WPS4013

The Role of Agriculture in Poverty Reduction

An Empirical Perspective

Luc Christiaensen, Lionel Demery and Jesper Kühl[1, 2]

Abstract:

The relative contribution of a sector to poverty reduction is shown to depend on its direct and indirect 'growth effects' as well as its 'participation effect'. The paper assesses how these effects compare between agriculture and non-agriculture by reviewing the literature and by analyzing cross-country national accounts and poverty data from household surveys. Special attention is given to Sub-Saharan Africa. While the direct growth effect of agriculture on poverty reduction is likely to be smaller than that of non-agriculture (though not because of inherently inferior productivity growth), the indirect growth effect of agriculture (through its linkages with non-agriculture) appears substantial and at least as large as the reverse feedback effect. The poor participate much more in growth in the agricultural sector, especially in low-income countries, resulting in much larger poverty reduction impact. Together, these findings support the overall premise that enhancing agricultural productivity is the critical entry-point in designing effective poverty reduction strategies, including in Sub-Saharan Africa. Yet, to maximize the poverty reducing effects, the right agricultural technology and investments must be pursued, underscoring the need for much more country specific analysis of the structure and institutional organization of the rural economy in designing poverty reduction strategies.

JEL classification: D3, O1
Keywords: Agriculture, Economic Growth, Poverty Reduction, Sub-Saharan Africa

World Bank Policy Research Working Paper 4013, September 2006

---

[1]The paper is prepared as part of a multi-country empirical investigation to re-assess the role of agriculture in poverty reduction in Sub-Saharan undertaken by the Africa Region in the World Bank and financed under the Norwegian ESSD Trust Fund. The case studies, undertaken in Ethiopia, Kenya, Madagascar and Tanzania, take a mainly micro-economic perspective, and typically utilize household and farm surveys. A companion paper synthesizes the results of these studies.

[2] The authors are at the World Bank and can be contacted at **lchristiaensen@worldbank.org**, **ldemery@worldbank.org**, **jesper_kuehl@yahoo.dk**. Comments by Martin Ravallion and Derek Byerlee helped improve an earlier draft and are gratefully acknowledged.

1 Introduction

While it has long been recognized that economic development is inextricably linked to agriculture, there has been little consensus about its precise role. The dual economy models inspired by Lewis (1954) and popular in development economics in the 1960s and the 1970s typically featured agriculture as a backward, subsistence sector. In this view, resources were to be drawn from the unproductive agricultural sector to encourage development of the productive industrial sector. Much of the early development economics literature was thus interpreted as supporting an industrialization strategy, leading to an urban bias in development planning (Lipton, 1977), and fiscal and trade systems that systematically over-taxed agriculture (Krueger et al., 1988).

A more positive view on the role of agriculture in development (especially during the early stages) emerged later, following the seminal contributions by Johnston and Mellor (1961) and Schultz (1964). They emphasized the critical contributions of the agricultural sector to growth in the non-agricultural sectors, implying that investments and policy reforms in agriculture might actually yield faster overall economic growth, even though agriculture itself might grow at a slower pace than non-agriculture. Since then several authors have found that the multiplier effects from agriculture to non-agriculture are indeed substantial, especially in Asia, but also in Sub-Saharan Africa (SSA) (Haggblade, Hammer and Hazell, 1991; Delgado et al., 1998). The experience of the Green Revolution in Asia, whereby traditional agriculture was rapidly transformed into a fast growing modern sector through the adoption of science based technology, provided further confidence in the proposition of agriculture as an engine of growth.

More recently, the development community has shifted its focus from fostering economic growth per se to maximizing poverty reduction, or achieving ‘shared’ growth—growth with a maximum pay-off in terms of poverty reduction (World Bank, 2005a). This has added a new dimension to the debate about the relative role of agriculture versus non-agriculture, as poverty reduction not only depends on the rate of overall economic growth, but also on the ability of poor people to connect to that growth (i.e. the 'quality' of growth). As the majority of poor people in the developing world (and especially in SSA) depend directly on agriculture for their livelihood, it is often argued that agricultural growth has a higher return in terms of poverty reduction (i.e. a higher 'participation effect') than an equal amount of growth in non-agriculture.

Both the growth and the participation effects continue to be hotly debated for each sector, especially in the African context. On the growth side, some contend that agricultural productivity growth is central to sustainable economic development (Mellor, 1976; Timmer, 2005). Others hold that for Africa at least, the classical intersectoral linkages no longer apply, and a pro-agriculture strategy will not deliver the overall growth necessary for rapid poverty reduction. On the participation side, the sheer weight of numbers, with the majority of poor people depending on agriculture, suggests that agriculture will deliver a greater participation effect. But it is also argued that African agricultural development will not involve the majority of poor smallholder farmers, but can only succeed among larger commercial farmers (Maxwell, 2004). The extent to which poor people would gain from a pro-agriculture strategy is questionable in this view.

Understanding how these counterbalancing forces play out in terms of poverty reduction across sectors is central to the development of effective poverty reducing strategies. Yet, to further this debate, an empirical perspective is needed, focusing on three key questions: 1) Do investment and policy reform in agriculture enhance overall growth more than investment and policy reform in non-agriculture? 2) Is participation by the poor in agricultural growth on average higher than their participation in non-agricultural growth, and if so, under what conditions? 3) If a focus on agriculture would tend to yield slower overall growth, but larger participation by the poor, compared with a focus on non-agriculture, which strategy would tend to have the largest pay-off in terms of poverty reduction, and under which circumstances?

These are the central issues addressed in this paper. To do so, it complements the empirical insights from the literature on historical experiences in Asia and Latin America (Ravallion and Datt, 1996, 2002; Bravo-Ortega and Lederman, 2005; World Bank, 2005b) with cross-country analysis using national accounts evidence on sectoral growth combined with poverty data from household surveys. Special attention is given to SSA, though the evidence we bring to the debate covers the wider developing world.

The paper begins by developing a simple conceptual framework (section 2) in which the effects of agriculture and non-agriculture on poverty are shown to arise from two principal sources: a growth effect and a participation effect. The paper then examines the direct and indirect growth effects across both sectors in sections 3 and 4, followed by an assessment of potential differences in the participation component in section 5. Section 6 synthesizes how these different effects are expected to play out in terms of poverty reduction across different groups of countries and concludes.

2 Conceptual Framework

Let P_i be any (decomposable) measure of poverty and Y_i per capita Gross Domestic Product (GDP) in country *i*. The proportionate change in poverty in a country *i* can then be seen to be identical to the GDP elasticity of poverty (defined as the proportionate change in poverty divided by the proportionate change in per capita GDP)[3], times the proportionate change in per capita GDP (Y_i):

$$\frac{dP_i}{P_i} \equiv \left(\frac{dP_i}{P_i}\frac{Y_i}{dY_i}\right)\frac{dY_i}{Y_i} \qquad (1)$$

We refer to the first multiplicative term in (1) as the *participation effect* and the second multiplicative term as the *growth* effect.

Not all growth processes generate an equal amount of overall growth nor an equal amount of poverty reduction (World Bank, 2000). The growth and participation effects may differ substantially across sectors. The latter has been illustrated empirically for India by Ravallion and

[3] Note, by using GDP growth rather than mean household income change as is common in this sort of identity, we are very much focusing on the overall growth process (not simply the growth in household income). The elasticity concept used here reflects the impact of growth on both average incomes of households and how those incomes are distributed. This is commonly referred to as the "growth elasticity of poverty" which is strictly speaking not correct.

Datt (1996; 2002) and for China by Ravallion and Chen (2004). To accommodate such differences, we rewrite (1) as a weighted sum of the contributions to poverty reduction of both the agricultural and the non-agricultural sectors:

$$\frac{dP_i}{P_i} \equiv q\left(\frac{dP_i}{P_i}\frac{Y_{ai}}{dY_{ai}}\right)\frac{dY_{ai}}{Y_{ai}} + (1-q)\left(\frac{dP_i}{P_i}\frac{Y_{ni}}{dY_{ni}}\right)\frac{dY_{ni}}{Y_{ni}} \quad (2)$$

with *a* denoting agriculture, *n* non-agriculture, and *q* any constant (1<*q*<0). A meaningful choice for *q* is $q=(Y_{ai}/Y_i)=s_{ai}$ the share of agriculture in total GDP in country *i*. It follows that (*1-q*) equals $(Y_{ni}/Y_i)=s_{ni}$, the share of non-agriculture in total GDP in country *i* and (2) becomes:

$$\frac{dP_i}{P_i} \equiv \left(\frac{dP_i}{P_i}\frac{Y_{ai}}{dY_{ai}}\right)s_{ai}\frac{dY_{ai}}{Y_{ai}} + \left(\frac{dP_i}{P_i}\frac{Y_{ni}}{dY_{ni}}\right)s_{ni}\frac{dY_{ni}}{Y_{ni}} \quad (3)$$

Using lower cases to represent rates of change for P_i and Y_i gives:

$$p_i \equiv \varepsilon_{ai}s_{ai}\,y_{ai} + \varepsilon_{ni}s_{ni}\,y_{ni} \quad (4)$$

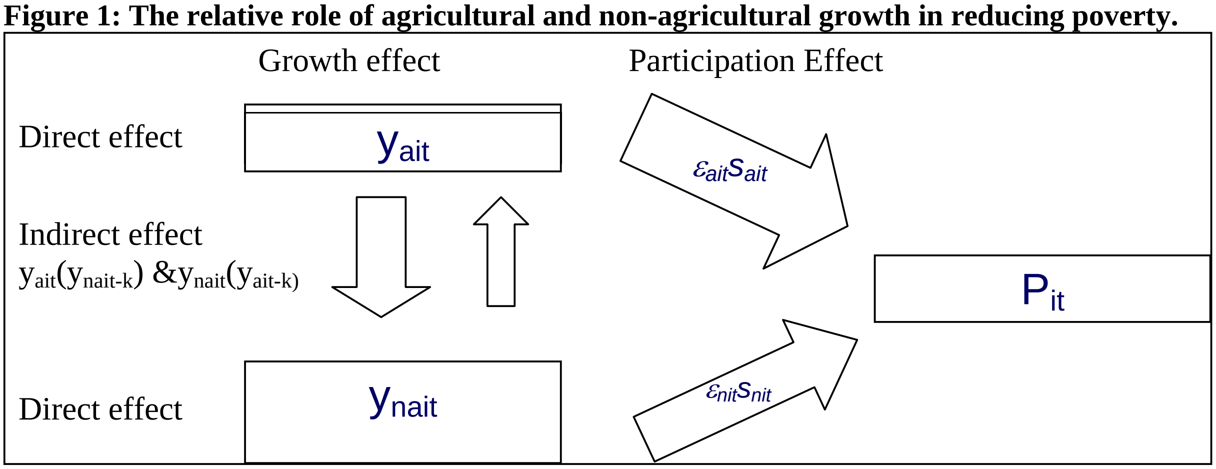
where y_{ki} is the growth rate of per capita GDP in sector *k*=*a*,*n*, ε_{ki} the elasticity of total poverty with respect to per capita GDP in sector *k*, and s_{ki} the share of sector *k* in total GDP.

From equation (4) it is clear that the impact of a sector (e.g. agriculture) on poverty depends on how its pace of growth performs compared with the other sector (non-agriculture). In addition, a large literature exists, showing that accelerating agricultural growth will induce changes in other sectors, resulting in higher non-agriculture growth. While the reverse interaction might also hold, the literature suggests that these effects are smaller. The growth effect of a sector therefore will have two components: the *direct* contribution (or the size of y_a) and an *indirect* effect, this being additional changes in poverty resulting from the induced change in the growth performance of the other sector (the effect of y_a on y_n).

In addition, an acceleration in the pace of per capita agricultural growth (y_a) will have a more marked effect on poverty than an identical increase in the rate of non-agricultural growth (y_n) if $\varepsilon_n s_n < \varepsilon_a s_a$. The participation effect therefore has two elements: an *elasticity* component and a *share* component. Even though agriculture is the largest sector in the economy of most developing countries, the share of non-agriculture (services and industry combined) in the overall economy is usually larger than the share of agriculture. Whether the participation effect of agriculture ($\varepsilon_a s_a$) outweighs the participation effect of non-agriculture ($\varepsilon_n s_n$) would then depend on whether ε_a is sufficiently larger than ε_n. Finally, note that when $\varepsilon_n = \varepsilon_a$, equation (4) collapses to equation (1) and the source of growth no longer matters in determining the poverty effect of growth (Ravallion and Datt, 1996). We return to this property of equation (4) in developing an empirical test to assess whether the GDP elasticity of poverty differs across sectors.

