growth to reduce the rate of poverty ($p'_3 - p_0$). The GPE gap is equal to the poverty overhang, $p'_3 - p_3$.

[5] See Appendix 1 for the table with the estimates. The fact that the inverse of the poverty rate is used does not change the implication for the value of ε, as explained in Appendix 3.
[6] Low case "p" in the figures denotes the inverse of poverty rate, that is 1/P.

In the second case, where a reduction in the rate of growth is associated with a decline in the rate of poverty, a growth deficit is generated, which is also composed of two components: the additional growth ($r'_4 - r_0$) that would have been called for to sustain the reduction in poverty from P_o to P_4; and the actual reduction in growth ($r_0 - r_4$) that has taken place concomitantly to the reduction in poverty. The GPS gap is measured by the growth deficit, or $R_4 - R'_4$.

Figure 4.1. Public expenditure convergence and growth–poverty effectiveness and sustainability



Estimating the Growth–Poverty Efficiency and Sustainability Gaps

Define $\varepsilon = \frac{(R_1 - R_0)}{|R_0|} / \frac{(p_1 - p_0)}{p_0}$ as the ratio between the change in the (inverse) poverty rate and the change in the rate of growth, or in more general terms $\varepsilon = TanAB_1C_1$ in Figure 4.1, where changes in growth and poverty rates are measured in relative rather than absolute terms. One can then derive the following three cases, depending on whether the growth–poverty point is above, below, or on the 45-degree line (B_1, B_2, or B in Figure 4.1):

a. $\varepsilon > TanABC$: when the change in the growth rate translates into a smaller change in the poverty rate;
b. $\varepsilon < TanABC$: when the poverty rate declines faster than the growth rate rises; and
c. $\varepsilon = TanABC$: when the change in the growth rate translates into an equal change in the poverty rate.

The third scenario depicts the case of a convergent growth–poverty pathway, as indicated by the 45-degree line in the figure in the text. The first scenario corresponds to the first example of a nonconvergent growth–poverty pathway, indicated by a GPE gap as defined in the text. The indicator for the GPE gap, that is, the related poverty overhang, $p'_1 - p_1$ in the graph, can be derived as follows: First, assume a country on a convergent growth–poverty pathway, meaning that $\exists p_1^{'}$ such that $Tan45^0 - \varepsilon = 0$; or $1 - \varepsilon = 0$. That is,

$$1 - \frac{(R_1 - R_0)}{|R_0|} / \frac{(p_1^{'} - p_0)}{p_0} = 0, \text{ or}$$

$$p_1^{'} = p_0 + \frac{p_0(R_1 - R_0)}{|R_0|}, \text{ yielding a value for the GPE gap as}$$

$$p_1^{'} - p_1 = (p_0 - p_1) + \frac{p_0(R_1 - R_0)}{|R_0|}.$$

Scenario b above denotes the other case of a nonconvergent growth–poverty pathway, where the decline rate of poverty is faster than the increase in the rate of growth, indicating a GPS gap as defined earlier in the text. Here, too, the GPS gap can be derived by first assuming a country on a convergent growth–poverty pathway, meaning that $\exists R_1^{'}$ such that $1 - \varepsilon = 0$, or

$$1 - \frac{(R_1^{'} - R_0)}{|R_0|} \Big/ \frac{(p_1^{'} - p_0)}{p_0} = 0, \text{ following which one obtains}$$

$$R_1^{'} = R_0 + \frac{|R_0|(p_1 - p_0)}{p_0}, \text{ and the value of the GPS gap as}$$

$$R_1^{'} - R_1 = (R_0 - R_1) + \frac{|R_0|(p_1 - p_0)}{p_0}.$$

Figures 4.2 and 4.3 show estimates of GPE and GPS gaps for selected countries. The first set of countries shown in the first two graphs have experienced GPE gaps, that is, growth rates that failed to translate into commensurate decreases in the rate of poverty, leading to the estimated levels of poverty overhang in Figure 4.2a. On average, the rate of poverty among the group of countries is 35 points higher than would have been the case had they been in a position to fully translate the growth that has taken place during the 15-year period from 1990 to 2005 into a decline in poverty rates. Figure 4.2b compares the *convergent poverty rates* (which would have resulted had the countries been on a convergent growth–poverty path and thus achieved *maximum poverty reduction*) with the actual rates of poverty over the same period. The convergent growth–poverty path is illustrated by growth–poverty combination points on the 45-degree line in Figure 4.1.

Figure 4.2a. Poverty overhang estimate, 1990–2005

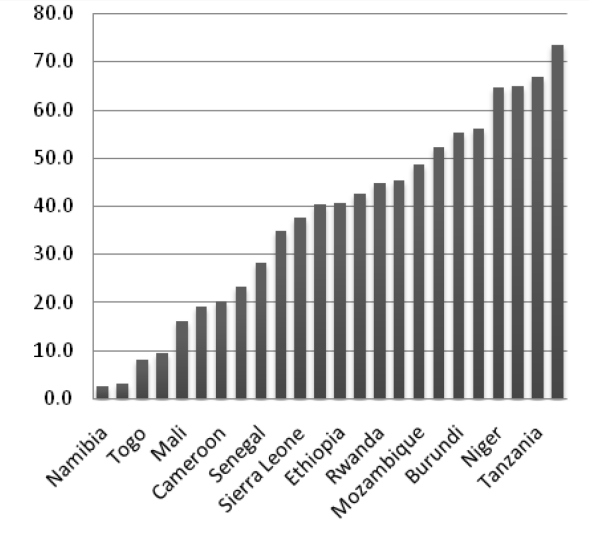


Figure 4.2b. Alternative poverty outcomes under convergence, 1990–2005

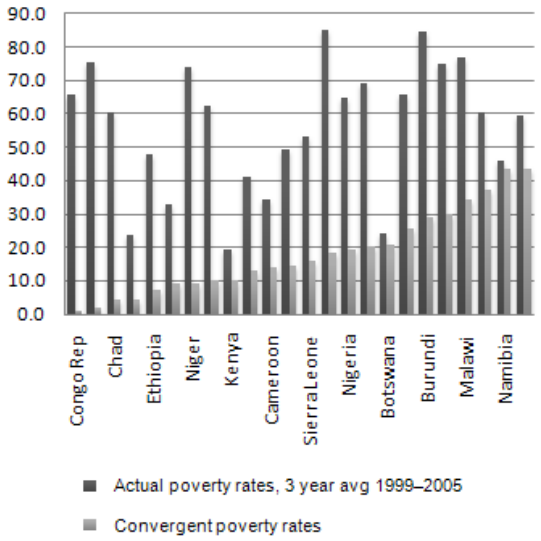


Figure 4.3a. Growth deficit estimates, 1990–2005

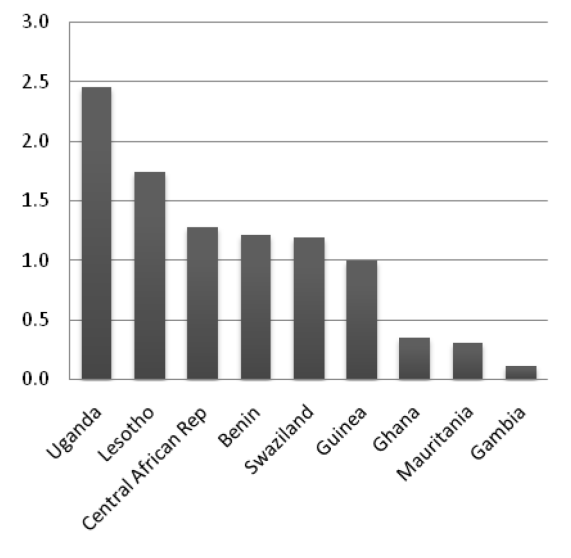
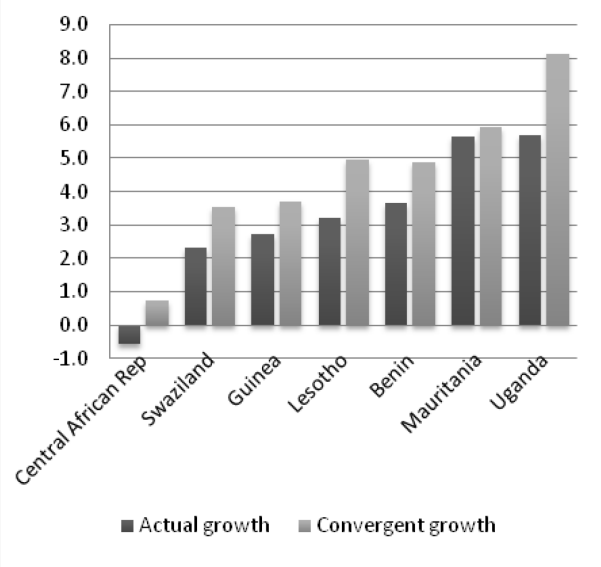


Figure 4.3b. Convergent growth outcomes under convergence, 1990–2005



Source: Authors' calculations based on growth and poverty data from World Bank World Development Indicators, 2008; World Bank Country Profiles, Poverty Reduction Strategy Papers, and Country Surveys

The second set of graphs shows countries with GPS gaps, where the actual rate of growth is not strong enough to sustain the observed level of poverty reduction, reflected in the growth deficit estimates in Figure 4.3a. Figure 4.3b compares the *convergent growth rates* (which would have put the country on a convergent growth–poverty path and thus achieved *sustainable poverty reduction*) with observed country rates of growth. The growth deficit estimates indicate that country growth rates would have to rise by close to 2 percentage points, in most cases, to sustain the recent poverty reduction trends.

It is interesting to note that the countries in each of the two groups do not share any of the conventional, a priori, discernable characteristics that would allow them to be categorized in any specific

way. For instance, one finds in the same group exhibiting GPE or GPS gaps countries that are oil exporting and importing, post-conflict and relatively stable, Sahelian and humid, large and small, mineral rich and poor, densely and sparsely populated, and so on. Similarly, the magnitude of the poverty overhang and growth deficit estimates does not seem to correlate with any of these characteristics. In other words, the deviation from the convergent growth–poverty path by individual countries does not seem to be determined structurally. In the absence of structural determinants, the sources for the divergent outcomes must be found in cross-country differences with respect to investment and expenditure choices and the related impact on the magnitude and distribution of growth. The convergence agenda argues for a strategic approach that seeks to eliminate the poverty overhang and growth deficit not just by (1) raising the level and efficiency of investments in the agricultural sector, but also by (2) optimizing investments in the social sectors so as to maximize their impact on agricultural labor productivity and incomes. The following section examines the theoretical relationships between the allocation of public expenditures in the health, education, and social safety net sectors and how they can affect labor productivity and incomes in the agricultural sector and the rural economy in general.

Public Expenditure in Social Services and Growth–Poverty Convergence

The theory behind the convergence agenda is that the GPE gap as well as the GPS gap can be reduced or eliminated through optimization of public expenditures in social services to maximize their impact on labor productivity and thus their poverty-reducing impact. Such optimization would, given a constant level of public expenditures, link increases in the rate of growth positively, and more strongly so, to the decline in the rate of poverty. That in turn would translate into greater efficiency and sustainability of the growth–poverty nexus: (1) the same level of growth leads to more poverty reduction; and (2) declines in the rate of poverty are more likely to be associated with positive and higher rates of economic growth, thereby guaranteeing their sustainability in the long run.

Figure 4.4a illustrates the relationships between the social services mix and labor productivity and incomes, as outlined above. This time the first quadrant represents the supply of education services and budget to cover the cost of such services. The second quadrant depicts the labor productivity curve, and the third, the labor supply curve in the agricultural sector.