In sum, from this simple framework, we identify two elements each of the growth and participation effects. The growth effect has a direct and indirect component; and the participation effect has an elasticity and a share component. A schematic representation is given in Figure 1. All four components have to be taken into account when considering the relative contribution of a sector in poverty reduction.[4] In what follows, we compare the size of each of these effects (as represented by the box and arrow size in Figure 1) across both sectors and empirically explore the overall contribution of each sector to poverty reduction across countries during 1980-2000.

Figure 1: The relative role of agricultural and non-agricultural growth in reducing poverty.



[4] In addition to these four effects, there might also be population reallocation effects taking place between the sectors which could further contribute to poverty reduction (also referred to as the 'Kuznets process by Anand and Kanbur (1985) and Ravallion and Datt (1996)). We have not pursued this in our decomposition here given the empirical challenge of estimating poverty by sector, as rural households are often involved in both agricultural and non-agricultural activities. We refer to Ravallion and Huppi (1991) who explore a decomposition of the proportionate change in poverty which also considers population shifts between sectors with an empirical application to Indonesia.

3 The Direct Effect of Growth—Agriculture's Relative Growth Potential

A review of the historical overall sectoral growth rates since 1960 across countries in the world (Table 1) indicates that on average agricultural growth has lagged non-agricultural growth rates, in line with common wisdom. The difference amounts on average to 1.6 percentage points. Looking across continents, the gap is largest in South and East Asia and smallest in the Middle Eastern and North African countries. In Sub-Saharan Africa, the average gap has historically been 1.2 percentage points, somewhat below the world average. The decline in agricultural growth rates over the past 4 decades—from 2.7 percent in the 1960s to 2.0 percent in the 1990s—was accompanied by an even larger decline in non-agricultural growth rates, from 5.7 percent to 3.1 percent in the 1990s, or 4 percent on average during the early 2000s.

The lower observed growth rates in agriculture versus non-agriculture have led many policymakers to be skeptical about the potential role of agriculture in development and poverty reduction strategies. Common wisdom further holds that observed agricultural growth rates have not only been historically lower than growth rates outside agriculture, but more importantly, that overall productivity growth in agriculture is also inherently inferior to overall productivity growth in non-agriculture. This widely held view, though there are important dissenters[5], goes back to the classical economists, starting with Adam Smith, who posited that due to greater impediments to specialization and labor division in agricultural production compared with manufacturing, productivity in agriculture was bound to grow at a slower pace than in manufacturing.

[5] These are for example North (1959), Johnston and Mellor (1961), Hayami and Ruttan (1985), and Timmer (1997).

Table 1: Agricultural and non-agricultural growth rates by decade and continent between 1960 and 2003.

Average annual growth rate (%)	1960-1969		1970-1979		1980-1989		1990-2000		2000-2003		Total	
	Agr.	Non-agri	Agr.	Non-agri	Agr.	Non-agri	Agr.	Non-agri	Agr.	Non-agri	Agr.	Non-agri
Sub-Saharan Africa	2.7	5.0	2.5	5.5	2.6	3.4	2.7	3.0	2.7	3.6	2.6	3.8
South Asia	2.9	5.7	1.7	4.7	3.6	6.4	3.2	6.2	3.0	5.9	2.9	5.8
East Asia & Pacific	4.0	7.7	3.2	7.4	3.0	4.9	1.7	5.1	0.1	5.0	2.3	5.7
East Europe & Central Asia	-1.4	7.0	1.7	7.0	1.3	3.3	-0.7	0.0	3.4	6.7	0.8	2.6
Europe, others	1.2	6.0	1.7	3.5	2.0	2.6	1.7	2.5	-0.8	2.3	1.5	2.9
Latin America & the Caribbean	2.8	5.2	2.3	5.0	1.5	1.6	1.9	3.3	2.2	2.0	2.0	3.3
Middle East & North Africa	1.3	6.1	6.0	7.3	4.8	3.0	3.9	4.2	4.4	3.7	4.4	4.7
North America	-	-	-0.3	3.7	3.2	2.7	2.7	2.7	-1.8	3.2	1.7	3.0
Total	2.7	5.7	2.6	5.3	2.5	3.2	2.0	3.1	2.1	4.0	2.3	3.9

Both annual agricultural and non-agricultural growth rates are based on GDP expressed in constant 2000 US$. Non-agricultural growth is defined as the sector weighted sum of GDP growth in industry and services.
Source: Authors' calculations based on World Bank data (2005c)

Despite the powerful appeal of this view throughout the development economics literature[6] and among policy makers, there are few comparable estimates available of productivity growth in agriculture and industry, especially for developing countries.[7] In a first simple step to explore this further, we decompose the sectoral GDP growth rates reported in Table 1 into their (labor) productivity and population growth components (see Table 2).[8] Table 2 presents the average sectoral growth rates and their (labor) productivity and population growth components during the 1960-2003 period.

Contrary to the widely held assumption that improvements in agricultural productivity cannot match those in non-agriculture, the results in Table 2 suggest that over the past 4 decades labor productivity in agriculture has on average been growing faster. With the exception of South

[6] The powerful dual economy models of development for example, critically assume a stagnant, traditional rural sector from which labor and resources flow to the dynamic, modern industrial sector.
[7] Productivity estimates for the economy as a whole or for individual sectors on the other hand abound.
[8] To see this, denote GDP by G_k, and population in sector k by L_k,. Through total differentiation of $G_k = L_k (G_k / L_k)$, it can readily be shown that $\frac{dG_k}{G_k} = \frac{d(G_k / L_k)}{(G_k / L_k)} + \frac{dL_k}{L_k}$.

Asia, this holds across all continents, including Sub-Saharan Africa. It further appears that overall GDP growth in agriculture has been largely driven by growth in agricultural productivity, while growth in the non-agricultural sector has been largely fueled by population growth in non-agriculture especially in the developing countries (except Eastern Europe and Central Asia). Finally, while population growth has been the key contributor to overall growth in both sectors in SSA, agricultural productivity growth exceeded productivity growth in the non-agricultural sector.

Table 2: Average agriculture and non-agricultural GDP, productivity and population[1)] growth rates, 1960-2003 by continent

Average annual growth rates (%)	**Agric. GDP**	**Labor productivity in agriculture**	**Population in agriculture**	**Non-agric. GDP**	**Labor productivity in non-agriculture**	**Population in non-agriculture**
Sub-Saharan Africa	2.6	0.91	1.7	3.8	-0.64	4.5
South Asia	2.9	1.2	1.6	5.8	2.2	3.6
East Asia & Pacific	2.3	2.9	-0.5	5.7	2.7	2.9
Eastern Europe & Central Asia	0.81	3.4	-2.5	2.6	1.4	1.2
Europe, others	1.5	4.6	-3	2.9	2	0.87
Latin America & the Caribbean	2	2.3	-0.24	3.3	0.48	2.8
Middle East & North Africa	4.4	4.3	0.21	4.7	0.26	4.4
North America	1.7	3.9	-2.1	3	1.8	1.2
Total	2.3	2.4	-0.05	3.9	0.74	3.1

[1)] Figures for the total population in agriculture and non-agriculture were obtained from the FAO statistics.
Source: Authors' calculations based on World Bank (2005c) and FAO data.

Nonetheless, it is quite possible that the trends observed in Table 2 simply reflect equilibrating movements of labor out of agriculture into non-agriculture in response to higher marginal products of labor (and thus wages) in non-agriculture (a phenomenon also known as "industrial pull"). This would lead to a convergence in sectoral labor productivity and is consistent with the observed faster (labor) productivity growth in agriculture. The faster agricultural labor productivity growth is in this view a result of labor movements out of the sector (consistent with labor surplus in agriculture) rather than a result of an increase in agricultural output.

Alternatively, if the observed agricultural labor productivity growth resulted from increased agricultural output, following investment and technological change in agriculture (or an increase in total factor productivity), productivity increases would free up labor in agriculture and induce it to move to the non-agricultural sector (a phenomenon coined “agricultural push”). According to this interpretation, the productivity gains in agriculture are the cause of the labor movements (and not its consequence). Without additional evidence, the relative merits of the industrial pull versus the agricultural push hypothesis cannot be ascertained further. Yet, while admittedly crude and partial, the descriptive findings in Table 2 are quite stark indicating that the hypothesis of agriculture as a backward sector with inherently inferior productivity growth deserves further scrutiny, and that it is quite likely that both forces (industrial pull and agricultural push) have been at work in the past.

The limited available empirical evidence in the literature, mostly from industrialized countries, would support the hypothesis that total factor productivity (TFP) growth in agriculture does not lag behind total factor productivity growth in non-agriculture. Estimating rates of sectoral TFP growth for the U.S. economy between 1948 and 1979 using a cost function approach Jorgenson, Gollop and Fraumeni (1987; table 6.7) found that TFP growth in agriculture had been more rapid than in almost all other sectors. Examining historical TFP growth rates of agriculture vis-à-vis the rest of the economy in Australia using a production function approach Lewis, Martin and Savage (1988) come to a similar conclusion. Using a sample of 14 industrialized countries between the early 1970s and the late 1980s Bernard and Jones (1996) estimated average TFP growth at 2.6 percent per year in agriculture compared with 1.2 percent in industry and 0.7 percent in services. In only one of their 14 sample countries was total factor productivity growth higher in industry than in agriculture.

But there is also evidence of a more productive agriculture from the developing world. Using a production function approach applied to panel data for about 50 low- and middle-income countries over the period 1967-2002, Martin and Mitra (2001) found on average total annual factor productivity growth in agriculture to be 0.5 to 1.5 percentage points larger than in non-agriculture, depending on the estimation technique. This difference was statistically significant and valid across the development spectrum.

In sum, the historical evidence reviewed here questions the view of agriculture as a backward sector with limited inherent growth potential and thus a limited direct growth effect on poverty reduction. While agriculture has been growing slower than non-agriculture, agricultural productivity appears to grow at least as fast as productivity in non-agriculture and a series of studies comparing productivity growth across both sectors suggest that this does not primarily follow from equilibrating labor movements in search for higher wages out of agriculture, but rather from a more rapid increase in TFP in agriculture per se. A focus on increasing agricultural productivity to raise the direct growth effect of agriculture as a key building block of poverty reduction strategies therefore cannot be rejected off hand from this perspective.

This does not imply that the agricultural sector as a whole should be expected to grow faster than the non-agricultural sector, or relatedly, that agriculture will increase its share in the economy. Engel's law implies that as incomes rise, the demand for agricultural products increases at a slower rate than the demand for non-agricultural products, and hence the share of agriculture in total output declines. This is consistent with the historical migration pattern between agriculture and non-agriculture observed in the data. In other words, while the direct growth effect of agriculture on poverty reduction will likely continue to be smaller than this of non-agriculture, historical experience shows that agricultural productivity and growth can be substantially increased, an increase which has also been shown to be necessary to facilitate labor migration of labor out of agriculture (Gollin, Parente and Rogerson, 2003) and foster non-agricultural growth (Irz and Roe, 2005).

Nonetheless, despite faster productivity growth in agriculture in Sub-Saharan Africa compared with non-agriculture, at 0.9 percent, agricultural (labor) productivity growth has historically been low, raising the question how agricultural growth in Sub-Saharan Africa could be increased, and at what cost. A comprehensive treatment of this question falls beyond the scope of this paper, though in this context, the potential of investment in agricultural R&D and extension in increasing agricultural productivity is worth highlighting. Thirtle, Lin, and Piesse (2003) estimated the elasticity of yield with respect to R&D investment at 0.36 in Sub-Saharan Africa. The InterAcademy Council (2004) also underscored the huge pay-offs from scaling up research in agriculture in their latest study “Realizing the Promise and Potential of African Agriculture”. They further emphasized the critical need to address soil degradation and soil nutrient depletion especially in African soils. Yet, given the limited technology adoption currently characterizing SSA agriculture, the role of policy and behavioral factors in adopting new technologies will also need to be much better understood.

4 Indirect Growth Effect—Interactions between Agriculture and the Rest of the Economy

In addition to its direct sectoral contribution to overall growth, agricultural development can also play an important role in fostering development in the rest of the economy (Johnston and Mellor, 1961; Schultz, 1964). Three broad types of mechanism were identified: 1) *inter-sectoral linkages*, forward to agro-processing activities and backward to input supply sectors (see Perry et al, 2005, for a recent assessment of these linkages); 2) *final demand effects* arising from a large and more affluent agricultural sector with a propensity to spend on locally produced non-traded goods and services (especially true of smallholder agriculture) generating significant demand for non-agricultural goods (reviewed in Haggblade, Hammer and Hazel, 1991) and thereby off-farm employment; and 3) *wage-good effects*—by reducing the price of food, agricultural productivity growth would lower the real product wage in non agriculture, thereby raising profitability and investment.[9] Much of this literature argued that the stronger links were from agriculture to non-agriculture rather than the other way around (Mellor, 1976; King and Byerlee, 1978; Thirtle, et al., 2001). In part this was because inputs into non-agriculture were more import intensive, and urban consumption patterns favored imported goods (the demand for food being income inelastic).

[9] Lower food prices would also raise real consumption wages, and thus directly benefit poor (urban and rural) wage earners.

Establishing the empirical validity of these linkages has been a 'cottage industry since the early 1970s (Timmer, 2005). While the models adopted in this literature typically embrace both production and consumption linkages,[10] it is the latter that have been found to be more important. Delgado et al. (1998) concluded that for both Africa and Asia, consumption-based agricultural growth linkages are four to five times more important to growth than production-based linkages. For the linkage effects to be significant, four conditions must apply (Delgado, et al., 1998). First, agriculture must be a sufficiently large sector in employment terms for the income generating effects to be significant. Second, the income gains from agricultural growth must be reasonably widespread, so that effective demand for locally produced goods and services is raised. Third, the consumption patterns of people in agriculture must favor locally produced non-tradable goods. And finally, the non-agricultural (non-traded) sector must have to hand underutilized resources and appropriate institutional arrangements to be able to respond to the raised levels of demand coming from agricultural growth.

Using micro data on consumption patterns in five African countries, Delgado et al (1998) concluded that the farm sector in Africa is better able to propagate income growth than previously thought. They estimated (p. xii) that 'adding US$1.00 of new farm income potentially increases total income in the local economy by an additional $1.88 in Burkina Faso, $1.48 in Zambia, $1.24 to $1.48 in two locations in Senegal, and $0.96 in Niger.' Further corrected estimates to account for potential inelastic supply response of the non-tradable non-agricultural sector by the same authors, situate the agricultural multiplier effects around 1.6 for Asian countries and 1.1 for the African cases. This difference is ascribed to the labor-abundant nature of the Asian economies, facilitating a larger supply response of the Asian non-tradable sector. Similarly, using computable general equilibrium (CGE) models applied to archetype economies for Africa, Asia and Latin America de Janvry and Sadoulet (2002) find the employment and overall linkage effects from

[10] Production linkages refer to purchases and sales of intermediate goods between the sectors. Consumption linkages occur when the incomes generated by growth in one sector lead to increases in final demands for the good of other sectors and as a result also increase employment in that sector.

increased land productivity in agriculture to be more important in Asia and Latin America where labor and food markets are better developed than in Africa.

More recent evidence by Dorosh and Haggblade (2003) applying both fixed price semi input-output (SIO) models as well as fully price endogenous CGE models to eight SSA countries confirms the existence of sizeable growth linkages from investments in agriculture—as before the indirect effects of investment induced growth prove to be about as large as the direct effects. Moreover, fixed price (SIO) multipliers from investments in export and food crops typically exceed the manufacturing multipliers, consistent with the literature, though they also find that this is no longer the case when prices of the non-tradables are endogenized (as in the CGE).

The methodologies (fixed price (semi) input-output models and price-endogenous CGE models) underpinning this micro evidence are structural in nature and data intensive. While this constitutes the strength of these approaches providing a lot of insights in the nature and extent of the linkage effects, it also constitutes their weakness as the results (partly) depend on the validity of the structural assumptions. To complement the empirical insights from the micro data we follow Bravo-Ortega and Lederman (2005), who focus on Latin America, and explore whether there exists evidence of a causal relationship between agricultural and non-agricultural output (in the Granger, 1969, sense)[11] by applying dynamic panel data estimation techniques to international cross country data. In doing so, we do not for example have to assume supply flexibility or fixed prices in the non-tradables sector, in effect observing a 'reduced form' of the full general equilibrium outcome. The downside of this "reduced form" approach is obviously that it does not provide much insight in the mechanisms of the linkage effects.

Bravo-Ortega and Lederman (2005) find evidence of a positive causal link (in the Granger, 1969, sense) between (lagged) agricultural growth and non-agricultural growth, also for poor countries, though the effect is smaller for Latin America. The reverse effect is also discernable—lagged effect of non-agricultural output on agriculture, though this is negative for low-income

[11] The concept of Granger causality holds that a variable Y_{ai} Granger causes Y_{ni} if Y_{ni} can be better predicted using lagged values of Y_{ai} than without them.

countries and only slightly positive (and not statistically significant) for Latin American countries. Although both the micro data and this cross-country evidence suggest that the linkage effects of agricultural growth appear to be true for Africa, the opening up of African economies might for example undermine the linkage effects from any expansion in rural demand (that demand possibly being increasingly met by imports). We therefore update the data set examined by Bravo-Ortega and Lederman and revisit their results taking an African focus and using a somewhat modified specification.

In particular, in our specification non-agricultural GDP per capita (Y^n_{it}) in country i at time t is assumed to depend on both lagged levels of per capita non-agricultural GDP and lagged levels of per capita agricultural GDP. In addition, we consider a vector X_{it} of country-specific exogenous explanatory factors, yielding:

$$Y^n_{it} = \gamma^0 + \sum_{p=1}^{P} Y^n_{it-p}\gamma^1_p + \sum_{p=1}^{Q} Y^a_{it-p}\gamma^2_p + \sum_{k=0}^{Ka} X_{it-k}\gamma^3_k + h_i + v_{it} \quad (5)$$

where h_i reflects unobserved country specific characteristics that determine the sectoral output, and v_{it} a white noise error term. Similarly, agricultural GDP per capita (Y^a_{it}) is expressed as a linear function of lagged agricultural and non-agricultural GDP per capita as well as observed and unobserved country specific exogenous explanatory factors.

In the empirical application, we estimate the agricultural and non-agricultural equations separately, regressing non-agricultural (change in) GDP on lagged (changes in) agricultural and non-agricultural GDP and vice versa. We introduce a time indicator to capture period-specific shocks common to all countries (e.g. global up or down turn of the economy) as exogenous variable in the non-agricultural regression and the yearly deviation from long run average rainfall in each country[12] as exogenous variable in agricultural regression. The estimation employs the Arellano-

[12] The meteorological data have been constructed by Dr. T.D. Mitchell at the Tyndall for Climate Change Research. Based on a comprehensive set of high-resolution grid data of monthly climate indicators 1901-2000 (version TYN CY 1.1), yearly means of precipitation and year-to-year variations are available for each country. For further information, see Mitchell et al. (2003) and http://www.cru.uea.ac.uk/~timm/cty/obs/TYN_CY_1_1.html. Bravo-Ortega and Lederman do not include rainfall shocks in their specification.

Bover system GMM estimator (1995) with the finite sample correction of the two-step standard errors proposed by Windmeijer (2005).[13] We use lagged differences of the predetermined variables as instruments for the predetermined variables (Y^a_{it-k} and Y^n_{it-k}) in our levels equation and lagged levels of the predetermined variables as instruments for the first difference equation.[14]

The analysis utilizes 3-year averages of log per capita GDP over the period 1960-2004. For the estimations we exclude OECD-countries and countries from Eastern Europe and Central Asia. The former have typically already passed through the structural transformation and the economic systems of the latter have undergone dramatic structural change over the past 15 years rendering their historical experience atypical of the remaining sample. The estimation sample consists of 106 countries and 1489 observations, but missing observations on the GDP figures and the use of lagged dependent variables in the regressions lead to a reduction in the actual regression sample sizes. Sub-Saharan Africa is comparably well represented with almost half of all countries and observations in the sample.

Table 3 reports the findings for the regressions of non-agricultural GDP. Non-rejection of the reported 2nd-order autocorrelation tests indicates that the autocorrelation of the models is in general well-specified.[15] The Sargan-Hansen-tests are not rejected, providing confidence in our set of instruments. As the linkage effects are also likely to differ depending on the stage in the structural transformation (see also Bravo-Ortega and Lederman, 2005), results are presented for the full sample (column 1) as well as for middle and low-income countries separately (columns 2-3 and 4-5 respectively).[16] A Sub-Saharan Africa indicator variable is subsequently introduced to examine whether linkages in SSA differ from those observed in other low and middle-income countries respectively.

---

[13] The use of estimated parameters for the construction of the weight matrix introduces extra variation and a difference between the finite sample and the usual asymptotic variance of the two-step GMM estimator. Windmeijer (2005) shows that this difference can be estimated for a finite sample corrected estimate of the variance.

[14] A more detailed exposition of the specification and estimation strategy is provided in Appendix A1.

[15] The regressions are estimated in differences, and 1st-order autocorrelation is therefore expected, while 2nd-order autocorrelation is a sign of serial correlation in the levels. Further lags in non-agricultural GDP were added in some specifications to adjust for serial correlation in the levels.

[16] To be consistent with the classification applied in the poverty regressions in section 5, we us the same cut-off value of US$ 1160 GDP per capita to classify countries.

The results in column (1) in Table 3 suggest a small positive effect of agriculture on non-agriculture, though it is imprecisely estimated. While it remains statistically insignificant when looking at the middle-income countries (column 2), it becomes larger and statistically significant for the low-income countries (column 4). Columns (3) and (5) introduce interaction terms of the GDP-variables with a SSA-indicator. For the middle-income countries the SSA sub-group shows a higher effect of agriculture (sign. at the 11%-level), while agriculture does not appear to affect non-agriculture in the SSA low-income countries (the coefficient on lagged agriculture and the interaction term basically cancel each other out).

The corresponding regression results looking at the effect of lagged non-agricultural GDP levels on agricultural GDP are presented in Table 4. As expected, rainfall shocks emerge as an important determinant of agricultural GDP, in particular in the low-income sub-sample. Yet we do not find any linkage effects from the non-agricultural sector to agriculture. Note that while the Sub-Saharan African interaction term is significant, the effect of non-agricultural growth on the agricultural sector in SSA (calculated as the sum of the basic coefficient and the interaction coefficient, and tested with an F-test) is not significantly different from zero in any of the regressions. Overall, these findings are consistent with the view that development in agriculture (Granger) causes on average development in non-agriculture in low-income countries, though not in the middle-income countries. We do not find evidence of a reverse effect.

To conclude, the micro-evidence from structural models and the cross-country regressions indicate that the indirect effects from fostering growth in agriculture are on average substantial, even though they tend to be lower in SSA than those found for Asian and Latin American countries. Second, while some recent evidence calls into question whether agricultural multipliers largely exceed the non-agricultural multipliers (Dorosh and Haggblade, 2003), virtually all studies (including the GMM analysis presented in this study) concur that the feedback effects from agriculture to non-agriculture are on average at least as large as the reverse effects. Finally, looking beyond the averages, the exact magnitude of the sectoral multipliers is likely to differ across countries depending on their institutions and structure.

Table 3: Dynamic Linkages of the Non-agricultural Sector

	(1)	**(2)**	**(3)**	**(4)**	**(5)**
Non Agricultural GDP per capita	**Full sample**	**Middle inc**	**Middle inc**	**Low inc**	**Low inc**
Non-agr. GDP $_{t-1}$	1.49	1.28	1.27	0.928	0.803
	0.000	*0.000*	*0.000*	0	*0.000*
Non-agr. GDP$_{t-1}$ * D$_{SSA}$			-0.18		0.227
			0.111		*0.047*
Non-agr. GDP $_{t-2}$	-0.499	-0.261	-0.232		
	0.000	*0.283*	*0.3629*		
Non-agr. GDP $_{t-3}$		-0.121	-0.117		
		0.425	*0.4803*		
Agr. GDP $_{t-1}$	0.0407	-0.0818	-0.117	0.138	0.259
	0.209	*0.172*	*0.0643*	0.0639	*0.0459*
Agr. GDP $_{t-1}$ * D$_{SSA}$			0.256		-0.313
			0.1119		*0.0267*
Time dummies	*Jointly sign.*	*Jointly sign.*	*Jointly sign.*	*Jointly sign.*	*Jointly sign.*
Constant	-0.0959	1.24	1.27	-0.188	-0.0163
	0.298	*0.064*	*0.010*	0.4204	*0.9567*
Observations	730	300	300	526	526
# of countries	104	42	42	74	74
# of instruments	81	60	60	72	72
P-value f/ no AR(1)	0.0000191	0.0487	0.0553	0.00142	0.00261
P-value f/ no AR(2)	0.695	0.0785	0.0889	0.864	0.94
Sargan test	0.185	0.992	0.989	0.281	0.588

Source: Authors' calculations

Table 4: Dynamic linkages of the agricultural sector

	(1)	(2)	(3)	(4)	(5)
Agricultural GDP/capita	**Full sample**	**Middle inc**	**Middle inc**	**Low inc**	**Low inc**
Non-agr. GDP $_{t-1}$	0.00956	-0.0329	-0.0386	-0.0449	0.0811
	0.489	*0.230*	*0.154*	*0.240*	*0.101*
Non-agr. GDP$_{t-1}$ * D$_{SSA}$			-0.0452		-0.148
			0.288		*0.031*
Non-agr. GDP $_{t-2}$	-0.215				
	0.001				
Agr. GDP $_{t-1}$	1.21	1.04	1	1.04	0.802
	0.000	*0.000*	*0.000*	*0.000*	*0.000*
Agr. GDP$_{t-1}$ * D$_{SSA}$			0.0595		0.147
			0.354		*0.077*
Precipitation[1)]	0. 0974	0. 0675	0. 0639	0. 2900	0. 2080
	0.077	*0.230*	*0.357*	*0.000*	*0.005*
Constant	-0.0527	0.0404	0.3	0.0725	0.54
	0.598	*0.909*	*0.311*	*0.825*	*0.036*
Observations	734	350	350	526	526
# of countries	104	44	44	74	74
# of instruments	81	50	74	50	50
P-value f/ no AR(1)	0.00204	0.0221	0.0236	0.00395	0.00294
P-value f/ no AR(2)	0.466	0.143	0.141	0.168	0.191
Sargan test	0.392	0.748	1.000	0.207	0.559

[1)] Deviation of actual rainfall (in mm) in t from long run average (in mm), normalized by the country-specific standard deviation of rainfall, divided by 1000.
Source: Authors' calculations.