Now in Figure 4.4b, assume, as in Figure 4.4a, that there are two distinct sub-bundles of education services, E_i and E_j, the combination of which can be adjusted from e to e', within the same bundle (composite) of education services, denoted by the line E, and representing the same level of overall supply of education services at constant public expenditure ($I_E = I'_E$). Such an adjustment in the composition of health services shifts the labor productivity curve in the second quadrant from Q_L to Q'_L, with a constant supply of labor, resulting in an increase in agricultural incomes given by the area contained in the triangle aq'_eq_e. The higher income levels in the agricultural sector would lead to a greater reduction in poverty levels, with a constant public expenditure and education services supply, as well as a constant level of employment.

A simple example of convergent public expenditure in the education sector can be illustrated as follows: Assume a country has a budget I_E to spend on a composite of education services E, which primarily emphasizes formal education in the elementary, secondary, and tertiary sectors in urban areas, given by e in Figure 4.4b. Compare that with an alternative mix of education services e', which also includes, in the same budget, a component on vocational training and workforce development to effectively raise labor skills and productivity levels in the agricultural and agribusiness sectors (point e'). Over time, the second strategy can be expected to put the country on a path toward higher and more broadly shared growth, and thereby greater reduction in poverty.

The same convergence effect can be realized in the health and safety net sectors, as illustrated in figures 4.4c and 4.4d. The first figure presents a case where the supply of health services is optimized in such a way as to raise the employment of labor and expand production along the same productivity curve. This is achieved by adjusting the sub-bundles of health services from h to h', while keeping the level of public expenditure and overall supply of health services constant, to shift the labor supply curve from L_h

to L'_h, and actual labor use from l_h to l'_h, thereby expanding production from q_h and q'_h. The corresponding increase in incomes is given by the area $l_h q_h q'_h l'_h$, which contributes to further reduction of poverty.

Figure 4.4a. Services and labor supply and productivity

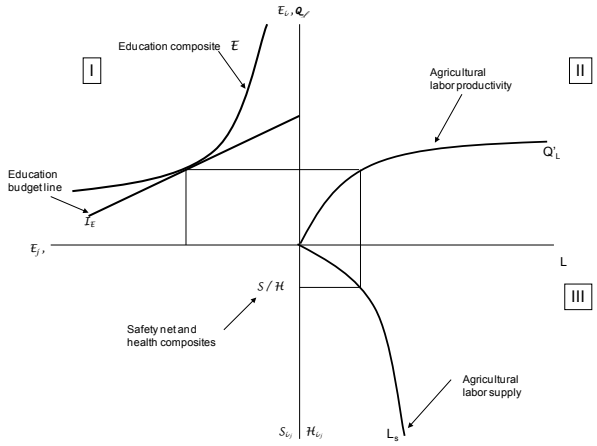


Figure 4.4b. Convergent education services and labor productivity

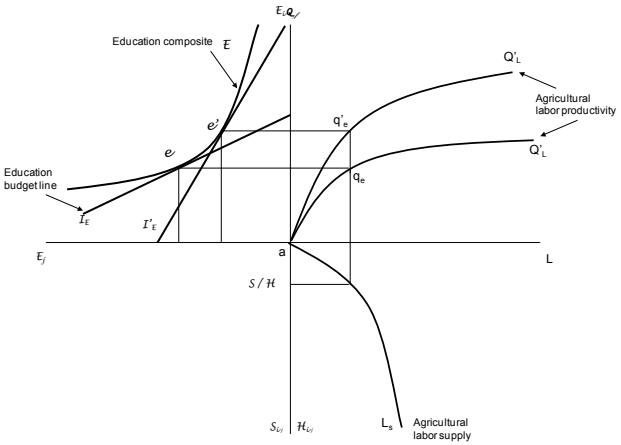


Figure 4.4c. Convergent health services and labor productivity

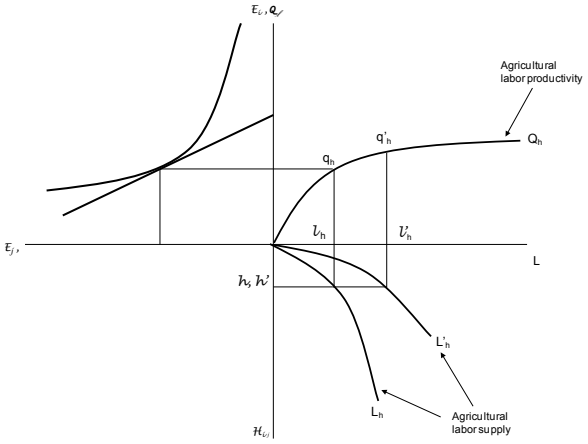
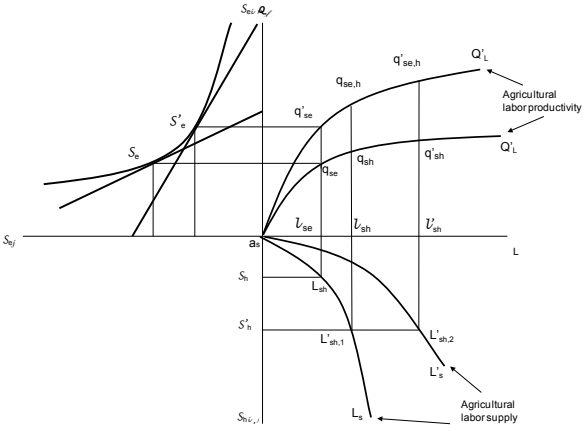


Figure 4.4d. Convergent safety nets and labor productivity



The convergence effect in the case of health services does not derive from the long-term impact on cognitive skills and productivity. It proceeds rather from the short-to-medium-term increase in the labor available to the family, due to greater capacity to work more days or longer hours. In other words, it does not involve a change in technology or a shift in the productivity curve but a more effective use of available labor.

An illustrative example is that of a health services program that includes a strong component targeting the main seasonal diseases that curtail labor availability during peak labor seasons, versus one that lacks such a focus. Such diseases, while seasonal and not necessarily affecting the same people every year, do return annually and thus have a permanent effect on labor supply during periods of peak demand. The program suggested above would enable farm households to raise supply to meet the rise in labor demand on an annual basis. This is indicated by the shift in the labor supply curve in Figure 4.4c.
In the social safety areas, the convergence effect would depend on the nature of the programs themselves. In cases where such programs are designed to target access to education and health services, including

nutrition, the convergence effect would work in the same way as has already been described above for the two sectors. It is in the case of African countries that the convergence agenda in the social safety net area is likely to be a bit broader than what has been discussed for the health and education sector. Africa has relatively limited experience with social protection and safety nets, besides the many emergency and less prevalent public works programs. The issue here, therefore, is not just one of mix but also of adequate level of public expenditures on safety net services.

Accordingly, convergent public expenditures on social safety nets would seek to raise the supply of the safety net services composite, while at the same time adjusting its component mix, from S_h to S'_h, as illustrated in Figure 4.4d. The impact would be twofold: On the one hand, the supply of labor from the initial labor pool is increased from L_{sh} to $L'_{sh,1}$, in response to the increase in safety net services. On the other, the adjustment in the safety net mix raises the available labor pool from $L'_{sh,1}$ to $L'_{sh,2}$. These combined changes lead to an increase in labor use from, respectively, l_{se} to l_{sh} and l_{sh} to l'_{sh}.

The convergence effect resulting from the above changes and adjustments raises overall labor productivity by $a_s q'_{se,q} q_{se} + l_{se} q'_{se} q'_{se,h} l'_{sh}$. This combined effect can be decomposed into several components, reflecting separate responses to individual changes within the safety net services. First, the expansion and adjustment of the health content of safety net services from S_h to S'_h raises labor incomes, respectively, by $l_{se} q_{se} q_{sh} l_{sh}$ (expansion effect) and $l_{sh} q_{se,h} q'_{sh} l'_{sh}$ (composition effect). The concomitant improvement of the education content of safety net services raises labor productivity and further augments the expansion and composition effects by $q_{se} q'_{se} q_{se,h} q_{sh}$ and $q_{sh} q_{se,h} q'_{se,h} q'_{sh}$, in addition to the incremental income derived from the separate adjustment of the education content of safety net services, as indicated earlier.

Modeling the Convergence Problem

The preceding sections defined metrics for the measurement of convergence and laid out the relationships between social services and labor productivity and incomes. The discussion above has shown how better optimization of public expenditure in social services can contribute to raise labor productivity and incomes under constant budget levels. How that translates to better poverty outcomes can be illustrated with the help of the dotted line in Figure 4.5a below. In the case of convergent expenditures, the line would follow a 45-degree angle. The shift in the labor productivity curve, induced by greater convergence of education, health, and safety net services, reduces the poverty level from p_0 to p_1, with p denoting the inverse of the poverty rate. The latter movement indicates a drop in the actual poverty rate.

The current sections bring all this together to link the allocation of public expenditures between the different subtypes of services to growth and poverty outcomes. The actual optimization problem underlying the convergence agenda is presented in Figure 4.5b and is expressed in a simple mathematical model that makes it possible to derive answers to the following key questions:

1. What are the conditions for maximizing the growth impact of public expenditures in health, education, and safety net services under given budget levels?
2. To what extent does the composition of health, education, and safety net services affect their impact on labor productivity?
3. What are the types of health, education, and safety net services that have the greatest impact on labor productivity in rural areas?

In sum, a government that pursues convergence in social services expenditures seeks to maximize a utility function U, which reflects a combined objective of meeting the urgent demand for social services and raising productivity and incomes among vulnerable population groups so as to speed up the pace of poverty reduction. Such a government faces the following optimization problem:

Government Objective Function

Let's assume that the government's overall goal is to minimize (or maximize its opposite) a quadratic loss function of the convergent growth and poverty rate targets R' *and* p', respectively, as shown in Figure 4.1 by choosing an optimal level of expenditures on subtypes of social services. The objective function can be specified as follows:

$$\text{Max}_{x_{11},\ldots,x_{mn}} -\frac{1}{2}[\alpha_1(Q-\bar{Q})^2 + \alpha_2(p-\bar{p})^2], \tag{1}$$

with $Q, \bar{Q}, p, \bar{p} \geq 0$; where the convergent level of agricultural production ($\bar{Q}$) instead of the growth rate R' is used; and the convergent poverty rate is denoted by ($\bar{p}$) instead of p' for the sake of notational convenience. The variable x_{ij} represents subtype *i* of social service *j*. The parameters α_1 and α_2 represent the government's assigned weights with respect to the existence or not of a GPS gap and GPE gap as defined above. In the case of a GPS gap, the objective of government is to reduce the growth deficit $(Q-\bar{Q})$, to zero by allocating social services public expenditures so as to move the actual growth rate *R* in Figure 3.1 to *R'*—in other words $\alpha_1 = 1, \alpha_2 = 0$. For the case of a GPE gap, the objective is to reduce the poverty overhang $(p-\bar{p})$ to zero so as to move the actual poverty rate *p* in the same figure to *p'*—that is $\alpha_2 = 1, \alpha_1 = 0$.

The Government's Budget Constraint

$$\overline{B} = B_1 + \ldots + B_m, \tag{2}$$

$$B_j = c_{j1}x_{j1} + \ldots + c_{jn}x_{jn}, \tag{3}$$

$$\bar{B} = \sum_{i=1}^{n}\sum_{j=1}^{m} c_{ij}x_{ij}, \tag{4}$$

where B_j is the budget allocated to social service *j*, c_{ji} is the marginal cost for subservice *i* of social service *j*, and $\overline{B}$ is the government budget for overall social services.

The Agricultural Production Function

Equation 5 describes the production function of the farm household, which treats the government's supply of social services as exogenous:

$$Q = AQ(K, L, I), \tag{5}$$

where *A* represents the level of technology, *K* stands for capital, and *L* and *I* denote labor and infrastructure, respectively. It holds that $Q_K > 0, Q_L > 0, Q_I > 0$.

The Agricultural Labor Supply Function

Next, the supply of labor can be expressed as a function of social services accessed by the farm household as follows:

$$L = L(x_{11}, \ldots, x_{mn}; W), \tag{6}$$

where *W* represents the wage rate, $\{x_{11}, \ldots, x_{mn}\}$ are as defined above, and $L_{x_{ij}} > 0$;and $L_W > 0$.

The Poverty Function

Finally, the following poverty function can be defined, linking the supply of social services via the level of labor productivity to changes in the rate of poverty:

$$p = p(Q_L, T), \tag{7}$$

where p is a measure of poverty (inverse of headcount ratio) positively correlated with the marginal productivity of labor (Q_L), and T represents exogenous locational attributes, such as the relative gap in income distribution (GNI-HNI gap) [7]for the region or study area, the overall level of infrastructure development, or the multi-attribute score of social services, defined below. The latter is defined as in equations 17 and 18:

It follows from equations 5, 6, and 7 that

$$\frac{\partial p}{\partial x_{ij}} = \frac{\partial p}{\partial Q_L}\frac{\partial Q_L}{\partial x_{ij}} > 0. \tag{8}$$

Solution to the Optimization Problem

Substituting equation 6 in equation 5 yields

$$Q = AQ(K; x_{11}, \dots, x_{mn}; W, I). \tag{9}$$

It follows that

$$Q_L = AL(x_{11}, \dots, x_{mn}; W), \tag{10}$$

and

$$p = p(A; x_{11}, \dots, x_{mn}; W; T). \tag{11}$$

Substituting equations 9 and 11 in the objective function, the optimization problem becomes

$$\text{Max}_{x_{11},\dots,x_{mn}} F(\alpha_1, \alpha_2; \bar{Q}, \bar{p}; A; x_{11}, \dots, x_{mn}; W; I;\ T), \text{ subject to } \bar{B} = \sum_{i=1}^{n}\sum_{j=1}^{m} c_{ij}x_{ij}.$$

Therefore the Lagrangian function can be defined as

$$F(\alpha_1, \alpha_2; \bar{Q}, \bar{p}; A; x_{11}, \dots, x_{mn}; W; I; T) + \lambda\left[\bar{B} - \sum_{i=1}^{n}\sum_{j=1}^{m} c_{ij}x_{ij}\right]. \tag{12}$$

The first-order conditions are given by the following system of $m + n + 1$ equations plus the non-negativity constraints

$$\begin{cases} x_{11}: F_{x_{11}} - \lambda c_{11} = 0 \\ \qquad \dots\dots\dots\dots \\ x_{ij}: F_{x_{ij}} - \lambda c_{ij} = 0 \\ \lambda: B - \sum_{i=1}^{n}\sum_{j=1}^{m} c_{ij}x_{ij} = 0 \end{cases}, \tag{13}$$

[7] GNI stands for Gross National Income and HNI for Households National Income.

where $F_{x_{ij}}$ stands for the first-order derivative of the objective function with respect to the individual social service. The solution to the above optimization problem being the set of social services $\{x_{11}^*, \dots, x_{ij}^*\}$, it follows that

$$Q^* = Q^*(x_{11}^*, \dots, x_{ij}^*), \tag{14}$$
$$L^* = L^*(x_{11}^*, \dots, x_{ij}^*), \text{ and} \tag{15}$$
$$p^* = p^*(x_{11}^*, \dots, x_{ij}^*), \tag{16}$$

where $x_{ij}^* = x\{\alpha_1, \alpha_2; c_{ij}; \bar{Q}, \bar{p}; W, K, I, T, A\}$.

Equations 14 to 16 can be estimated individually using ordinary least squares, or alternatively, seemingly unrelated regression techniques, depending on the degree of correlation of the error terms across equations.

The multi-attribute score variable *T* in the above equation is defined as follows: For each location *r,* the score for social service *j,* say health, with respect to attribute *i* defining the existence of that service in region *r*, say the average distance to a health center, is given by

$$S_{ij}^r = \frac{A_{ij}^r}{\max_{r=1,\dots,R}\{A_{ij}^r\}}, \tag{17}$$

where A_{ij}^r is, for instance, the average distance to a health facility in location *r.* Equation 17 accommodates both discrete and continuous attributes. Moreover, such attributes are constructed so that $\partial S_{ij}^r / \partial A_{ij} \geq 0$. For example, we would consider the inverse of the distance to the nearest health facility instead of the distance itself. In other words, locations closer to a health facility are given a higher score than those located far away.

It follows that for every location *r,* the total score over all attributes of service *j* is given by

$$S_{.j}^r = \sum_{i=1}^{m} S_{ij}, \tag{18}$$

with $S_{.j}^r \geq 0$ by construction.

The system of equations 1 through 7 is presented graphically in Figure 3.5b for the case of two social services, X_1 and X_2, each consisting of two subtypes of services. The government maximizes its overall utility function (equation 1) through subutilities u_1 and u_2, yielding the optimum composites of social services X_1 and X_2 (equation 4), under constant sectoral expenditures B_1 and B_2 (equation 3), leading to a decrease in poverty levels from P_0 to P_1 (equation 7), via the increase in labor supply from L_{12} to L'_{12} and of labor productivity from q_{12} to q'_{12} (equations 6 and 5, respectively). The straight, 30-degree-angled line in the third quadrant reflects the assumption of a ratio around 1 between the change in the growth rate and that of the poverty rate, as supported by the empirical estimates of the growth poverty elasticity.

The optimization problem described above is presented graphically in Figure 3.5b for the case of two social services X_1 and X_2, each consisting of two subtypes of services. The government maximizes its overall objective function (equation 1) by eliminating the GPE or GPS gap, subject to the budget constraint (equation 4), yielding the optimum composites of social services X_1 and X_2, the realization of convergent growth and poverty targets, as defined by equations 14 and 16, resulting in the decrease in poverty levels from P_0 to P_1, via the increase in labor supply from L_{12} to L'_{12} and of labor productivity from q_{12} to q'_{12} (equations 15 and 10, respectively). The straight, 30-degree-angled line in the third quadrant reflects the assumption of a convergent growth–poverty pathway, or a ratio around 1 between

the change in the growth rate and that of the poverty rate, as supported by the empirical estimates of the growth–poverty elasticity.

Figure 4.5a. Convergent services PE, labor productivity, and poverty outcomes

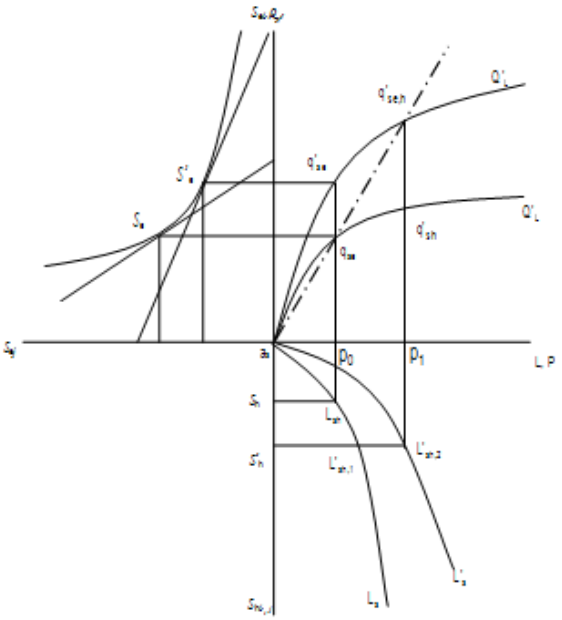
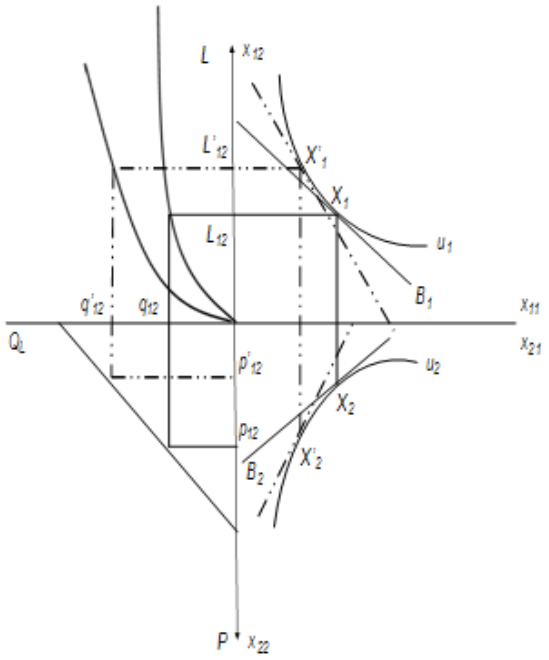


Figure 4.5b. The optimization problem



Quality and Effectiveness of Current Public Expenditures in Social Sectors

Before looking into the conditions for raising the convergence of public expenditures in social sectors, one ought to ask whether current expenditures have any effect at all on income levels and distribution. In other words, have social public expenditures been adequately targeted at the poor and effective at improving income distribution? The next question then is the extent to which there exists a scope to improve public expenditure policies and programs so as to better target the poor and/or prevent a worsening of income distribution, in particular between regions or across gender and other socioeconomic groups. In most countries, a substantial gap exists between per capita national income . and per capita national household income as measured by household surveys. To make a good assessment of the implications of the level and composition of public expenditure in social sectors on income distribution, we must consider not only their effects on the dispersion of income or consumption within the household sector but also their effects on the GNI–HNI gap. Changes in the GNI–HNI gap offer a good first indicator of the extent to which public expenditures have an impact on income distribution. Many factors affect the GNI–HNI gap, including among others the level and structure of taxation and the level and composition of public spending; such factors may vary over time and across countries. In addition to the fiscal variables, several other structural/macroeconomic factors, including per capita GDP, rates of economic growth, debt indicators, and certain institutional factors, affect the GNI–HNI gap. Evidence of the impact of public expenditures on income distribution within the household sector can be analyzed by disaggregating such expenditures into several components and seeing how changes in the total per capita expenditures and changes in the composition of such expenditures affect distribution.

The techniques used to analyze the quality and effectiveness of current public expenditures in social sectors focus on the following:

a. *A measure of household participation in national income.* This is done through estimation of the GNI–HNI gap as a function of the levels and composition of taxes and public expenditures as well as relevant control variables. The actual specification of the estimating equation(s) is to be developed as part of the research process.
b. *An econometric model to study the impact of public expenditures on income distribution within the household sector.* The total household population of a country is thereby divided into different major subregions and into *M* social groups. Parameters are then estimated separately for *M* different equations as follows:

$$y_{ijt} = \psi_{ij} + \alpha_{1i} B_{jt} + \alpha_{2i} Y_{jt} + \widetilde{v}_t + \widetilde{\varepsilon}_{ijt}, \quad i = 1,2,.....M \tag{19}$$

where y_{ijt} stands for the per capita household income of a particular group *i* at time *t* in subregion *j* (alternatively, one may use per capita consumption levels); Y_{jt} is the average household per capita income in the study area; B_{jt} is the stock vector of public goods and social services; ψ_{ij} represents unobserved effects specific to the social group and country; $\widetilde{v}_t$ represents unobserved time effects; and $\widetilde{\varepsilon}_{ijt}$ represents random disturbance. All income variables will come from household living standards measurement study–type surveys in each of the countries. Following Lopez and Galinato (2007), three categories of public expenditures can be considered in equation 19: (1) expenditures in social services (education, health, and social safety nets); (2) public expenditures outside of the social sectors (e.g., technology, infrastructure, law and order, etc.); and (3) other public expenditures.[8]

Parameters in equation 19 are obtained by estimating the equations in differences as that allows the use of flows of public expenditures as proxies for the changes in the stocks of services that may affect the changes in group income.[9] This also helps to mitigate possible biases due to omitted variables. Approaches to deal with possible biases associated with reverse causality will be developed as part of the research work, including eventual use of an approach based on a recent paper by López and Islam (2008), who deal with the problem of reverse causality in estimating the relationships between economic growth and the structure of public spending, also using aggregate panel data.

c. *In-depth interviews and detailed analyses of social expenditures.* A detailed review of public expenditures in social services through in-depth interviews at the level of central and local government is a first step toward identifying the reasons for and possible solutions to an eventual failure of social sector public expenditures to reduce poverty and improve income distribution.