5 Participation Effect

There are several reasons why the contribution to poverty reduction from growth might differ across sectors. First, connecting to the growth process might be easier for the poor if growth happens where the poor are located. Indeed, much of the literature underscoring the importance of agriculture in poverty reduction has argued that the poor stand to benefit much more from an increase in agricultural incomes than from an increase in non-agricultural incomes because many of the poor live in rural areas and most of them earn their living in agriculture or agriculture related activities.[17] This implicitly assumes that it is difficult to transfer income generated in one sector/location (e.g. people employed in industry or services in urban areas) to another sector/location (e.g. people employed in agriculture in rural areas). This may be because of market segmentations or a political economic constellation unfavorable to redistribution. Second, given that the major asset of poor people is usually their labor, differences in labor intensity across sectors might generate sectoral differences in poverty reduction from growth as emphasized by Loayza and Raddatz (2005). Third, the distribution of other (complementary) assets (e.g. land in agriculture, capital in industry) may further affect the poverty reducing effect of growth in different sectors.

Few studies have explicitly compared the GDP elasticities of poverty across the sectors. And some studies even hint that the GDP elasticities of non-agricultural sectors might be greater, contrary to what is often implicitly assumed. Ravallion and Datt (1996) for example, find that the elasticity of rural headcount poverty with respect to agricultural growth in India is -0.9, compared with -2.4 for tertiary sector growth. The latter they conjecture being attributable to growth in the informal sector. For China however—and consistent with expectations—Ravallion and Chen (2004) estimated that agricultural growth has the greatest impact on poverty reduction (by a factor of 4 compared with the secondary and tertiary sectors) underscoring the existence of potentially important differences across countries in the participation effect depending on the structure and institutional organization of the economy.[18]

Inspired by this work and in the absence of good country time-series data, other authors have most recently compared GDP elasticities across sectors using cross country data. Using five-year panel data for the period 1960-2000, Bravo-Ortega and Lederman (2005) find that agricultural output per worker is not as effective as non-agricultural output in raising the incomes of the poorest quintile. Quintiles 2 and 3 appear to gain most from increases in agricultural output. Loayza and Raddatz (2005) argue that the labor intensity of the production process is a critical factor in determining the poverty reducing effect of growth. Linking sectoral growth rates in different

[17] For a more extensive review of this literature we refer to Timmer (2005) and Byerlee, Diao and Jackson (2005).

[18] Similar findings are reported for China by Fan *et al* (2005).

countries with data on the intensity of labor use in these sectors and the evolution of poverty, they conclude that growth in agriculture which is typically the most labor intensive sector, has also the largest potential to reduce poverty, followed by growth in manufacturing, construction and services; mining and utilities, which are usually very capital intensive, do not seem to help poverty reduction.

Our particular interest here is in Africa and it is not clear that the somewhat cautionary findings of some of the authors on the agricultural GDP elasticity based on the country specific (Ravallion and Datt, 1996) or the cross-country evidence (Bravo-Ortega and Lederman, 2005) would apply in equal force to Africa. Conditions in Africa are certainly different from the wider developing world, including India. For example, a key determinant of how much poverty reduction is obtained from a given rate of growth is the initial income or consumption inequality. The income or consumption distributions are found to be important in determining the GDP elasticity of poverty in part because they reflect other, possibly deeper-seated inequalities. Ravallion (2001) has estimated that for countries with initial Gini coefficients of around 0.60 the GDP elasticity of poverty would typically be -1.2. But if the initial Gini were 0.30, the expected GDP elasticity would be -2.1. Bourguignon and Morrisson (1998) have shown that the difference in labor productivity in agriculture and non-agriculture is an important factor in explaining differences in income inequality across countries. In particular, the larger is the gap in labor productivity between agriculture and non-agriculture, the lower is the elasticity of poverty to growth.

Although these estimates refer to overall income inequality, it is likely that differences in the Gini ratios between the sectors could be an indicator of the differences in the sectoral GDP elasticities of poverty (ε_k). Of the assets that are important for production and income in rural Africa, perhaps land is central. Economic growth in a rural economy in which there is little landlessness, and in which land is more equally distributed, would be expected to have a greater impact on poverty than where land is unequally distributed and there is pervasive landlessness, as for example in India. Bourguignon and Morrisson (1998) find indeed that the larger is the share of land cultivated by small and medium farmers, the lower is the observed income inequality, and thus the larger the effect of growth on poverty. Similarly, the distribution of human capital can exert a profound effect on the poverty effect of growth. If large sections of the rural population are uneducated and illiterate, it is unlikely that they will be able to benefit from growth. In a similar vein, farmers who have little access to health services are also less likely to benefit from growth. Poor African farmers may also have limited access to other services, such as irrigation, roads and communications limiting their ability to participate in the growth process (Christiaensen, Demery, and Paternostro, 2005).

In sum, unequal distribution of both private and public assets will influence how any given agricultural and non-agricultural growth rate will reduce poverty. To further investigate the potential differential participation effects across the sectors and resolve some of the uncertainties concerning these relationships in the African context, we turn to the data and perform some cross-country analysis.[19] An appropriate empirical specification to test whether the source of growth matters on average for its effect on poverty reduction can be derived from equation (4) as follows:

$$\Delta \ln P_{it} = \pi_0 + \pi_a s_{ait} \Delta \ln Y_{ait} + \pi_n s^n_{nit} \Delta \ln Y_{nit} + u_{it} \qquad (6)$$

where π_j ($j = 0, a, n$) are parameters to be estimated and u_{it} is assumed to be a white-noise error term.

The rationale of this specification is that if we cannot reject the null hypothesis H_0: $\pi_a = \pi_n$, equation 6 collapses to a simple regression of the rate of poverty reduction on the rate of growth of GDP (see Ravallion and Datt, 1996; 2002, and Ravallion and Chen, 2004, for applications to India and China). Under such circumstances, the sectoral composition of growth would not matter, and the debate about the advantages of fostering agriculture versus non-agriculture in alleviating poverty reduces to the question whether investments in agriculture yield faster overall economic growth (i.e. the direct and indirect effect combined) than investments in non-agriculture. If on the

[19] In doing so, we were not able to account explicitly for differences in inequality across sectors, as sectoral inequality measures are not systematically available and rural/urban inequality measures are incomplete proxies (Bourguignon and Morrisson, 1998). Yet, we also performed estimations which explicitly accounted for variations in overall (as opposed to sectoral) inequality across countries in their systematic assessment.

other hand, the estimated (slope) coefficients in (6) are (statistically) significantly different across the sectors, the composition of growth would also be important for poverty reduction. Note further that the intercept, which reflects the change in poverty in the absence of growth, could be interpreted as an estimate of the effect of the average change in income inequality during the time period under consideration.

To estimate (6) we bring together poverty measures derived from nationally representative household surveys with data on economic growth by sector. The poverty data here refer to spells of change in the poverty measures, the change being derived from two (comparable) household surveys in years $t-\tau$ and t. For comparability all poverty estimates are based on the US$1 a day poverty benchmark. The poverty data are part of the World Bank's *Povcal* database (World Bank, 2005d). Table 5 provides an overview of these.[20] Poverty spells are available for 82 countries and the total number of spells amounts to 289 (73 percent of the sample countries have more than one spell).[21] Exclusion of 7 urban-only surveys and systematic elimination of outliers reduced the sample to 75 countries and 222 observations.[22] We use three common poverty measures (the headcount index, H, the poverty gap index, PG, and the squared poverty gap index, SPG). Data on the GDP shares and per capita GDP growth for the agricultural and non-agricultural sectors are taken from World Bank (2005c).

[20] Chen and Ravallion (2004) provide a descriptive analysis of the *Povcal* data; the table in appendix A2 provides an overview of the data used.

[21] While we did not weigh the spell observations by country population size, China and India, the most populous countries have the most spells in our sample, while other large countries such as Brazil and Indonesia tend to have more than one observation, indicating that our results are implicitly population weighted (albeit approximately).

[22] Observations with poverty changes exceeding |50%| were eliminated. Observations dropped came largely from the richer eastern European countries with very low 1$ day poverty rates causing large relative (percentage) changes in poverty following small absolute (percentage point) changes in poverty.

Table 5: Data coverage of poverty spells

Continent	**# of countries**		**#of survey spells**		**% of survey spells**	
	Original	After cleaning	Original	After cleaning	Original	After cleaning
Sub-Saharan Africa	20	20	42	39	15	18
South Asia	4	4	22	22	8	10
East Asia & Pacific	8	8	47	43	17	19
East Europe & Central Asia	23	16	68	28	24	13
Latin America & the Caribbean	20	20	89	77	32	35
Middle East & North Africa	7	7	14	13	5	6
Total	**82**	**75**	**282**	**222**	**100**	**100**

Source: Authors' calculations

Estimates of the parameters in equation 6 were obtained using ordinary least squares regression with suitable corrections of the standard error for heteroscedasticity across countries.[23] The estimates were obtained for the three measures of poverty (H, PG and SPG), and are reported in Table 6. We find that the cross-country data confirm the expectation that economic growth reduces poverty, the GDP elasticity of poverty increasing from -1.7 for the H measure to -2.0 for the PG measure and -2.2 for SPG (all of which are statistically significant—see panel A in Table 6) and comparable with earlier estimates by Ravallion (2001) and Adams (2004).

The results also show that the composition of growth matters greatly for poverty reduction. The null hypothesis (that $\pi_a = \pi_n$) is rejected in most cases (panel B). Taking the sample as a whole, π_a is greater than π_n by a wide margin. For the headcount, it is over 9 times greater, and for the PG measure it is over 7 times greater, these differences being statistically significant. However, while the estimated coefficient on agricultural growth for the SPG measure is still much larger than that on non-agriculture (by a factor of 6 times), this difference is no longer statistically significant (p-value > 0.1). For SPG the null hypothesis cannot be rejected. In sum, agricultural growth contributes significantly more to poverty reduction across our sample of countries, at least as measured by the H and PG measures. Whether the composition of growth matters for reducing extreme poverty (as reflected in the SPG measure), is less certain.

[23] This is similar to other comparable approaches, for instance Ravallion and Datt (1996) and Adams (2004).

Interestingly, the constant term is not significantly different from zero in most of the empirical specifications reported in Table 6. With zero growth, poverty is predicted on average to remain unchanged, implying constancy on average in income/consumption inequality.[24] But for the SPG measure, the constant term is significantly negative, suggesting favorable changes at the bottom of the distribution. There inequality changes appear to exert a downward pressure on poverty when there is no growth.

To explore further whether the composition of growth matters for poverty reduction across the development spectrum, we split the sample in two groups of equal size based on the country's GDP per capita and run separate regressions for the low and middle-income countries.[25] For the middle-income countries, the null hypothesis is rejected (see panel C of Table 6). Agricultural growth has a significantly greater impact on poverty (π_a being greater than π_n by a factor of 13.8 for the H and 10.2 for the PG measure). But as with the whole sample, the evidence of the differential impact of sectoral growth on the SPG measure is less certain. While both the coefficients on agricultural and non-agricultural growth are statistically significant (at the 10% level), they are not statistically different, despite the fact that the coefficient on agricultural growth is 7.6 times larger than the one on non-agricultural growth.

[24] We also applied a Gini correction to the GDP growth variables (following Ravallion, 1997) using initial year Ginis of each spell. We obtained qualitatively very similar results to those reported in Table 6.
[25] Taking the pooled sample, this resulted in a cut-off of US$ 1,160 GDP/capita.

Table 6 : Decomposition of poverty changes

	All countries				*Middle-income countries*		*Low-income countries*			
	Coef ficient	*p-value*	*Coef-ficient*	*p-value*	*Coef-ficient*	*p-value*	*Coef-ficient*	*p-value*	*Coef-ficient*	*p-value*
	A		**B**		**C**		**D**		**E**	
Headcount index (H)										
GDP/pc growth	-1.68	0.00	-		-		-		-	
Non agriculture pc growth			-0.98	0.05	-1.57	0.01	0.12	0.89	0.12	0.91
Non-ag pc growth*SSA					-	-	-	-	-0.08	0.95
Agriculture pc growth			-9.35	0.02	-21.74	0.00	-6.00	0.05	-12.95	0.06
Agric pc growth*SSA					-	-	-	-	7.07	0.21
Constant	-0.05	0.27	-0.06	0.22	-0.07	0.43	-0.06	0.27	-0.03	0.55
Number of observations	222		222		111		111		111	
R^2		0.08		0.14		0.26		0.10		0.13
Ho: test ag=nag				0.04		0.00		0.08		0.07
Ho: test nag+nag*X=ag+ag*X						-		-		0.31
Poverty gap index (PG)										
GDP/pc growth	-2.03	0.00							-	
Non agriculture pc growth			-1.32	0.04	-2.07	0.00	0.05	0.96	-0.05	0.98
Non-ag pc growth*SSA			-		-	-	-	-	0.23	0.89
Agriculture pc growth			-9.99	0.02	-21.15	0.01	-7.33	0.06	-9.99	0.14
Agric pc growth*SSA			-		-	-	-	-	4.79	0.51
Constant	-0.10	0.11	-0.11	0.09	-0.13	0.16	-0.10	0.25	-0.07	0.39
Number of observations	222		222		111		111		111	
R^2		0.07		0.10		0.18		0.08		0.09
Ho: test ag=nag				0.06		0.02		0.10		0.18
Ho: test nag+nag*X=ag+ag*X					-	-	-	-		0.18
Squared poverty gap index (SPG)										
GDP/pc growth	-2.22	0,00								
Non agriculture pc growth			-1.60	0.05	-2.36	0.02	-0.22	0.87	-0.51	0.80
Non-ag pc growth*SSA			-		-	-	-	-	0.78	0.70
Agriculture pc growth			-9.36	0.07	-18.00	0.10	-7.63	0.10	-8.29	0.33
Agric pc growth*SSA			-		-		-	-	1.07	0.91
Constant	-0.15	0.05	-0.16	0.04	-0.20	0.10	-0.14	0.18	-0.12	0.26
Number of observations	222		222		111		111		111	
R^2		0.05		0.06		0.09		0.06		0.06
Ho: test ag=nag				0.16	-	0.16		0.18		0.42
Ho: test nag+nag*X=ag+ag*X					-	-	-	-		0.13

*10%, **5%,***1% significance All estimations are corrected for heteroskedasticity with robust (cluster)

Source: Own calculations based on World Bank data (2005c; 2005d)

However, in the low-income countries (for all measures of poverty—see panel D of Table 6) only agricultural growth appears to affect poverty reduction—and the null hypothesis is therefore rejected. The estimated effect of non-agricultural growth on poverty is not statistically significant.[26] In this context it is especially worth highlighting how sectoral growth affects the poorest differently in the medium and low-income countries (as measured by changes in the SPG). While both agricultural and non-agricultural growth offer scope for extreme poverty reduction in the middle-income countries, it is only agricultural growth that appears to affect the poorest in the low-income countries. This may suggest that the poorest groups in the middle-income countries are more likely to rely also on non-agricultural activities—possibly because extreme poverty is associated with landlessness and concentrated in urban areas as in many Latin American countries which make up more than 40 percent of our middle-income group. This result also resonates somewhat with Bravo-Ortega and Lederman's (2005) finding that growth in agricultural output per worker was slightly less effective as growth in non-agricultural output per worker in raising the incomes of the poorest quintile, at least where it concerns the middle-income countries.

Finally we consider the sectoral impacts in Sub-Saharan African (SSA) countries. Of the 111 observations in our low-income sample, 36 are from SSA. It is not clear, therefore, that the findings for the low-income group would necessarily apply to SSA.[27] It would not be appropriate to estimate the poverty regressions separately for SSA, given the small sample. Our approach is to apply an SSA interaction term to the right-hand-side variables in the low-income country data. The results are presented in panel E of Table 6. As in case of the low-income countries, we find that only agricultural growth affects poverty reduction, while the estimated coefficients on non-agricultural growth are not statistically different from zero, supporting the critical role of agricultural growth in poverty reduction in SSA. None of the SSA interactive terms is statistically significant, indicating that the relationship between sectoral growth and poverty in low-income countries also applies to the Sub-Saharan-Africa group of countries covered in our sample.

---

[26] The non-significance of non-agricultural growth for poverty reduction in low-income countries (and the positive sign on some of the estimated coefficients) might be the result of counteracting effects of growth within non-agriculture. Indeed, re-estimation of equation 6 using further disaggregated measures of non-agriculture into industrial and service growth, indicates that industrial growth is positively associated with poverty changes—it increases poverty, while service growth is negatively associated. Yet, consistent with the results reported here, only the coefficient on agricultural growth is statistically significant and the coefficients on industrial and service growth are neither jointly nor individually statistically significant. This holds across all poverty measures for the low-income countries. Results are available upon request from the authors.

[27] Two countries—China and India— between them contribute 30 observations to the low-income country sample.

The data reported in Table 6 give the response of total poverty to changes in the *share weighted* growth rates of the sectors. Estimates of the participation effects for each sector can then be obtained by simply multiplying the estimated coefficients (columns B-D, Table 6) by the sectoral shares for each country. The results (as averages per region) are reported in Table 7. We find the participation effect of agricultural growth on average across the world to be 2.2 times (=1.72/0.80) larger than the participation effect of non-agriculture. In other words, one percentage point additional growth in agricultural GDP per capita would reduce the poverty headcount on average 2.2 times more than an additional percentage point growth in non-agriculture GDP per capita.

This broad finding lends support to a continued emphasis on fostering agricultural growth in reducing poverty especially given that the growth linkage effects from agriculture to non-agriculture tend to be at least as large as the reverse feedback effects. Moreover, historical evidence from both developed (Bernard and Jones, 1996) and developing (Martin and Mitra, 2001) countries indicating that agricultural productivity (as captured by TFP) has been growing at least as fast as non-agricultural productivity supports the view of agriculture as a dynamic sector with substantial growth potential which would help release labor from agriculture to non-agriculture.

Table 7: Decomposition of the participation effect of sectoral growth with respect to head count poverty into its share and elasticity components

Region	*# of countries*	*GDP share (%)*		*Estimated coefficient*		*Participation effect of growth on head count poverty*	
		Agric	*Nonag*	*Agric*	*Nonag[1)]*	*Agric*	*Non-agric[1)]*
Low-income group							
SSA	18	31	70	-6.00	-	-1.83	-
South Asia	4	29	71	-6.00	-	-1.73	-
East Asia & Pacific	6	24	76	-6.00	-	-1.44	-
Eastern & Central Europe	4	26	74	-6.00	-	-1.57	-
Latin America & Caribbean	4	19	82	-6.00	-	-1.11	-
Middle East & North Africa	2	15	85	-6.00	-	-0.92	-
ALL LOW-INCOME	**38**	**27**	**73**	**-6.00**	**-**	**-1.60**	**-**
Middle-income							
SSA[2)]	2	4	97	-21.74	-1.57	-0.76	-1.52
South Asia	0						
East Asia & Pacific	2	13	87	-21.74	-1.57	-2.76	-1.37
Eastern & Central Europe	12	10	91	-21.74	-1.57	-2.07	-1.42
Latin America & Caribbean	16	10	90	-21.74	-1.57	-2.13	-1.42
Middle East % North Africa	5	14	86	-21.74	-1.57	-3.07	-1.35
ALL MIDDLE-INCOME	**37**	**10**	**90**	**-21.74**	**-1.57**	**-2.24**	**-1.41**
Pooled sample							
SSA	20	28	72	-9.35	-0.98	-2.66	-0.70
South Asia	4	29	71	-9.35	-0.98	-2.70	-0.70
East Asia & Pacific	8	22	78	-9.35	-0.98	-2.03	-0.77
Eastern & Central Europe	16	14	86	-9.35	-0.98	-1.27	-0.85
Latin America & Caribbean	20	11	89	-9.35	-0.98	-1.03	-0.87
Middle East & North Africa	7	14	86	-9.35	-0.98	-1.34	-0.84
ALL POOLED	**75**	**18**	**82**	**-9.35**	**-0.98**	**-1.72**	**-0.80**

1) The estimated coefficients on the effect of (share weighted) non-agricultural growth in the low-income countries are not statistically significantly different from zero.
2) The two middle-income countries are Botswana and South Africa
Source: Authors' calculations based on World Bank data (2005c)

While an overall focus on fostering agricultural growth in reducing world poverty appears justified from the broad average perspective, the results in Table 7 also underscore the critical need to look beyond the averages and explore the size of the participation effect across regions and countries. First, as discussed above, the elasticity of total poverty reduction with respect to sectoral GDP (i.e. the estimated coefficients) differs substantially between the middle and low-income countries where the effect of agricultural growth on overall poverty was found to be much more important. Second, the larger the share of agriculture in the total economy the more important the participation effect from agriculture. The combined effect of these two forces in the middle-income countries results in the participation effect of agriculture on head count poverty being on average 1.6 times (-2.24/-1.41) larger than that of non-agriculture, while it is on average multiple times larger in the low-income countries.

6 The Relative Contribution of Agriculture and Non-Agriculture to Poverty Reduction – Evidence from the Recent Past

From equations (4) and (6) we know that poverty reduction during a certain period can be decomposed into sectoral participation and growth effects. We estimated the participation effects of the different sectors and concluded that one percent of agricultural growth yields on average 2.2 times more poverty reduction than one percent growth in non-agriculture. While agriculture could potentially grow faster, it is likely to continue to grow at a slower pace than non-agriculture due to Engel's Law. But the indirect effects of agricultural growth on non-agriculture are substantial and likely at least as large as the reverse feedback effects. Whether investments in agriculture in a particular country would generate faster or slower *overall* economic growth than investments in non-agriculture is a priori not clear. This would depend on the structure of the economy and the governing institutional arrangements.[28]

How these potentially counterbalancing forces (potentially slower overall growth from investments in agriculture against a much larger participation effect) play out, remains an empirical question. To shed more light on this, we explore how agriculture and non-agriculture contributed to poverty reduction over the past two decades in the countries in our PovCal sample. In particular, we revisit equation (6) and estimate the relative contribution of each sector to the (predicted) change in (US1$/day) poverty incidence in these countries. To do so, we apply the estimated coefficients from the pooled data set reported in Table 6 column B to the (share weighted) sectoral GDP growth rates in our PovCal sample. The poverty spells in our sample concern the 1980-2000 period, with about two thirds of the spells occurring in the 1990s. It is especially useful to examine

[28] These two forces may further affect the country specific size of the participation effect as well, as will be discussed below.

the relative contribution of agriculture and non-agriculture to poverty reduction during this period, as it coincides with the increasing liberalization and globalization of the world economy. These evolutions might affect the feedback effects of agriculture to non-agriculture, as well as the participation effects, if globalization induced a greater correlation between domestic and international food prices and a change in the farming structures through increased vertical integration. The effect of non-agricultural growth and the constant (a measure of the effect of inequality change) is retained in the decomposition, even though their estimated coefficients are not statistically significant. Observations where the share of a sector in poverty reduction exceeds |10| are excluded, resulting in a loss of nine observations (from 222 to 213).

Table 8: Sectoral decomposition of changes in headcount poverty [1)]

Average share to poverty reduction of	**No. of obser-vations**	**Non agriculture**	**Agriculture**	**Inequality change**
Continent				
Sub-Saharan Africa	37	**0.342**	**0.623**	0.035
South Asia	20	**0.316**	**0.437**	0.247
East Asia & Pacific	43	**0.430**	**0.215**	0.355
East Europe & Central Asia	27	**0.378**	**0.451**	0.171
Latin America & the Caribbean	73	**0.388**	**0.403**	0.209
Middle East & North Africa	13	**0.593**	**-0.109**	0.515
Total	213	**0.393**	**0.382**	0.226

Spells with sectoral shares exceeding |10| excluded.
Bolded shares are based on statistically significant regression coefficients.
Source: authors' calculations

The results confirm that despite its slower (direct) growth record, agriculture played a major role in the evolution of poverty during the 1980-2000 period (Table 8). On average just under 40 percent of the change in poverty incidence across the world was attributable to growth in agricultural GDP—as much as growth in both industry and services combined. Even so, this is likely an underestimate, as the decompositions are based on contemporaneous growth rates in agriculture and non-agriculture. As a result, the contribution of agriculture to poverty reduction through its effect on growth in non-agriculture is attributed to the non-agricultural sector in this decomposition exercise. To the extent that the indirect feedback effect from agriculture to non-agriculture exceeds the feedback effect from non-agriculture to agriculture, the contribution from agriculture to poverty reduction will be underestimated. In SSA two thirds of the predicted poverty change could be attributed to agriculture, underscoring the continuing critical importance of fostering agricultural growth in SSA for poverty reduction.