Measuring the Supply of and Access to Social Services

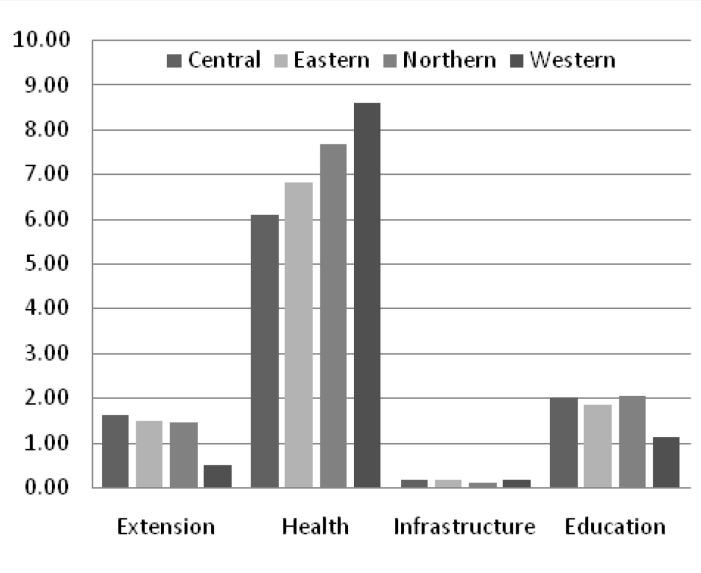
The multi-attribute score indicator discussed above is applied to Ugandan data as an illustration. We use the Ugandan National Household Survey 2005–2006, which covered about 7,400 nationally representative households (UBOS 2007). The survey was comprehensive and had five modules: socioeconomic, agriculture, community, market, and qualitative. It includes data on production and sales of different crops. In terms of attributes, (A_{ij}), over more than 600 communities, we found 28 attributes for infrastructure, 35 for health, 11 for extension, and 15 for education. The list of attributes extracted from the survey is presented in Appendix 2.

[8] The "other public expenditures" category includes mainly government expenditures in private goods, including non-safety-net-related subsidies, the so-called development expenditures, as well as "unproductive" expenditures, such as defense and debt service.

[9] This is important given that, while we have data on the flows of government expenditures for various key components, we do not have reliable measures of their respective stock levels as would be needed to estimate equation 19 directly.

Equations 17 and 18 were computed for four main regions of Uganda—the country's central, eastern, northern, and western areas. The results are presented in Figure 4.6. Several interesting facts can be noted. First, the distribution of scores is very uneven across services and areas. In terms of geographic distribution, the western area exhibits much higher scores with respect to health services than the remaining three regions, whereas the central region is relatively better supplied with education and extension services. Second, the distribution across service sectors shows considerably higher scores for health services, six times higher than for education and extension and significantly higher than infrastructure. The latter is by far the scarcest service. Finally, scores for individual services are highly uneven for a given region, raising the issue of imbalance in availability and uses of such services. Although one cannot assume that the scores have to be the same for every service sector, the severity of the indicated imbalance must mean that the returns on investment in some services may be affected negatively by the lower availability of others. For instance, the extremely low infrastructure score must limit the returns that can be realized from extension services. Low infrastructure development should also limit access to health services and thus reduce returns on investment in the health sector.

Figure 4.6. Social attributes scores across Ugandan regions



Illustrative Evidence of the Impact of Social Services on Productivity

In the following sections, we carry out analysis to provide initial evidence to support the theory of convergence. We do this in three distinct steps. First, we estimate the relationship between individual social services as well as subtypes of services and production efficiency among farming households. The results will indicate the extent to which there is scope to raise the level of household efficiency through adjustments in the mix of services. We then evaluate the relationship between efficiency and poverty outcomes among the same households. Finally, we estimate the impact of expenditures on social outcomes, that is, the access to services and their impact among farming households. The three sets of findings together allow us to link expenditures to social outcomes, and the latter to efficiency and poverty outcomes among farming households.

The Impact of Social Services on Production Efficiency

We illustrate the impact of alternative social services among farming households using the same Ugandan National Household Survey. The list of attributes extracted from the survey is presented in Appendix 2. We use the survey results and the formulas indicated in section E of Appendix 2 to construct disease

prevalence and educational attainment scores for individual households in the survey areas. We then use the attribute scores to estimate the impact of education attainment and illness prevalence, as proxies of the impact of education and health services, on agricultural efficiency, assuming a stochastic production frontier of the following form (Battese and Coelli 1995; Kumbhakar and Lovell 2000):

$$q_i = f(x_i, \beta)\varepsilon_i \exp(\upsilon_i), \tag{20}$$

where $i = 1,..., N$ indexes farmers, q_i is a $(n \times 1)$ vector of output for farmer *i*, x_i is a $(1 \times k)$ vector of associated inputs, β is a $(k \times 1)$ vector of unknown parameters to be estimated, and ε_i represents farmer *i*'s level of efficiency. In addition, the farmer's production activity is subject to a stochastic shock $\upsilon_i \sim N(0, \sigma_\upsilon^2)$.

In log form, equation 20 can be written as

$$\ln q_i = \beta_0 + \sum_{j=1}^{k-1} \beta_j \ln x_{ij} + \ln \varepsilon_i + \upsilon_i . \tag{21}$$

Let $u_i = -\ln \varepsilon_i$, it follows that

$$\ln q_i = \beta_0 + \sum_{j=1}^{k-1} \beta_j \ln x_{ij} - u_i + \upsilon_i , \tag{22}$$

where $u_i \sim N^+(0, \sigma_\upsilon^2)$, and $\lambda = \sigma_u / \sigma_\upsilon$.

Since variables influencing agricultural efficiency (ε_i) may also have a direct impact on agricultural production (q_i), we adopt the approach proposed by Wang and Schmidt (2002) and Liu and Myers (2009) where equation 22 is rewritten as follows:

$$lnq_i = \beta_0 + \sum_{j=1}^{n} \beta_i lnx_{ij} + \upsilon_i - u_i(z_i, \theta),\ u_i(z_i, \theta) \geq 0. \tag{23}$$

where z_i include health and education variables. Thus, to achieve both efficiency and consistency, the frontier function and the inefficiency segment are jointly estimated using a one-step maximum likelihood estimation procedure.
The marginal effect of z_i on production (q_i) and efficiency (u_i) is given by

$$\partial[E(q_i|x_i, z_i)]/\partial z_{ik} = \partial[E(-u_i|x_i, z_i)]/\partial z_{ik}. \tag{24}$$

Equation 24 represents the semi-elasticity of output (efficiency) with respect to exogenous factors—that is, the percentage change in expected output (efficiency) when z_{ik} increases by one unit.

The results of the estimation are presented in Table 4.1. They show positive production elasticities with respect to land and labor as expected, with a labor elasticity (0.11) that is slightly higher than the elasticity of land (0.10).[10] The results also show that the marginal effect of educational attainment on agricultural efficiency is significant and positive. The marginal effect of illness on

[10] Overall, the production function does not exhibit a constant return to scale technology.

efficiency is also significant and negative, confirming that an increase in disease prevalence reduces farmer's efficiency. The results are presented graphically in Figure 4.7a, together with the geographic ramifications in figures 4.8a and 4.8b.

The theory of convergence presupposes the existence of differential impact of social services on productivity or production efficiency. Data on different education services were not available, but we were able to test the variability of the marginal effect of illness on efficiency across diseases or symptoms. The results are reported in Figure 4.7b. They indicate that diseases associated with headache, diarrhea, and cough affect efficiency much more than malaria, for instance, although the latter may be occurring more frequently. Given that the symptoms of malaria also include headache, we had to make sure that the headache variable is not capturing some of the effect of malaria prevalence. For that purpose, we estimate agricultural efficiency again using only the malaria variable and excluding other disease variables. The absolute value of the coefficient increased only marginally, from -0.018 to -0.024, but is still lower than that of headache (-0.043), diarrhea (-0.038), and cough (-0,027). The results indicate that for an equal score, say 3, agricultural efficiency is lowered more for farmers experiencing headache, from the average of 0.7 to 0.57, compared with those suffering from malaria, which lowers efficiency to 0.65, or cough and diarrhea, with corresponding efficiency levels of 0.58 and 0.62.

Table 4.1. Agricultural production and social sector attributes

	Variables[a]	Coefficient[b]	S.E.[c]
Production function (independent variable: production in shillings)			
	Land	0.0978*	0. 0235
	Labor	0.1116*	0. 0182
	Intercept	3.6787*	0.0782
Efficiency function			
	Education (score)	0. 8917*	0. 2826
	Illness (score)	-0.4801**	0.2179
# observations	3,594		
Wald statistic	88.2; *p*-value: 0.00		
Log likelihood	-6345.7		

[a] All variables in the production function are in log form.
[b] *, **, ***: significant respectively at 1%, 5%, and 10%.
[c] S.E.: standard error.

Figure 4.7a. Education, health, and efficiency

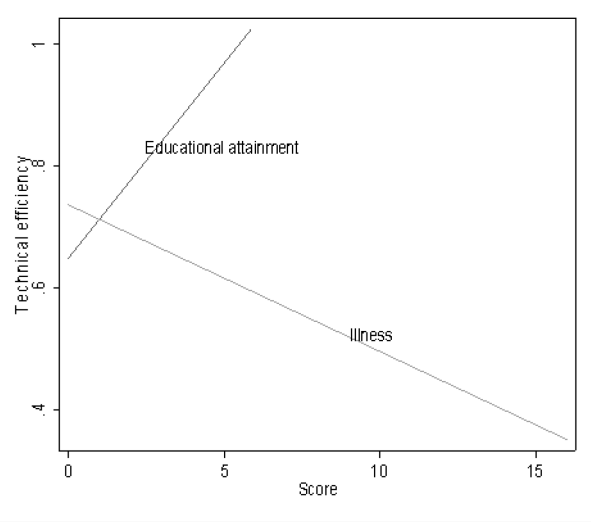
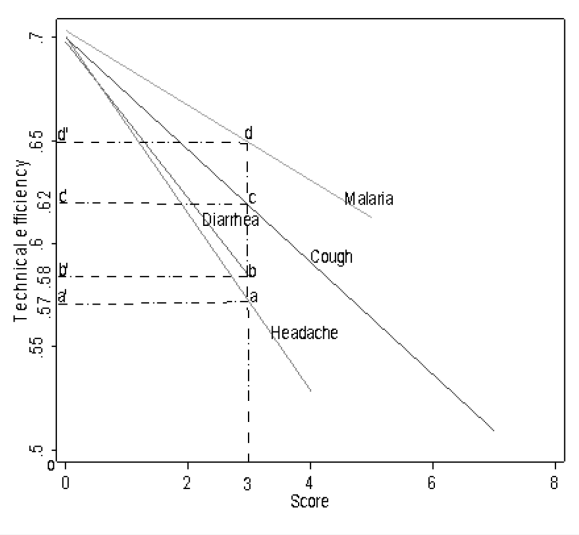


Figure 4.7b. Disease prevalence and efficiency



Access to social services and the implications for production efficiency and poverty do have a strong geographical dimension. That fact is illustrated with the help of figures 4.8a and 4.8b, which show the constellation of districts across the social-score-technical-efficiency space. Districts in the northeast quadrant fare much better in terms of both social scores and efficiency outcomes. The opposite is true for districts in the southwest quadrant, where social scores as well as efficiency outcomes are below average. In addition to seeking the combination of social services that maximizes production efficiency, the convergence agenda should also aim to promote access to social services among households in the latter group of districts. The typology emanating from figures 4.8a and 4.8b should provide helpful guidance to government in formulating and implementing strategies that fit each district situation.