While the evidence presented so far supports a focus on fostering agricultural growth as the starting point in designing poverty reducing strategies, especially in most low-income countries, there are differences to be expected in the size of the participation and indirect growth effects across countries depending not only on the share of the sector but also on the structure of the economy (e.g. equal versus unequal distribution of assets; a small open versus a large closed economy) and its institutional organization (e.g. functioning of labor and commodity markets). Our inequality corrected estimates of the participation effects indicate for example that a 0.20 increase in the national Gini (corresponding roughly to the difference in equality between Ethiopia and Zambia) would decrease the participation effect of agriculture in low-income countries on average from -1.60 to -0.96.[29] Growth linkages on the other hand are likely to be smaller in small, open economies (such as Lesotho) with small elastically supplied non-tradable sectors, while countries such as Cameroon, Nigeria and Tanzania with large non-tradable agriculture and service sectors are likely to encounter large growth linkages from investments in tradables (Dorosh and Haggblade, 2003).

The choice of the agricultural technology (e.g. focused on non tradable food versus tradable export crops; land versus labor saving) and its targeting (small versus large farms) can also substantially affect the size of the participation and indirect growth effects of technological change on poverty. Using CGE models applied to archetype economies de Janvry and Sadoulet (2002) emphasize for example that improvements in agricultural technology primarily affect poverty in SSA through their direct growth effects. This suggests that technological change should focus on small farmer production system though with an appropriate balance in enhancing productivity

[29] The coefficient on the share weighted Gini corrected agricultural and non-agricultural growth rates in low-income countries were estimated at -8,82 and -0,72 respectively, though the latter was not statistically significant.

among tradable crops (often export crops) and non-tradables (most often food staple crops) to avoid falling price effects.[30] In Asia on the other hand, where the landless account for an important share of the poor and the labor markets are much better developed, technological change for maximum employment creation (i.e. land saving and not labor saving technologies) is advised for maximal poverty reduction. Benefits from agricultural technological change come mostly from linkage effects through the rest of the economy in Latin America, leading to the possibility that technological changes in the fields of large farmers can be more beneficial to the poor farmers than the direct effects derived from technological change on their own farm.

7 Concluding Remarks

To analyze the role of agriculture in poverty reduction, the paper developed a simple conceptual framework in which the relative contribution of a sector to poverty reduction is shown to depend on four factors: its direct (1) and indirect (2) growth effects as well as its elasticity of total poverty to sectoral growth (3) and the sector's share in the overall economy (4) which together determine the sector's participation effect. Reviewing the evidence on the growth contributions of agriculture and the non-agricultural sector, it emerges that while the agricultural sector on average has grown more slowly than non-agriculture, this appears to be largely due to a migration out of agriculture into non-agriculture. The latter could simply be due to equilibrating labor movements out of agriculture into non-agriculture in response to more productive opportunities in non-agriculture (industrial pull). Yet, the more rapid increase in agricultural TFP historically observed in both developed and developing countries lends support to the view of agriculture as a dynamic sector with substantial growth potential whereby productivity increases in agriculture induce labor to move out of agriculture (agricultural push).

In addition, both the micro and the cross-country evidence indicate that the indirect or growth linkage effects from agriculture to non-agriculture appear quantitatively large and at least as

[30] See World Bank (2005e) for a detailed discussion of this argument in Ethiopia.

large as the reverse feedback effect. While the evidence further suggests that these indirect growth effects are likely to be smaller in SSA compared with the rest of the developing world, they appear nonetheless quantitatively important. In sum, while the direct growth contribution of agriculture is on average likely to be smaller, this is often likely to be compensated by its contribution to non-agriculture growth through the linkage effects which tends to be at least as large as the reverse feedback effect. In evaluating the potential growth contribution to poverty reduction from investment in agriculture in a particular country, it is thus critical to account for both the contemporaneous direct effects as well as the lagged indirect effects.

We find the participation effect from agriculture on the poverty head count on average to be 2.2 times larger than the participation effect from non-agriculture. This difference does not primarily follow from the large share of agriculture in these economies, but rather from the much larger elasticity of overall poverty to agricultural GDP than to non-agricultural GDP. This also holds for the middle-income countries where the participation effect of agricultural growth on head count poverty is on average 1.6 times larger than that of the other sectors. However, the *poorest* groups in these countries appear to be equally well served by growth in the agricultural and non-agricultural sectors. The difference in participation by poor people in growth in agriculture versus growth in non-agriculture is especially pronounced in the low-income countries, with the poverty gains from growth in agriculture multiple times larger on average than those from growth in non-agriculture, irrespective of the poverty measures used. These results also hold for SSA.

The much stronger participation effects from agriculture in low-income countries clearly outweigh its potentially lower contribution to overall growth, lending support to a concerted focus on fostering agricultural growth in reducing poverty in these countries (including SSA). This is borne out by the more recent historical experience of the past two decades. It is also consistent with the more forward looking in-depth country specific evidence from four Sub-Saharan countries by Dorosh and Haggblade (2003) who find that investments in agriculture favor the poor more than similar investments in manufacturing. The evidence presented in this paper thus supports the overall premise that enhancing agricultural productivity is a critical starting point in designing effective poverty reduction strategies, especially in low-income countries.

This raises the question of how this can and should be achieved, especially in SSA, where agricultural productivity growth has been lagging. While a comprehensive treatment of this question falls beyond the scope of this paper, we conclude highlighting the following three points. First, the debate about investment in agriculture versus non-agriculture is often misleading, especially when applied to rural areas, as many public investments (especially rural roads but also the provision of education and health services) are equally necessary for the development of the farming and the (rural) non-farming sector (Fan, Hazell, and Thorat, 2000). Second, when it comes to agricultural specific interventions, the important potential of increased investment in agricultural R&D and extension, accounting for the great diversity of farming systems in SSA, cannot be sufficiently underscored. Agriculture is typically an atomistic industry. There are therefore few incentives for private investment in research. Relatedly, given the limited use of technology in African agriculture, the role of policies, market access and behavioral factors in adopting new technologies must also be further explored.

Third, the poverty reducing effect of different agricultural technologies and investments depends greatly on the structure and institutional organization of the economy. Maximizing the poverty reducing effects of these investments thus requires in depth country specific understanding of the key features of the rural and urban economy (e.g. functioning of input, factor and commodity markets, proportion of net buyers of food staple crops, price and income elasticities of demand and supply of basic staple commodities). Too many poverty reduction strategies are still being developed without a proper diagnostic of basic facts of the agricultural sector, the rural economy and its linkages with the rest of the economy as well as an articulation of the implications of these findings for developing agricultural and rural sector strategies with a maximum impact on poverty.

References

Adams, Richard H.J. (2004): "Economic Growth, Inequality, and Poverty: Estimating the Growth Elasticity of Poverty"; *World Development* 32(12), pp.1989-2004.

Anand, Sudhir, and S.M.R. Kanbur, (1985): "Poverty under the Kuznets Process"; *Economic Journal* 95(0) (Supplement), pp. 42-50.

Arellano, Manuel, and Olympia Bover (1995): "Another Look at the Instrumental Variable Estimation of Error-Components Models"; *Journal of Econometrics* 68, p.29-51.

Bernard, A., and C. Jones (1996): Productivity across Industries and Countries: Time Series Theory and Evidence, *Review of Economics and Statistics* 78(1), pp. 135-146.

Bond, Stephen. (2002): "Dynamic Panel Data Models: A Guide to Micro Data Methods and Practice" *Centre for Microdata methods and Practice Working Paper 09/02,* The Institute for Fiscal Studies, Department of Economics, Université Catholique de Louvain.

Bourguignon, Francois, and Christian Morrisson (1998): "Inequality and Development: The Role Dualism." *Journal of Development Economics,* 57: 233-257.

Bravo-Ortega, Claudio and Daniel Lederman (2005): "Agriculture and National Welfare around the World: Causality and International Heterogeneity since 1960"; *World Bank Policy Research Working Paper* 3499, February 2005.

Byerlee, Derek, Xinshen, Diao, and Chris Jackson (2005): Agriculture, Rural Development, and Pro-Poor Growth, Country Experiences in the Post-Reform Era, *Agriculture and Rural Development Discussion Paper 21*, World Bank: Washington D.C.

Chen, Shaohua, and Martin Ravallion (2004): "How Have the World's Poorest Fared Since the Early 1980s?" *World Bank Research Observer* 19(2), pp. 141-170.

Christiaensen, Luc, Lionel Demery, and Stefano Paternostro (2005) "Reforms, Remoteness, and Risk in Africa: Understanding Inequality and Poverty during the 1990s", in R. Kanbur, and

A.J. Venables (eds.) *Spatial Inequality and Development*, UNU-WIDER Studies in Development Economics, Oxford University Press: Oxford.

Delgado, Christopher L., Jane Hopkins, and Valerie A. Kelly (1998): "Agricultural Growth Linkages in Sub-Saharan Africa"; IFPRI Research Report 107; International Food Policy Research Institute, Washington D.C.

de Janvry, Alain, and Elisabeth Sadoulet (1996): "Growth, Inequality and poverty in Latin America: a causal analysis, 1970–94"; Working Paper 784, Department of Agricultural and Resource Economics, University of California at Berkeley, California, USA.

de Janvry, Alain, and Elisabeth, Sadoulet (2002): "World Poverty and the Role of Agricultural Technology: Direct and Indirect Effects" *Journal of Development Studies* 38(4), pp. 1-26.

Dorosh, Paul, and Steven Haggblade (2003): "Growth Linkages, Price Effects and Income Distribution in Sub-Saharan Africa", *Journal of African Economies* 12(2), pp. 207-235.

Fan, Shenggen, Peter, Hazell, and Sukhadeo Thorat (2000): "Government Spending, Growth and Poverty in Rural India", *American Journal of Agricultural Economics* 82(4): pp. 1038-51.

Fan, Shenggen, C., Chan-Kang, and A., Mukherjee (2005): "Rural and Urban Dynamics and Poverty: Evidence from China and India" International Food Policy Research Institute, Washington D.C., mimeograph.

Gollin, Douglas, Stephen Parente, and Richard Rogerson (2002) "The Role of Agriculture in Development", *American Economic Review* 92 (May): pp. 160-164.

Granger, Clive W.J. (1969) "Investigating Causal Relations by Econometric Models and Cross-Spectral Methods", *Econometrica* 37(3), pp.424-438, August 1969.

Haggblade, Steven, Jeffrey Hammer, and Peter Hazell. 1991. "Modeling Agricultural Growth Multipliers"; *American Journal of Agricultural Economics* 73 (2): pp.361-374.

Hayami, Yujiro and Vernon Ruttan (1985) *Agricultural Development: An International Perspective*; Baltimore : Johns Hopkins University Press.

InterAcademy Council (2004): *Realizing the Promise and Potential of African Agriculture: Science and Technology Strategies for Improving Agricultural Productivity and Food Security in Africa*; Report, Amsterdam, June.

Irz, Xavier, and Terry Roe (2005) "Seeds of Growth? Agricultural Productivity and The Transitional Dynamics of the Ramsey Model", *European Review of Agricultural Economics*, 32 (2): pp. 143-165.

Johnston, Bruce, and John Mellor, 1961, "The Role of Agricultural in Economic Development", *American Economic Review*, No 4, pp. 566-93.

Jorgenson, Dale W., Frank M. Gollop, and Barbara M. Fraumeni (1987) "Productivity and U.S. Economic Growth"; Harvard Economic Studies, vol. 159 Cambridge, Mass.: Harvard University Press.

King, Robert P. and Derek Byerlee (1978): "Factor Intensities and Locational Linkages of Rural Consumption Patterns in Sierra Leone" *American Journal of Agricultural Economics* 60(2), pp. 197-206, (May 1978).

Krueger, Ann, Maurice Schiff, and Alberto Valdes (1988): "Agricultural Incentives in Developing Countries: Measuring the Effect of Sectoral and Economywide Policies"; *World Bank Economic Review* 2-3, pp.255-271.

Lewis, William Arthur (1954): "Economic Development with Unlimited Supply of Labor"; *Manchester School of Economic and Social Studies* 22, May, 139-191.

Lewis, P., W. Martin, and C. Savage (1988) "Capital and Investment in the Agricultural Economy" *Quarterly Review of the Rural Economy* 10(1), pp. 48-53.