Figure 4.8a. Education and efficiency by districts

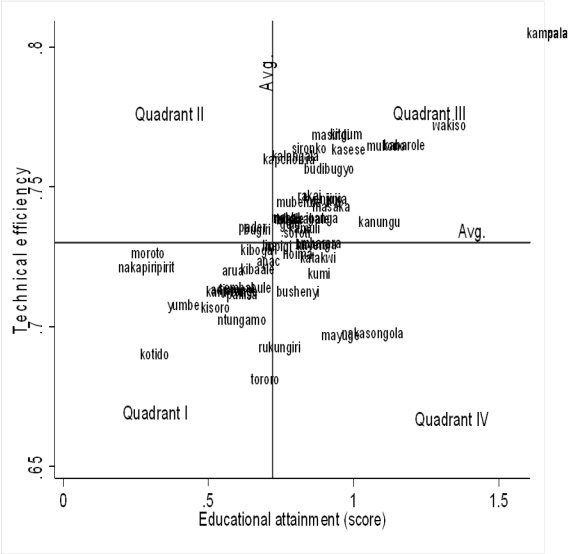
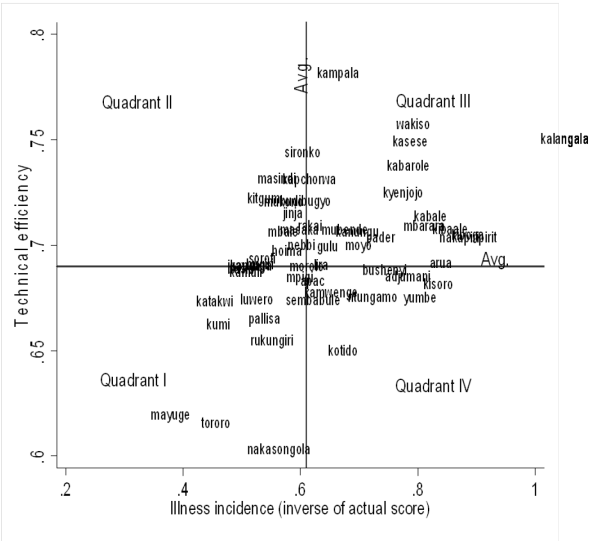


Figure 4.8b. Disease and efficiency by districts

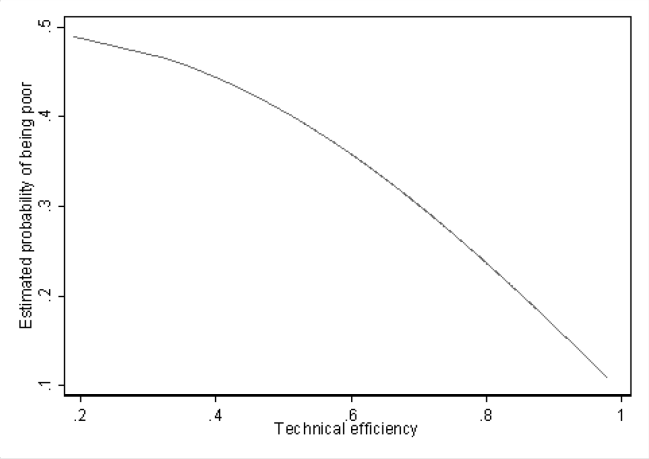


Production Efficiency and Poverty Outcomes

The above results confirm the scope for raising productivity by targeting specific diseases with a strong impact on agricultural production. That covers the first part of the argument behind the convergence agenda. The second is to show that production efficiency outcomes and poverty outcomes are positively related. To do that, we apply a probit model to investigate the relationship between household poverty outcome and production efficiency, after controlling for both individual characteristics and regional heterogeneity. Detailed results of the estimation are presented in Appendix 1, Table A.2.

We find that the marginal effect of technical efficiency on the probability of being poor is -0.56. In other words, a 1 percent increase in production efficiency reduces the probability of being poor by 0.56 percent. The relationship between efficiency and poverty is illustrated with the help of Figure 4.9, which shows the strong negative link between the estimated probability of being poor and changes in the level of agricultural efficiency across farm households in the survey districts.

Figure 4.9. Technical efficiency and household poverty



Source: Authors' calculations.

A cursory look at the pattern of poverty and efficiency across regions provides insight into the equity and distributional issues embedded in the convergence agenda. In figures 4.10a and 4.10b, the levels of efficiency and poverty are compared across regions and gender. With average indices of 0.708 and 0.703, respectively, against a national average of 0.696, the central and western regions are by far the most efficient. Interestingly, poorer households in all regions tend to have lower efficiency levels. Moreover, poorer households in more efficient regions tend to do better than their counterparts in less efficient ones. In sum, the strong link between efficiency and poverty is confirmed.

Figure 4.10a. Regional efficiency and poverty

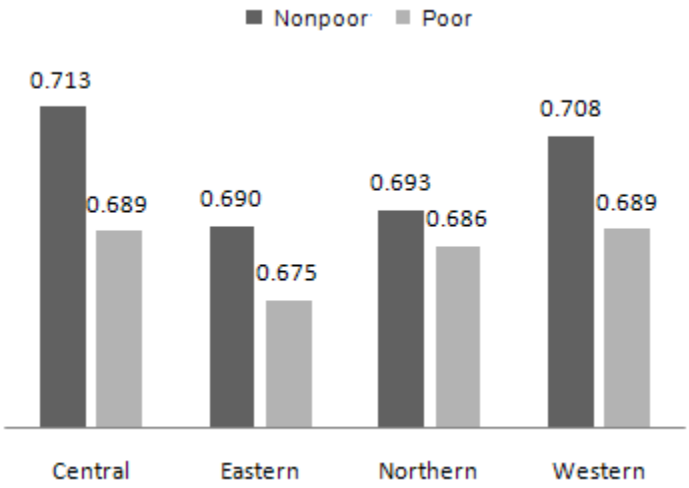
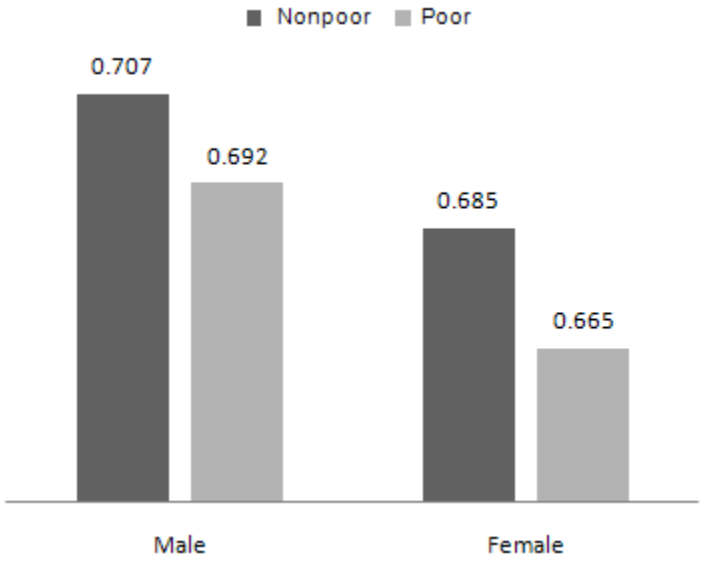


Figure 4.10b. Efficiency, poverty, and gender



Source: Authors' calculations.

Figure 4.10b highlights the gender dimension of the efficiency–poverty nexus. Male farmers appear to be more efficient than their female counterparts. Furthermore, poor male farmers tend to be more efficient than both poor and nonpoor female farmers. Moreover, the poor are still found to be less efficient than the nonpoor, irrespective of the farmers' gender. Strikingly, the difference in efficiency levels between poor and nonpoor is slightly larger among female than male farmers.

Public Expenditure and Access to Social Services

The illustrative evidence presented in the above section proves the validity of two premises of the convergence argument. First, the different subcategories of social services affect efficiency differently, and it should be possible to adjust the mix of services to maximize the productivity impact of social expenditures. Second, agricultural production efficiency is strongly correlated with poverty outcomes

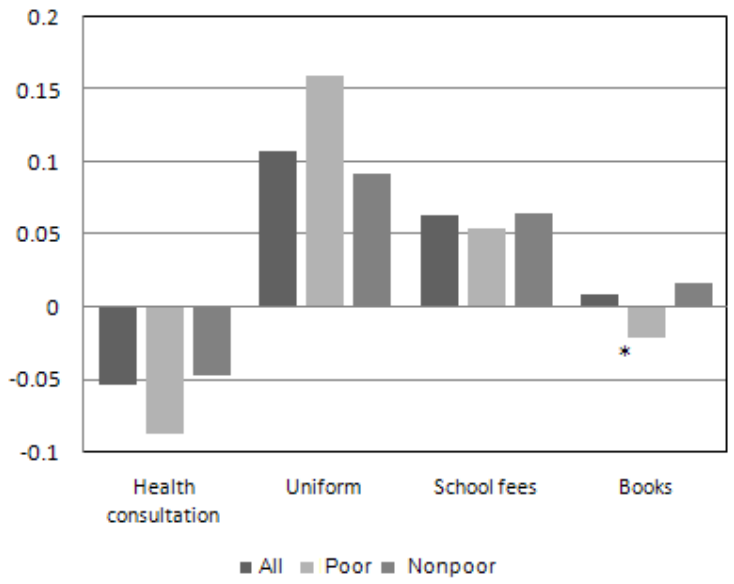
among rural households. The third element of the proof is to show the extent to which public expenditures can improve social outcomes, which would raise efficiency, which in turn would lower poverty levels.

In the absence of public expenditure data on individual subtypes of social services at the district level, we use expenditures by individual households on these services as proxies. Changes in public expenditures on services would affect efficiency and poverty by increasing access to services and improving social outcomes. The same can be said about changes in household expenditures on services. One can therefore interpret higher household expenditures on individual services as an indication of greater access, just as would result from an increase in public expenditures on services in line with the convergence theory, that is, by targeting them toward broadening access and use of priority subservices.

Accordingly, we start by estimating the impact of changes in household expenditures on school fees, books, and uniforms on educational attainment. For health services, we estimate the impact of changes in household expenditures on consultation fees on the disease prevalence. For the latter sector, we could run the estimations for different types of illnesses. The lack of data did not allow us to disaggregate the estimations on the education side. Rather, we computed a log-linear model of overall educational attainment to estimate the impact of household expenditures. On the health services side, we estimate a simultaneous equation system where both illness incidence and consultation fees are endogenous. The reason is that the relationship between health expenditures and illness incidence is not linear, since the incidence of illness should lead to higher expenditures for treatment, while higher expenditures on preventive consultations should reduce the disease prevalence.

In both cases, attribute scores aggregating access to services are used as endogenous variables. The estimations were carried out for all households as well as for poor and nonpoor households, separately. The results are summarized in Figure 4.11. Detailed results from the simultaneous equation estimations are presented in Table A.3 in Appendix 1. The estimated health expenditure elasticities are all positive, except in the case of expenditures by poor households on books, where the elasticity is statistically nonsignificant. The health expenditure elasticities, in contrast, are all negative and statistically significant. The health expenditure elasticities are much higher, in absolute terms, for poor households. For education, elasticities tend to be higher for poor households with respect to expenditures on uniforms, while the opposite is observed for expenditures on school fees. All in all, however, the estimated coefficients support the hypothesized relationships between expenditures and social outcomes.