Lipton, Michael (1977): *Why Poor People Stay Poor: Urban Bias and World Development*, Temple Smith, London, and Harvard University Press.

Loayza, Norman and Claudio Raddatz. (2005): 'The Composition of Growth Matters for Poverty Alleviation' World Bank (mimeo, September).

Martin, Will, and Devashish Mitra (2001) "Productivity Growth and Convergence in Agriculture versus Manufacturing", *Economic Development and Cultural Change* 49(2), pp.402-422.

Maxwell, S. (2004) Launching the DFID consultation "New Directions for Agriculture in Reducing Poverty", Department for International Development. Available at http://dfid-agriculture-consultation.nri.org/launchpapers/simonmaxwell.html

Mellor, John (1976): The New Economics of Growth: A Strategy for India and the Developing World; Ithaca, NY, USA; Cornell University Press.

Mitchell, T.D., T.R. Carter, P.D. Jones, M. Hulme, and M. New (2003): "A comprehensive set of high-resolution grids of monthly climate for Europe and the globe: the observed record (1901-2000) and 16 scenarios (2001-2100)"; *Journal of Climate*: submitted.

North, Douglas (1959): "Agriculture in Regional Economic Growth", *Journal of Farm Economics* 41(5), pp.943-951.

Perry, G., D. de Ferranti, D. Lederman, W. Foster and A. Valdes (2005): *Beyond the City: the Rural Contribution to Development—Complete Report*; World Bank, Washington D.C.

Ravallion, Martin (1997) 'Can High Inequality Countries Escape Poverty?' *Economic Letters 56(1), pp.51-57.*

Ravallion, M. (2001). "Growth, Inequality and Poverty: Looking Beyond Averages" *World Development* 29(11), pp.1803-1815.

Ravallion, Martin, and Monica Huppi (1991) 'Measuring Changes in Poverty: A Methodological Case Study of Indonesia during an Adjustment Period.' *World Bank Economic Review*, Vol. 5 (January) pp. 57-82.

Ravallion, M., and G. Datt (1996): "How important to India's Poor is the Sectoral Composition of Economic Growth?"; *World Bank Economic Review* 10(1), pp.1-25.

Ravallion, M., and G. Datt (2002): "Why has Economic Growth been More Pro-Poor in Some States of India than Others?" *Journal of Development Economics* 65, pp. 381-400.

Ravallion, M., and S. Chen (2004): "China's (Uneven) Progress Against Poverty" World Bank Policy Research Working Paper No. 3408.

Schultz, Theodore W. (1964): *Transforming Traditional Agriculture*, New Haven, Conn., Yale University Press.

Thirtle, C., L. Irz, L. Lin, V. McKenzie-Hill and S. Wiggins (2001) "Relationship between Changes in Agricultural Productivity and the incidence of poverty in developing countries" Report commissioned by DFID, London, UK.

Thirtle, Colin, Lin Lin, and Jenifer Piesse (2003): "The Impact of Research-Led Agricultural Productivity Growth on Poverty Reduction in Africa, Asia and Latin America" *World Development* 31-12, pp.1959-1975

Timmer, Peter (1997): "How Well Do the Poor Connect to the Growth Process?" Harvard Institute for International Development. United States Agency for International Development.

Timmer, Peter (2005): "Agriculture and Pro-Poor Growth: What the Literature Says." Draft paper, Agricultural and Rural Development Dept., World Bank.

Windmeijer, Frank (2005): "A Finite Sample Correction for the Variance of Linear Efficient Two-Step GMM estimators" *Journal of Econometrics* 126, pp.25-51.

World Bank (2000): *The Quality of Growth*, Oxford University Press: Oxford.

World Bank (2005a): Meeting the Challenge of Africa's Development: A World Bank Group Action Plan, World Bank: Washington D.C.

World Bank (2005b): *Agriculture, Rural Development and Pro-Poor Growth*, World Bank: Washington D.C..

World Bank (2005c): World Development Indicators and Global Development Finance Database, World Bank: Washington D.C.; April 2005

World Bank (2005d): *PovcalNet*; http://iresearch.worldbank.org/PovcalNet/jsp/index.jsp, May 2005.

World Bank (2005e) "*Well-Being and Poverty in Ethiopia: The Role of Agriculture and Agency*" Report No. 29468-ET, World Bank: Washington D.C.

Appendix A1: Specification and estimation of agriculture and non-agriculture linkages

In particular, in our specification non-agricultural GDP per capita (Y^n_{it}) in country i at time t is assumed to depend on both levels of per capita non-agricultural GDP in previous periods as well as per capita agricultural GDP now[31] and in the past. In addition, we consider a vector X_{it} of country-specific exogenous explanatory factors, yielding:

$$Y^n_{it} = \alpha^0 + \sum_{k=1}^{Kn} Y^n_{it-k}\alpha^1_k + \sum_{k=0}^{Ka} Y^a_{it-k}\alpha^2_k + X_{it}\alpha^3 + c_i + \varepsilon_{it} \tag{A1}$$

where c_i reflects unobserved country specific characteristics that determine the sectoral output, and ε_{it} a white noise error term. Per capita agricultural GDP can be similarly expressed as:

$$Y^a_{it} = \beta^0 + \sum_{l=1}^{Ln} Y^n_{it-l}\beta^1_l + \sum_{l=1}^{La} Y^a_{it-l}\beta^2_l + X_{it}\beta^3 + f_i + \varphi_{it} \tag{A2}$$

with f_i a time invariant country-specific unobserved effect and φ_{it} a white noise error term.[32] The specifications (A1) and (A2) are assumed to capture the full correlations between (per capita) non-agricultural and agricultural GDP, and ε_{it} and φ_{it} are therefore assumed to be uncorrelated.

Equations (A1) and (A2) constitute our model of intersectoral growth linkages, where agricultural and non-agricultural GDP are interdependently determined in a dynamic process. Through the substitution of equation (A2) into equation (A1), we can obtain a reduced form expression for non-agricultural growth:

$$\begin{aligned} Y^n_{it} = {} & \alpha_0 + \sum_{k=0}^{Ka}\beta^0\alpha^2_k + \sum_{k=1}^{Kn} Y^n_{it-k}\alpha^1_k + \sum_{k=0}^{Ka}\sum_{l=1}^{Ln} Y^n_{it-k-l}\beta^1_l\alpha^2_k + \sum_{k=0}^{Ka}\sum_{l=1}^{La} Y^a_{it-k-l}\beta^2_l\alpha^2_k \\ & + \sum_{k=0}^{Ka} X_{it-k}\beta^3\alpha^2_k + X_{it}\alpha^3 + \sum_{k=0}^{Ka}\left(f_i + \varphi_{it}\right)\alpha^2_k + c_i + \varepsilon_{it} \end{aligned} \tag{A3}$$

which can be further reduced to:

---

[31] The level of contemporaneous agricultural GDP is included since a good agricultural harvest can induce an immediate higher agricultural demand for goods from the non-agricultural sector.

[32] Concurrent non-agricultural GDP is omitted on the right-hand side, as the agricultural cycle imposes a lagged effect of any non-agricultural stimuli to agricultural output growth. Increased demand for agricultural products can only lead to a higher agricultural production at the next harvest period. We abstract from the potential increased demand for agricultural inputs reflected in concurrent non-agricultural growth.

$$Y_{it}^{n} = \gamma^{0} + \sum_{p=1}^{P} Y_{it-p}^{n}\gamma_{p}^{1} + \sum_{p=1}^{Q} Y_{it-p}^{a}\gamma_{p}^{2} + \sum_{k=0}^{Ka} X_{it-k}\gamma_{k}^{3} + h_{i} + v_{it} \qquad \text{(A4)}$$

This single equation now constitutes a dynamic relationship between non-agricultural GDP and lagged levels of agricultural and non-agricultural GDP which we estimate in first differences and levels using the Arellano and Bover (1995) system GMM estimator. The lagged levels of non-agricultural GDP are correlated with the unobserved country specific effects h_i and OLS is therefore inconsistent. First-differencing of equation (A4) eliminates the country-specific effect h_i yielding:

$$\Delta Y_{it}^{n} = \sum_{p=1}^{P} \Delta Y_{it-p}^{n}\gamma_{p}^{1} + \sum_{p=1}^{Q} \Delta Y_{it-p}^{a}\gamma_{p}^{2} + \sum_{k=0}^{Ka} \Delta X_{it-k}\gamma_{k}^{3} + \Delta v_{it} \qquad \text{(A5)}$$

The assumed feedback mechanism between changes in agricultural and non-agricultural GDP introduces another correlation between Δv_{it} and the lagged changes in agricultural and non-agricultural GDP (ΔY_{it-1}^{a} and ΔY_{it-1}^{n}). To ensure consistent estimates we follow Arellano and Bover and use further lagged levels as instruments in the first difference equation (A5) and lagged differences to instrument Y_{it-1}^{a} and Y_{it-1}^{n} in the levels equation (A4) in effect assuming $E(\Delta Y_{it-1}^{a}, h_i + v_{it}) = E(\Delta Y_{it-1}^{n}, h_i + v_{it}) = 0$ for t=3, …, T. The additional moment conditions following from the level equation help address the potential problem of weak instruments, and thus low efficiency, that afflicts the Arellano-Bond estimation when the data generation process of the variables of interest approaches a unit root (Bond, 2002). A reduced form along the lines of equations (A3-A5) can also be constructed for agricultural GDP(Y_{it}^{a}) and its change (ΔY_{it}^{a}).

Appendix A2: Povcal data overview

Country	Spell	Headcount ($1)		Pov. gap ($1)		Pov. gap squ. ($1)		Gini	
		Start	End	Start	End	Start	End	Start	End
Albania	1997-2002	0.62	0.23	0.07	0.04	0.02	0.04	29.12	28.14
Algeria	1988-1995	1.75	1.16	0.64	0.24	0.49	0.09	40.14	35.33
Argentina-Urban	1986-1992	0.29	0.09	0.17	0.01	0.20	0.00	44.51	45.35
Argentina-Urban	1992-1996	0.09	1.14	0.01	0.18	0.00	0.05	45.35	48.58
Argentina-Urban	1996-1998	1.14	7.69	0.18	3.61	0.05	2.27	48.58	52.82
Argentina-Urban	1998-2001	7.69	3.33	3.61	0.48	2.27	0.09	52.82	52.24
Azerbaijan	1995-2001	10.94	3.67	2.62	0.63	1.01	0.20	35.99	36.50
Bangladesh	1984-1986	26.16	21.96	5.99	3.92	1.96	1.08	25.88	26.92
Bangladesh	1986-1989	21.96	33.75	3.92	7.72	1.08	2.44	26.92	28.85
Bangladesh	1989-1992	33.75	35.86	7.72	8.77	2.44	2.98	28.85	28.27
Bangladesh	1992-1995.5	35.86	28.61	8.77	6.04	2.98	1.87	28.27	33.00
Bangladesh	1995-2000	28.61	26.81	6.04	5.31	1.87	1.49	33.00	31.79
Belarus	1988-1993	0.09	0.00	0.07	0.00	0.11	0.00	22.76	21.60
Belarus	1993-1995	0.00	1.43	0.00	0.52	0.00	0.41	21.60	28.76
Belarus	1995-1997	1.43	0.03	0.52	0.01	0.41	0.00	28.76	25.62
Belarus	1997-1998	0.03	0.00	0.01	0.00	0.00	0.00	25.62	27.95
Bolivia-Urban	1986-1991	20.08	5.68	6.17	0.76	2.50	0.14	51.68	42.04
Bolivia	1997-1999	20.43	14.38	9.66	5.35	6.09	2.68	58.46	44.68
Botswana	1986-1994	33.30	30.66	12.54	12.72	6.09	6.89	54.21	66.70
Brazil	1981-1984	11.80	15.21	2.97	4.09	0.99	1.44	57.57	57.88
Brazil	1984-1985	15.21	15.75	4.09	4.64	1.44	1.79	57.88	59.52
Brazil	1985-1987	15.75	11.90	4.64	3.36	1.79	1.25	59.52	59.31
Brazil	1987-1989	11.90	9.00	3.36	2.01	1.25	0.59	59.31	63.42
Brazil	1989-1990	9.00	14.04	2.01	4.27	0.59	1.70	63.42	60.68
Brazil	1990-1993	14.04	8.27	4.27	2.01	1.70	0.65	60.68	59.82
Brazil	1993-1995	8.27	10.53	2.01	3.88	0.65	1.88	59.82	61.51
Brazil	1995-1996	10.53	6.86	3.88	1.37	1.88	0.36	61.51	59.98
Brazil	1996-1997	6.86	8.96	1.37	2.09	0.36	0.65	59.98	59.05
Brazil	1997-1998	8.96	9.94	2.09	3.15	0.65	1.32	59.05	60.66
Brazil	1998-2001	9.94	8.17	3.15	2.09	1.32	0.71	60.66	59.25
Bulgaria	1989-1994	0.05	0.29	0.06	0.23	0.16	0.44	23.43	24.32
Bulgaria	1992-1996	0.33	1.76	0.30	0.97	0.63	1.16	30.80	35.04
Bulgaria	1994-1995	0.29	3.86	0.23	1.37	0.44	0.67	24.32	31.13
Bulgaria	1995-1997	3.86	0.50	1.37	0.14	0.67	0.09	31.13	26.38
Bulgaria	1997-2001	0.50	4.73	0.14	1.39	0.09	0.56	26.38	31.91
Burkina Faso	1994-1998	51.41	44.85	19.52	14.42	9.28	6.27	50.71	46.85
Burundi	1992-1998	45.24	54.56	13.83	22.69	5.66	12.67	33.33	42.39
Cameroon	1996-2001	32.45	17.10	9.05	4.09	3.30	1.38	46.82	44.55
Chile	1987-1989	6.20	4.92	1.01	1.09	0.22	0.40	56.43	57.88
Chile	1989-1990	4.92	6.19	1.09	2.12	0.40	1.15	57.88	56.49
Chile	1990-1992	6.19	1.15	2.12	0.20	1.15	0.06	56.49	55.75
Chile	1992-1994	1.15	0.81	0.20	0.08	0.06	0.01	55.75	54.79
Chile	1994-1996	0.81	0.00	0.08	0.00	0.01	0.00	54.79	57.47
Chile	1996-1998	0.00	0.85	0.00	0.11	0.00	0.02	57.47	56.65
Chile	1998-2000	0.85	0.97	0.11	0.18	0.02	0.06	56.65	57.61
China	1981-1982	23.02	13.70	5.51	2.89	1.90	0.87	30.95	28.53
China	1982-1983	13.70	10.48	2.89	1.96	0.87	0.52	28.53	28.28
China	1983-1984	10.48	7.67	1.96	1.24	0.52	0.28	28.28	29.11
China	1984-1985	7.67	6.78	1.24	1.13	0.28	0.27	29.11	28.95
China	1985-1986	6.78	7.49	1.13	1.45	0.27	0.40	28.95	32.41