Figure 4.11. Expenditure elasticity of education and health services among Ugandan households



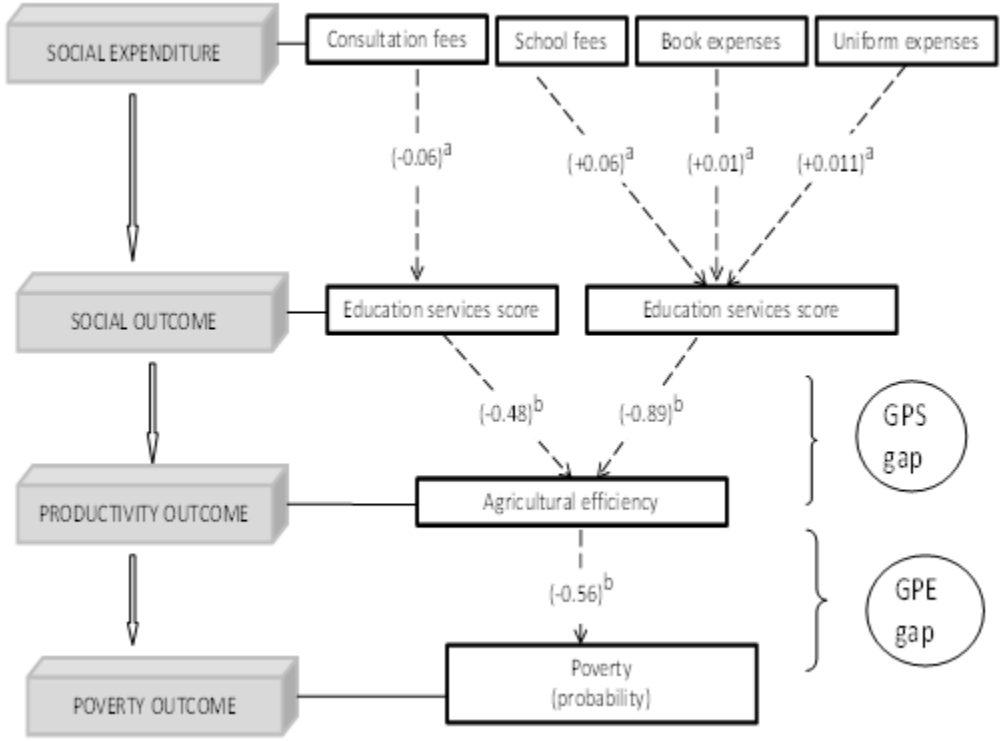
Source: Authors' calculations.

* Not statistically significant.

The evidence that is presented in the preceding sections is summarized in figures 4.12a and 4.12b below. The diagrams illustrate the workings of the theory behind the convergence agenda, which posits that social services are not growth-neutral, meaning that countries facing the double challenge of meeting short-term social needs resulting from large-scale poverty while at same time having to significantly expand investment to boost long-term growth and reduce future poverty can achieve faster progress on both fronts by optimizing expenditures in social sectors so as to maximize their contribution to labor productivity increases among poor households.

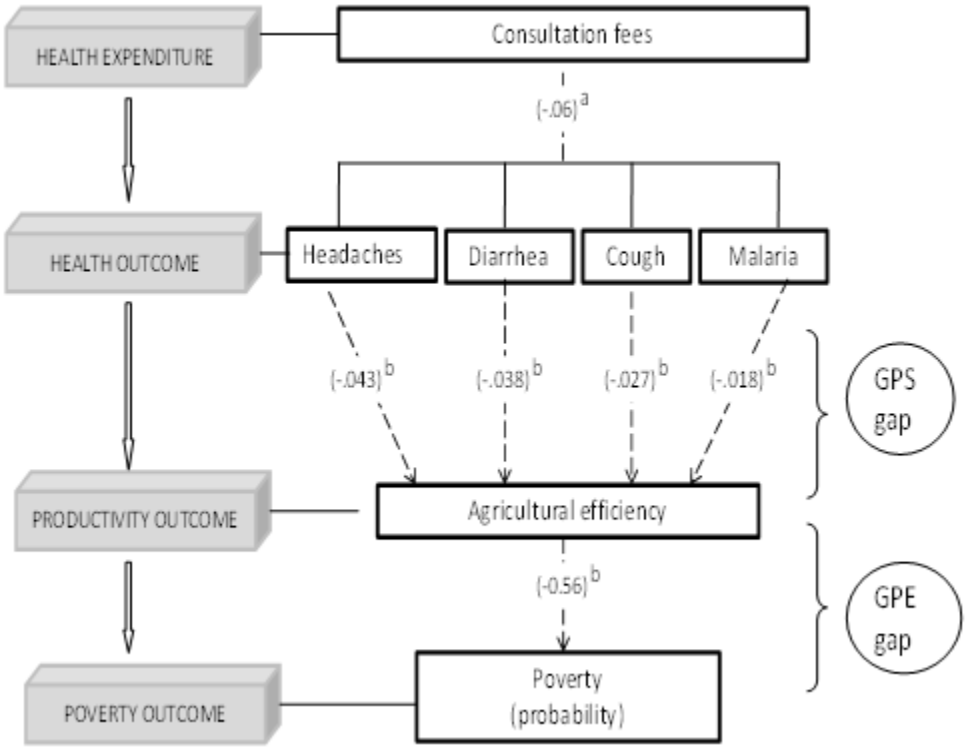
In the case of countries facing a GPS gap and thus having to overcome a growth deficit to sustain the rate of poverty reduction, expenditure policies would have to focus on maximizing the efficiency impact of social services first and foremost, as indicated by the top circles in both figures. In countries dealing with a GPE gap, where growth is not translating into enough poverty reduction, the focus would go beyond the narrow target of efficiency to consider the scope for deploying services to meet short-term social needs and reduce the impact of poverty.

Figure 4.12a. Expenditures, social outcomes, and poverty



Notes: Based on data from Ugandan National Household Survey 2005–2006.
[a] expenditure elasticity coefficient; [b] marginal effect coefficients (impact of 1% increase in top variable on bottom variable).

Figure 4.12b. Health expenditures, illness, and poverty



Notes: Based on data from Ugandan National Household Survey 2005–2006.
[a] expenditure elasticity coefficient; [b] marginal effect coefficients (impact of 1% increase in top variable on bottom variable).

Data Requirement and Future Research Agenda

The current paper has (1) discussed the terminology used in describing the problem being studied and formulated the assumptions and hypotheses underlying the research; (2) defined a typology of growth–poverty pathways; (3) developed metrics to measure the strength of the relationship between growth and poverty reduction; (4) laid out the theory for the measurement of the degree of convergence of public expenditures on social services, that is, the extent to which they are optimized with respect to their impact on labor productivity and growth; and (5) outlined models for (a) the quantification of social services availability at the local level using a single-score concept, (b) the evaluation of the quality and efficiency of public expenditures in social services sectors in rural areas, and (c) the optimization of public expenditures allocation to maximize the impact on growth and poverty reduction; as well as (6) provided initial evidence proving the validity of the theory of convergence. The next steps are to gather the required primary data and apply the different models proposed in this paper to study cases involving more disaggregated social services data.

The main data challenge is that social services and expenditures in these areas are not normally disaggregated into the various sub-bundles. And where they are, they may be at the national and not decentralized level. Assembling the necessary primary and secondary data will require, in addition to existing sources, the implementation of household and community surveys in selected countries. The econometric models will then be applied to such data to estimate parameters linking the supply of and access to individual subtypes of social services to changes in labor productivity and incomes. This part of the analysis can be disaggregated by social categories, making it possible, for instance, to highlight

differences across gender, ethnicity, or other socioeconomic characteristics. More specifically, we intend to combine three different approaches:

1. *Econometric models with secondary macro-level (and partly micro-) data.* This will require relatively large (preferably geographically disaggregated) time series data on social spending, growth, and poverty plus a recent living standards measurement study–type household data set.
2. *Econometric models with primary micro-level data.* Household and community surveys will be carried out in selected areas where significant variability is observed in terms of social policies. Accordingly, a clear sampling framework will be designed to address selectivity issues.
3. *A micro-simulation model combined with a computable general equilibrium (CGE) model, to simulate the long-term growth and poverty impact of changes in the composition of health, education, and social safety services.* While CGE models consider cross-activity interdependencies and facilitate simulation of behavioral responses across institutions, micro-simulation models allow for more heterogeneity and a much more detailed description of household behavior.

The overall findings would then be applied to define service-provision strategies that would help meet social needs while maximizing and sustaining the contribution of public expenditures to growth and poverty reduction in rural areas. Our methodology also allows an explicit assessment of the linkage between progress in MDG 1 and MDGs 2 through 7.

APPENDIX 1

Table A.1. Review of elasticities of growth with respect to poverty among African countries

Country/region	Elasticity	Years	Source
Elasticity of poverty with respect to mean household expenditure			
Ghana	-0.99	1992–1998	Christiaensen, Demery, and Paternostro 2002
Madagascar	-0.27	1993–1997	
Madagascar	-4.51	1997–1999	
Mauritania	-0.82	1987–1995	
Nigeria	-1.3	1992–1996	
Uganda	-1.21	1992–1997	
Zambia	-0.56	1991–1996	
Zambia	-0.35	1996–1998	
Zimbabwe	-1.23	1991–1996	
Tanzania	**-0.69**		TAKWIMU (Bureau of Statistics, Tanzania) 2000
Elasticity of poverty with respect to GDP per capita			
Ghana	-1.19	Early 1990s to early 2000s	World Bank 2005
Senegal	-0.95		
Uganda	-1.04		
Burkina Faso	-2.00		
	Baseline scenario at current trends	Agriculture-led and nonagriculture-led growth	Diao et al. 2007
Ethiopia	-1.10	-1.66 and -0.73	
Ghana	-1.49	-1.78 and -1.33	
Zambia	-0.35	-0.58 and -0.38	
Uganda	-0.98	-1.58 and -1.10	
Kenya	-0.67	-1.25 and -0.57	
Coastal countries avg. (-1.2)	Natural resources–rich avg (-1)	Land-locked avg. (-0.7)	UNIDO 2004
Benin (-1.9)	Cameroon (-1.2)	Burkina Faso (-0.9)	
Cote d'Ivoire (-2.3)	Congo Rep (-1)	Burundi (-0.7)	
Gambia (-1.2)	Guinea (-0.7)	Central African Republic (-0.4)	
Ghana (-1.4)	Mauritania (-1.5)	Chad (-0.4)	
Guinea-Bissau (-0.3)	Namibia (-1.3)	Ethiopia (-0.4)	
Kenya (-1.1)	Nigeria (-0.6)	Lesotho (-0.9)	
Madagascar (-1)	Zambia (-0.4)	Malawi (-1)	
Mozambique (-1.4)		Mali (-0.6)	
Senegal (-1.5)		Niger (-0.7)	
Tanzania (-0.6)		Uganda (-1.2)	
Togo (-0.8)		Zimbabwe (-0.7)	

Table A.1. (continued)

Country/region	Elasticity	Years	Source
Sub-Saharan Africa (SSA)	-2.17	1990–1999	Mosley, Hudson, and Verschoor 2004
Elasticity of poverty with respect to survey mean income			
SSA including South Africa and Nigeria	**-1.23**	1981–2001	Bhorat 2005
SSA excluding South Africa and Nigeria	**-2.32**	1981–2001	

Source: Fan et al. 2008.

Table A.2. Results of the probit model for poverty

Dependent variable: binary (1 if poor, 0 if not poor)			
	Coefficient[a]		S.E.[b]
Technical efficiency	-1.609	*	0.330
Male (1 if male, 0 otherwise)	-0.032		0.057
Urban (1 if live in urban, 0 otherwise)	0.030		0.082
Age (years)	-0.001		0.009
Age squared	5.52E-06		8.5E-05
Central region (default)			
Eastern region	0.072		0.078
Northern region	0.689	*	0.077
Western region	0.155	**	0.077
Intercept	0.412		0.309
Wald: 162.8; *p*-value = 0.00			
Pseudolikelihood: -2113.8			
# Observations: 3,593			

[a] *,**: significant respectively at 1% and 5%.
[b] S.E.: standard error.

Table A.3. Health services expenditures and illness incidence among households

	All households			Poor households			Nonpoor households		
	Coefficient[a]		S.E.[b]	Coefficient[a]		S.E.[b]	Coefficient[a]		S.E.[b]
Illness incidence (score)[c]									
Consultation fees (10,000 Ugandan Shilling)	-0.0532	*	0.0140	-0.0867	**	0.0365	-0.0470	*	0.0151
Male	0.1825	*	0.0248	0.1942	*	0.0414	0.1760	*	0.0316
Age	0.0391	*	0.0038	0.0337	*	0.0063	0.0431	*	0.0048
Age square	-0.0004	*	3.72E-05	-0.0004	*	6.34E-05	-0.0004	*	4.72E-05
Central region (default)									
Eastern region	0.0862	*	0.0301	0.0669		0.0529	0.0954	*	0.0369
Northern region	-0.1303	*	0.0347	-0.2012	*	0.0614	-0.0699		0.0451
Western region	-0.1428	*	0.0301	-0.2292	*	0.0538	-0.1064	*	0.0367
Intercept	-0.4537	*	0.0893	-0.2544	***	0.1472	-0.5676	*	0.1139
Consultation fees (10,000 Ugandan Shilling)									
Illness incidence (score)[c]	1.7395	*	0.4199	1.7126	*	0.5790	1.7922	*	0.5521
Distance to the nearest health facility (km)	0.1034	*	0.0067	0.0757	*	0.0098	0.1152	*	0.0088
Central region (default)									
Eastern region	-0.7004	*	0.1510	-0.4287	**	0.2116	-0.8224	*	0.2035
Northern region	-0.9688	*	0.1517	-0.7347	*	0.2033	-1.0036	*	0.2230
Western region	0.4908	*	0.1571	0.4248	***	0.2499	0.5374	*	0.2003
Intercept	0.5424	*	0.2290	0.3394		0.3232	0.6128	*	0.3008

[a] *, **, ***: significant respectively at 1%, 5%, and 10%.
[b] S.E.: standard error.
[c] In log.

APPENDIX II

SOCIAL SERVICES ATTRIBUTES IN UGANDA

A. EDUCATION SECTOR

General attributes

1. Does a Parent Teachers Association operate? (Yes = 1, No = 0)
2. What is the official school fee per child (highest grade) per year (shillings)?
3. Average spent on text-books and other materials per child in highest grade per year (shillings)?
4. What is the ratio of students per teacher (all grades)?
5. How many passed the national examination last year?
6. Condition of building(s) in general (code)
    a. Well maintained (6)
    b. Average (5)
    c. Poor maintenance (4)
    d. Very poor maintenance (3)
    e. No buildings/no furniture (2)
    f. No proper building/furniture (1)
    g. Others (specify) (0)
7. Has maintenance improved or otherwise over the last year? (code)
    a. Really improved (4)
    b. Some improvements (3)
    c. Same (2)
    d. Some deterioration (1)
    e. Really deteriorated (0)
    f. Constructed this year (.)

Education facilities: Availability

8. Government primary school: 1 if available, 0 if not
9. Private primary school: 1 if available, 0 if not
10. Government secondary school: 1 if available, 0 if not
11. Private secondary school: 1 if available, 0 if not

Education facilities: Distance

12. Government primary school
13. Private primary school
14. Government secondary school
15. Private secondary school

B. EXTENSION SECTOR

1. Proportion of farmers using improved seeds
    a. All of the community (4)
    b. More than half (3)
    c. Half (2)
    d. Less than half (1)
    e. None (0)
2. Proportion of farmers using chemical fertilizer

a. All of the community (4)
b. More than half (3)
c. Half (2)
d. Less than half (1)
e. None (0)

3. Proportion of farmers using pest management
    a. All of the community (4)
    b. More than half (3)
    c. Half (2)
    d. Less than half (1)
    e. None (0)
4. Proportion of farmers with irrigation facility
    a. All of the community (4)
    b. More than half (3)
    c. Half (2)
    d. Less than half (1)
    e. None (0)
    f. Proportion of farmers using ox driven ploughs
    g. All of the community (4)
    h. More than half (3)
    i. Half (2)
    j. Less than half (1)
    k. None (0)
    l. Proportion of farmers participating in rental markets of ox driven ploughs
    m. All of the community (4)
    n. More than half (3)
    o. Half (2)
    p. Less than half (1)
    q. None (0)
5. Is there an agricultural extension center in this community (LC1)? (1 if yes, 0 if no)
6. How far away is the agricultural extension center from the center of this community in kilometers?
7. Proportion of farmers visited by extension agents in the past 12 months
    a. All of the community (4)
    b. More than half (3)
    c. Half (2)
    d. Less than half (1)
    e. None (0)
8. Proportion of female farmers visited by extension agents in the past 12 months
9. Is this community (LC1) covered under NAADS program? (1 if yes, 0 if no)

C. HEALTH SECTOR

General

1. Average number of patients treated per day during week days.
2. How many full-time doctors are posted in this health facility?
3. How many part-time doctors work in the health facility?
4. How many full-time nurses & mid-wives are posted in the health facility?
5. How many part-time nurses & mid-wives work in the health facility?
6. How many other health workers are posted in the health facility?
7. How many nurses & mid-wives are working today in the facility?

8. What is the bed capacity of the health facility?
9. For how many hours is the facility open for public in a week?
10. Is Fansidar (SP) available in your facility? (Yes = 1; No = 0)
11. Is cotrimoxazol available in your facility? (Yes = 1; No = 0)
12. Are there any oral rehydration packages available? (Yes = 1; No = 0)
13. Are there acute respiratory disease medications available? (Yes = 1; No = 0)
14. Are contraceptives available in your facility? (Yes = 1; No = 0)
15. Are there children's immunization vaccines (particularly DPT and measles) available?
16. Regular and available for all types (3)
17. A few regularly available, others at specified periods (2)
    a. Irregular supply (1)
    b. No supply (0)
18. Fee for initial consultation (shillings)
19. Price for Fansidar (SP)—adult dosage (shillings)
20. Price for cotrimoxazol—adult dosage (shillings)
21. Is there any equipment to sterilize needles etc.? (yes = 1; no = 0)
22. Is there any cooling storage with back-up power supply? (code)
    a. Yes, with back-up supply
    b. Yes, without back-up
    c. No
23. Is minimum supply of sterile needles & syringes available? (Yes = 1, n = 2)

Health facilities: Availability

24. Health unit government: 1 if available, 0 if not
25. Hospital government: 1 if available, 0 if not
26. Health unit NGO: 1 if available, 0 if not
27. Hospital NGO: 1 if available, 0 if not
28. Private clinic: 1 if available, 0 if not
29. Pharmacy: 1 if available, 0 if not

Health facilities: Distance

30. Health unit government
31. Hospital government
32. Health unit NGO
33. Hospital NGO
34. Private clinic
35. Pharmacy

D. INFRASTRUCTURE SECTOR

Infrastructure: Availability

1. Only dry season feeder roads: 1 if available, 0 if not
2. All season feeder roads
3. Trunk road (murram)
4. Trunk road (tarmac)
5. Bus stop
6. Taxi/matatu stop
7. Railway stop
8. Factory employing at least 10 people
9. Waterway transport
10. Truck/pickup for transporting inputs/produce

11. Post office
12. Telephone service
13. Bank branch office
14. Microcredit institution

Infrastructure: How far?

15. Only dry season feeder roads
16. All season feeder roads
17. Trunk road (murram)
18. Trunk road (tarmac)
19. Bus stop
20. Taxi/matatu stop
21. Railway stop
22. Factory employing at least 10 people
23. Waterway transport
24. Truck/pickup for transporting inputs/produce
25. Post office
26. Telephone service
27. Bank branch office
28. Microcredit institution

E. ATTRIBUTE SCORES FOR HEALTH AND EDUCATION

For each household *h* , every member *i* of the household has a score for social outcome *j* given by

$$S_{ij} = \frac{A_{ij}}{\max_{=1,\dots,H}\{A_{ij}\}}.$$

It follows that for every household *h*, the total score for social outcome *j* is given by

$$S_{.j} = \sum_{i=1}^{m} S_{ij}.$$

By construction, $S_{.j} \geq 0$.

Individual attributes are calculated as follows:

1. For the health sector, attributes are calculated based on the incidence of given illnesses, with a value of 1 if the household member is affected and 0 otherwise.
2. The attributes in the educational sector are computed based on the following rule:
   attribute = 1 if not completed primary 1
   attribute = 2 if completed primary 1
   attribute = 3 if completed primary 2
   attribute = 4 if completed primary 3
   attribute = 5 if completed primary 4
   attribute = 6 if completed primary 5
   attribute = 7 if completed primary 6
   attribute = 8 if completed primary 7
   attribute = 9 if completed junior 1
   attribute = 10 if completed junior 2
   attribute = 11 if completed junior 3

attribute = 12 if completed secondary 1
attribute = 13 if completed secondary 2
attribute = 14 if completed secondary 3
attribute = 15 if completed secondary 4
attribute = 17 if completed secondary 5
attribute = 18 if completed primary 6
attribute = 19 if post secondary specialized training
attribute = 20 if completed degree and above

APPENDIX III

The Relationship between the Value of ε Based on the Poverty Rate and the Inverse Poverty Rate

The derivation of the GPE and GPS gaps are based on the assumption of a 45-degree line depicting the convergent growth–poverty path, yielding a tangent value of 1, in line with the empirical estimates of growth–poverty elasticities summarized in Appendix 1. The above elasticity estimates are based on the poverty rate, whereas the geometrical constructs in Figure 3.1 are based on the inverse poverty rate. Consequently, the mathematical expressions for the poverty overhang and growth deficit that are used as measures for the GPE and GPS gaps, respectively, are based on an elasticity formula using the inverse poverty rate and not the poverty rate itself. The relationship between the two elasticity formulas is derived below to verify that this should not affect the validity of the GPE and GPS indicator as defined in the text.

First, let $\varepsilon = \frac{\Delta R}{\Delta P}\frac{\bar{P}}{\bar{R}}$ be the elasticity of growth (R) with respect to poverty, using the poverty rate (P), and $\varepsilon' = \frac{\Delta R}{\Delta p}\frac{\bar{p}}{\bar{R}}$ the elasticity of growth with respect to poverty, using the inverse poverty rate (p).

The inverse of the poverty rate being $p_t = 1/P_t$; its first difference Δp can be written as

$$\Delta p = p_t - p_{t-1} = \frac{1}{P_t} - \frac{1}{P_{t-1}} = -\frac{(P_t - P_{t-1})}{P_t P_{t-1}} \quad (1)$$

Further, the average of the inverse of the poverty rate for any two periods is given by

$$\bar{p} = \frac{p_t + p_{t-1}}{2} = \frac{1}{2}\left(\frac{1}{P_t} + \frac{1}{P_{t-1}}\right) = \frac{(P_{t-1} + P_t)}{2P_t P_{t-1}}. \quad (2)$$

It follows that

$$\varepsilon' = -\frac{\Delta R}{(P_t - P_{t-1})/P_t P_{t-1}}\frac{(P_{t-1} + P_t)/2P_t P_{t-1}}{\bar{R}} = -\frac{\Delta R}{\Delta P}\frac{\bar{P}}{\bar{R}} = -\varepsilon. \quad (3)$$

The absolute value of the elasticity is the same, thus confirming the validity of the geometric and mathematical derivation of the GPE and GPS indicators, and its conformity with observed empirical estimates.

REFERENCES

Afonso, A., L. Schuknecht, and V. Tanzi. 2008. *Income distribution determinants and public spending efficiency.* Working Paper 861. Frankfurt: European Central Bank.

Agénor, P. R., and K. C. Neanidis. 2006. *The allocation of public expenditure and economic growth.* Centre for Growth and Business Cycle Research Discussion Paper 69. Manchester: UK. University of Manchester.

Ajani, O. I. Y., and P. C. Ugwu. 2008. Impact of adverse health on agricultural productivity of farmers in Kainji Basin north-central Nigeria using a stochastic production frontier approach. *Trends in Agriculture Economics* 1: 1–7.

Alene, A. D., and V. M. Manyong. 2006. Endogenous technology adoption and household food security: The case of improved cowpea varieties in northern Nigeria. *Quarterly Journal of International Agriculture* 45 (3): 211–230.

Alesina, A. F., and D. Rodrik. 1994. Distributive politics and economic growth. *Quarterly Journal of Economics* 109 (3): 465–490.

Appleton, S. 2000. *Education and health at the household level in Sub-Saharan Africa.* Center for International Development Working Paper 33. Cambridge: Harvard University.

Appleton, S., and A. Balihuta. 1996. Education and agricultural productivity: Evidence from Uganda. *Journal of International Development* 8: 415-444.

Audibert, M., and J.-F. Etard. 2003. Productive benefits after investment in health in Mali. *Economic Development and Cultural Change* 51: 760–782.

Badiane, O. 2008. *Sustaining and accelerating Africa's agricultural growth recovery in the context of changing global food prices.* Policy Brief 9. Washington, D.C.: International Food Policy Research Institute.

Barro, R. J. 1990. Government spending in a simple model of endogenous growth. *Journal of Political Economy* 98 (5): 103–126.

Bassett, W., F. J. P. Burkett, and L. Putterman. 1999. Income distribution, government transfers, and the problem of unequal influence. *European Journal of Political Economy* 15 (2): 207–228.

Battese, G. E., and T. J. Coelli. 1995. A model for technical inefficiency effects in a stochastic frontier production function for panel data. *Empirical Economics* 20: 325–332.

Becker, G. S. 1964. *Human capital: A theoretical and empirical analysis, with special reference to education.* New York: Columbia University Press.

Bhargava, A., T. Dean, L. J. Jamison, and C. J. L. Murray. 2001. Modeling the effects of health on economic growth. *Journal of Health Economics* 20: 423–440.

Bhorat, H. 2005. *Poverty, inequality, and labor markets in Africa: A descriptive overview.* Development Policy Research Unit Working Paper 05/92. Cape Town: South Africa. University of Cape Town.

Christiaensen, L., L. Demery, and S. Paternostro. 2002. *Economic growth and poverty reduction in Africa: Messages from the 1990's.* Washington, D.C.: World Bank.

Devereux, S. 2007. The impact of droughts and floods on food security and policy options to alleviate negative effects. In *Contributions of agricultural economics to critical policy issues: Proceedings of the 26th Conference of the International Association of Agricultural Economists,* ed. K. Otsuka and K. Kalijaran. Oxford: Blackwell.

_____. 2008. Targeting social safety nets to support agricultural growth in rural areas. Paper presented at the international conference "Convergence between Social Service Provision (SSP) and Productivity Enhancing Investments (PEI) in Development Strategies," January 29–31, University of KwaZulu-Natal, Pietermaritzburg, South Africa.

Diao, X., P. Hazell , D. Resnick, and J. Thurlow. 2007. *The role of agriculture in development: Implications for Sub-Saharan Africa.* Research Report 153. Washington, D.C.: International Food Policy Research Institute.

Fan, S., and N. Rao. 2003. *Public spending in developing countries: Trend, determination, and impact.* Environment and Production Technology Division Discussion Paper 99. Washington, D.C.: International Food Policy Research Institute.

Fan, S., and M. W. Rosegrant. 2008. *Investing in agriculture to overcome the world food crisis and reduce poverty and hunger.* Policy Brief 3. Washington, D.C.: International Food Policy Research Institute.

Fan, S., P. Hazell, and S. Thorat. 2000. Government spending, growth, and poverty in rural India. *American Journal of Agricultural Economics* 82: 1038-1051.

Fan, S., X. Zhang, and N. Rao. 2004. *Public expenditure, growth, and poverty reduction in rural Uganda.* Development Strategy and Governance Division Discussion Paper 4. Washington, D.C.: International Food Policy Research Institute.

Fan, S., L. Zhang, and X. Zhang. 2002. *Growth, inequality, and poverty in rural China: The role of public investments.* Research Report 125. Washington, D.C.: International Policy Food Research Institute.

Fan, S., M. Johnson, A. Saurkar, and T. Makombe. 2008. *Investing in African agriculture to halve poverty by 2015.* Washington, D.C.: International Policy Food Research Institute.

Fields, G. S. 2001. *Distribution and development.* New York: Russell Sage Foundation.

Fiszbein, A., and N. Schady. 2009. *Conditional cash transfers reducing present and future poverty.* Washington, D.C.: World Bank.

Fogel, R. W. 1994. The relevance of Malthus for the study of mortality today: Long-run influences on health, mortality, labor force participation, and population growth. In *Population, Economic Development, and the Environment,* ed. K. Lindahl-Kiessling and H. Landberg, 231–284. Oxford: Oxford University Press.

_____. 2004. Health, nutrition, and economic growth. *Economic Development and Cultural Change* 52: 643–658.

Fox, M. P., S. Rosen, W. B. MacLeod, M. Wasunna, M. Bii, G. Foglia, and J. L. Simon. 2004. The impact of HIV/AIDS on labour productivity in Kenya. *Tropical Medicine and International Health* 9: 318–324.

Gemmell, N. 1996. Evaluating the impacts of human capital stocks and accumulation on economic growth: Some new evidence. *Oxford Bulletin of Economics and Statistics* 58: 9–28.

Gillespie, S., ed. 2006. AIDS, poverty, and hunger: Challenges and responses. *Highlights of the International Conference on HIV/AIDS and Food and Nutrition Security*, April 14–16, 2005, Durban, South Africa. Washington, D.C.: International Food Policy Research Institute.

Gilligan, D., J. Hoddinott, and A. S. Taffesse. 2008. *The impact of Ethiopia's productive safety net programme and its linkages.* Discussion Paper 00839. Washington, D.C.: International Food Policy Research Institute.

Griliches, Z. 1963. The sources of measured productivity growth: United States agriculture, 1940-60. *Journal of Political Economy 71 (4)*: *331-346.* University of Chicago Press.

_____. 1964. Research expenditures, education, and aggregate agricultural production function. *American Economic Review* 54: 961–974.

Gylafson, T., and G. Zoega. 2003. *Education, social equality, and economic growth: A view of the landscape.* CESifo Working Paper 876. Munich: Center for Economic Studies and Institute for Economic Research.

Hawkes, C., and M. T. Ruel. 2006a. The links between agriculture and health: An intersectoral opportunity to improve the health and livelihoods of the poor. *Bulletin of the World Health Organization* 84: 985–991.

_____. 2006b. Understanding the links between agriculture and health for food, agriculture, and the environment: Overview. *2020 Focus 13.* Brief 1 of 16. Washington, D.C.: International Food Policy Research Institute.

Hoddinott, J. 2005. *Vulnerability, shocks, and impacts in Ethiopia and Malawi: Implications for public action.* Washington, D.C.: International Food Policy Research Institute.

Holmes, R., J. Farrington, T. Rahman, and R. Slater. 2008. *Extreme poverty in Bangladesh: Protecting and promoting rural livelihoods.* Project Briefing 15. London: Overseas Development Institute.

Jayachandran, S. And A. Lleras-Muney. 2009. Life Expectancy And Human Capital Investments: Evidence From Maternal Mortality Declines. The Quarterly Journal of Economics Volume 124 (1): 349-397.

Klasen, S. 2004. In search of the holy grail: How to achieve pro-poor growth? In *Annual World Bank Conference on Development Economics—Europe 2003*, Bertil Tungodden,B., N. Stern and I. Kolstad (eds.). Paris: International Bank for Reconstruction and Development / World Bank.

Kraay, A. 2006. When is growth pro-poor? Evidence from a panel of countries. *Journal of Development Economics* 80: 198–227.

Krueger, A. B., and M. Lindahl. 2001. Education for growth: Why and for whom? *Journal of Economic Literature* 39: 1101–1136.

Kumbhakar, S. C., and C. A. K. Lovell. 2000. *Stochastic frontier analysis.* Cambridge: Cambridge University Press.

Liu, Y., and R. Myers. 2009. Model selection in stochastic frontier analysis with an application to maize production in Kenya. *Journal of Productivity Analysis* 31: 33–46.

Lockheed, M. E., D. T. Jamison, and L. J. Lau. 1980. Farmer education and farm efficiency: A survey. *Economic Development and Cultural Change* 29 (1): 37–76.

López, R., and G. Galinato. 2007. Should governments stop subsidies to private goods? Evidence from rural Latin America. *Journal of Public Economics* 91: 1071–1094.

López, R., and A. Islam. 2008. When government spending serves the elites: Consequences for economic growth in a context of market imperfections. Draft paper, University of Maryland, College Park, U.S.A., September.

Miguel, E., and M. Kremer. 2004. Worms: Identifying impacts on education and health in the presence of treatment externalities. *Econometrica* 72: 159–217.

Mincer, J. 1974. *Schooling, earnings, and experience.* New York: Columbia University Press.

Mosley, P., J. Hudson, and A. Verschoor. 2004. Aid, poverty reduction, and the "New Conditionality." *The Economic Journal* 114 (496): F217–F243.

Phillips, J. M. (1994). "Farmer Education and Farmer Efficiency: A Meta-Analysis," Economic Development and Cultural Change 43.

Persson, T., and G. Tabellini. 1994. Is inequality harmful for growth? *American Economic Review* 84: 600–621.

Ravallion, M. 1995. Growth and poverty: Evidence for developing countries in the 1980's. *Economics Letters* 48: 411–417.

Ravallion, M. 2004. *Pro-poor growth: A primer.* Policy Research Working Paper 3242. Washington, DC: World Bank.

Ravallion, M., and S. Chen. 1997. What can new survey data tell us about recent changes in distribution and poverty? *World Bank Economic Review* 11:357–382.

Ross, C., and C. Wu. 1995. The links between education and health. *American Sociological Review* 60 (5): 719–745.

Sachs, J. D. 2001. *Macroeconomics and health: Investing in health for economic development. Report of the Commision on Macroeconomics and Health*. Geneva: World Health Organization.

Strauss, J. 1986. Does better nutrition raise farm productivity? *Journal of Political Economy* 94: 297–320.

TAKWIMU. 2000. *Developing a poverty baseline in Tanzania.* Der es Salaam, Tanzania: National Bureau of Statistics.

Thurlow, J., S. Benin, X. Diao, H. Kalinda, and T. Kalinda. 2008. *Agricultural growth and investment options for poverty reduction in Zambia.* Discussion Paper 00791. Washington, D.C.: International Food Policy Research Institute.

Topel, R. 1999. Labor markets and economic growth. In *Handbook of labor economics,* ed. Orley Ashenfelter and David Card. Amsterdam: North Holland.

Uganda Bureau of Statistics. 2007. Uganda National Household Survey 2005/2006: Report on the Socio-Economic Module. Available at: http://www.ubos.org/onlinefiles/uploads/ubos/survey%20documentation/UNHS2005-2006/survey0/technicalInformation/questionnaire.html

United Nations Industrial Development Organization (UNIDO). 2004. *Industrialization, environment, and the Millennium Development Goals in Sub-Saharan Africa: The new frontier in the fight against poverty.* UN Industrial Development Report. Vienna, Austria.

Van der Ploeg, F. 2003. *Do social policies harm employment and economic growth?* CESifo Working Paper 886.Munich: Center for Economic Studies and Institute for Economic Research, European University Institute.

Wang, H. J., and P. Schmidt. 2002. One-step and two-step estimation of the effects of exogenous variables on technical efficiency levels. *Journal of Productivity Analysi*s 18: 129–144.

Weir, S. 1999. *The effects of education on farmer productivity in rural Ethiopia.* Working Paper 91.Oxford: Center for the Study of African Economies.

World Bank. 1990. *World development report: Poverty.* New York: Oxford University Press.

_____. 2000. *World development report: Attacking poverty.* New York: Oxford University Press.

_____. 2005. *Pro-poor growth in the 1990s: Lessons and insights from 14 countries.* Operationalising Pro-Poor Growth Research Program. Washington, D.C.: Agence Française de Développement, Bundesministerium für Wirtschaftliche Zusammenarbeit und Entwicklung, U.K. Department for International Development, and World Bank.

Zhang, X., and S. Fan. 2004. How productive is infrastructure? A new approach and evidence from rural India. *American Journal of Agricultural Economics* 86: 494–501.

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