Country	Spell	Headcount ($1)		Pov. gap ($1)		Pov. gap squ. ($1)		Gini	
		Start	End	Start	End	Start	End	Start	End
China	1986-1987	7.49	6.39	1.45	1.15	0.40	0.33	32.41	32.38
China	1987-1988	6.39	6.13	1.15	1.04	0.33	0.31	32.38	33.01
China	1988-1989	6.13	9.73	1.04	2.15	0.31	0.71	33.01	35.15
China	1989-1990	9.73	7.96	2.15	1.45	0.71	0.41	35.15	34.85
China	1990-1991	7.96	8.52	1.45	2.08	0.41	0.85	34.85	37.06
China	1991-1992	8.52	7.13	2.08	1.61	0.85	0.63	37.06	39.01
China	1992-1993	7.13	8.27	1.61	1.79	0.63	0.54	39.01	41.95
China	1993-1994	8.27	7.58	1.79	2.00	0.54	0.74	41.95	43.31
China	1994-1995	7.58	5.65	2.00	1.55	0.74	0.75	43.31	41.50
China	1995-1996	5.65	2.97	1.55	0.81	0.75	0.42	41.50	39.75
China	1996-1997	2.97	3.35	0.81	0.58	0.42	0.15	39.75	39.78
China	1997-1998	3.35	2.16	0.58	0.24	0.15	0.04	39.78	40.33
China	1998-1999	2.16	2.24	0.24	0.27	0.04	0.05	40.33	41.61
China	1999-2000	2.24	3.34	0.27	0.64	0.05	0.18	41.61	43.82
China	2000-2001	3.34	2.96	0.64	0.51	0.18	0.12	43.82	44.73
Colombia	1980-1988	7.85	4.48	2.92	1.31	1.58	0.58	59.13	53.11
Colombia	1988-1989	4.48	2.45	1.31	0.59	0.58	0.24	53.11	53.59
Colombia	1989-1991	2.45	2.82	0.59	0.76	0.24	0.32	53.59	51.32
Colombia	1991-1995	2.82	3.12	0.76	0.36	0.32	0.06	51.32	57.22
Colombia	1995-1996	3.12	5.28	0.36	1.03	0.06	0.27	57.22	56.96
Colombia	1996-1998	5.28	8.26	1.03	3.29	0.27	1.91	56.96	60.66
Colombia	1998-1999	8.26	8.18	3.29	2.21	1.91	0.79	60.66	57.92
Costa Rica	1981-1986	14.81	7.32	5.91	3.16	3.17	1.87	47.49	34.48
Costa Rica	1986-1990	7.32	5.24	3.16	1.34	1.87	0.46	34.48	45.66
Costa Rica	1990-1993	5.24	4.11	1.34	1.36	0.46	0.74	45.66	46.28
Costa Rica	1993-1996	4.11	3.57	1.36	1.09	0.74	0.54	46.28	47.08
Costa Rica	1996-1997	3.57	1.85	1.09	0.51	0.54	0.25	47.08	45.88
Costa Rica	1997-1998	1.85	6.94	0.51	3.41	0.25	2.24	45.88	51.30
Costa Rica	1998-2000	6.94	2.01	3.41	0.66	2.24	0.39	51.30	46.60
Cote d'Ivoire	1985-1986	4.71	0.00	0.59	0.00	0.11	0.00	41.21	38.62
Cote d'Ivoire	1986-1987	0.00	3.28	0.00	0.34	0.00	0.06	38.62	40.43
Cote d'Ivoire	1987-1988	3.28	7.46	0.34	1.37	0.06	0.40	40.43	36.89
Cote d'Ivoire	1988-1993	7.46	9.88	1.37	1.86	0.40	0.55	36.89	36.91
Cote d'Ivoire	1993-1995	9.88	12.29	1.86	2.41	0.55	0.71	36.91	36.68
Cote d'Ivoire	1995-1998	12.29	15.53	2.41	3.82	0.71	1.42	36.68	43.75
Croatia	1998-1999	0.07	0.23	0.07	0.24	0.15	0.54	26.82	27.71
Croatia	1999-2000	0.23	0.09	0.24	0.06	0.54	0.09	27.71	31.33
Croatia	2000-2001	0.09	0.08	0.06	0.05	0.09	0.06	31.33	31.10
Czech Republic	1988-1993	0.00	0.00	0.00	0.00	0.00	0.00	19.40	26.55
Czech Republic	1993-1996	0.00	0.12	0.00	0.24	0.00	1.05	26.55	25.82
Dominican Republic	1986-1989	8.61	3.85	2.89	0.55	1.46	0.12	47.78	50.46
Dominican Republic	1989-1992	3.85	1.55	0.55	0.55	0.12	0.38	50.46	51.36
Dominican Republic	1992-1996	1.55	1.76	0.55	0.38	0.38	0.14	51.36	48.71
Dominican Republic	1996-1998	1.76	0.00	0.38	0.00	0.14	0.00	48.71	47.44
Ecuador	1994-1995	28.89	20.21	8.47	5.77	3.27	2.28	46.55	43.73
Ecuador	1995-1998	20.21	15.00	5.77	5.97	2.28	3.42	43.73	53.39
Egypt, Arab Rep.	1991-1995	3.97	2.58	0.53	0.31	0.13	0.07	32.00	32.60
Egypt, Arab Rep.	1995-2000	2.58	3.08	0.31	0.42	0.07	0.11	32.60	34.41
El Salvador	1989-1995	21.35	25.05	12.20	10.06	10.50	5.70	48.96	49.86
El Salvador	1995-1996	25.05	25.26	10.06	10.35	5.70	5.79	49.86	52.25
El Salvador	1996-1997	25.26	21.40	10.35	7.87	5.79	3.95	52.25	50.79
El Salvador	1997-1998	21.40	21.39	7.87	7.94	3.95	3.89	50.79	52.17
El Salvador	1998-2000	21.39	31.07	7.94	14.07	3.89	8.57	52.17	53.27
Estonia	1988-1993	0.05	0.98	0.05	0.40	0.09	0.34	22.97	39.50

Country	Spell	Headcount ($1)		Pov. gap ($1)		Pov. gap squ. ($1)		Gini	
		Start	**End**	**Start**	**End**	**Start**	**End**	**Start**	**End**
Estonia	1995-1998	0.35	0.08	0.09	0.02	0.05	0.01	30.06	37.64
Ethiopia	1982-1995	32.73	31.25	7.69	7.95	2.72	3.00	32.42	39.96
Ethiopia	1995-2000	31.25	22.98	7.95	4.82	3.00	1.63	39.96	30.01
Gambia	1992-1998	53.69	26.49	23.27	8.76	13.28	3.77	47.80	50.23
Georgia	1996-1997	1.74	1.21	0.96	0.43	1.09	0.31	37.13	36.08
Georgia	1997-1998	1.21	1.62	0.43	0.14	0.31	0.02	36.08	37.38
Georgia	1998-1999	1.62	2.59	0.14	0.85	0.02	0.53	37.38	38.05
Georgia	1999-2000	2.59	2.83	0.85	0.88	0.53	0.52	38.05	38.85
Georgia	2000-2001	2.83	2.71	0.88	0.93	0.52	0.62	38.85	36.90
Ghana	1988-1989	46.51	45.45	16.06	15.27	7.51	6.99	35.35	35.99
Ghana	1989-1992	45.45	47.24	15.27	16.40	6.99	7.54	35.99	38.10
Ghana	1992-1999	47.24	44.81	16.40	17.28	7.54	8.72	38.10	40.71
Guatemala	1987-1989	47.04	34.85	22.47	16.84	13.63	10.49	58.26	59.60
Guatemala	1989-2000	34.85	15.95	16.84	4.60	10.49	1.74	59.60	59.87
Guyana	1993-1998	8.14	2.98	1.95	0.60	0.63	0.16	51.55	44.58
Honduras	1986-1989	33.74	34.22	13.67	14.33	7.15	7.72	55.09	59.49
Honduras	1989-1990	34.22	37.83	14.33	16.84	7.72	9.64	59.49	57.36
Honduras	1990-1992	37.83	28.33	16.84	11.80	9.64	6.42	57.36	54.51
Honduras	1992-1994	28.33	23.66	11.80	9.52	6.42	5.09	54.51	55.22
Honduras	1994-1996	23.66	24.96	9.52	9.12	5.09	4.37	55.22	53.72
Honduras	1996-1998	24.96	23.84	9.12	11.62	4.37	7.47	53.72	56.30
Honduras	1998-1999	23.84	20.74	11.62	7.45	7.47	3.51	56.30	56.24
Hungary	1987-1989	0.06	0.03	0.08	0.01	0.26	0.02	20.96	25.05
Hungary	1989-1993	0.03	0.19	0.01	0.16	0.02	0.31	25.05	27.94
Hungary	1993-1998	0.19	0.38	0.16	0.32	0.31	0.66	27.94	24.44
India	1983-1986	52.70	48.29	16.32	14.23	6.83	5.75	32.06	33.68
India	1986-1987	48.29	45.88	14.23	12.52	5.75	4.68	33.68	33.08
India	1987-1988	45.88	49.45	12.52	14.05	4.68	5.39	33.08	32.93
India	1988-1989	49.45	40.80	14.05	10.42	5.39	3.73	32.93	31.84
India	1989-1990	40.80	42.06	10.42	11.09	3.73	4.04	31.84	31.21
India	1990-1992	42.06	51.08	11.09	14.98	4.04	5.89	31.21	34.31
India	1992-1994	51.08	45.13	14.98	12.04	5.89	4.41	34.31	31.52
India	1994-1995	45.13	50.62	12.04	13.92	4.41	5.16	31.52	36.32
India	1995-1996	50.62	41.85	13.92	10.44	5.16	3.61	36.32	32.86
India	1996-1997	41.85	44.21	10.44	44.21	3.61	4.52	32.86	37.83
India	1993-1999	42.13	35.60	10.81	8.45	3.87	2.74	31.52	32.46
Indonesia	1984-1987	37.30	28.08	10.18	6.10	3.94	1.78	34.15	33.12
Indonesia	1987-1990	28.15	20.62	6.10	3.93	1.78	1.05	33.12	33.18
Indonesia	1990-1993	20.62	17.39	3.93	2.70	1.05	0.56	33.18	34.36
Indonesia	1993-1996	17.39	13.93	2.70	2.16	0.56	0.49	34.36	36.45
Indonesia	1996-1998	13.93	26.33	2.16	5.44	0.49	1.70	36.45	38.36
Indonesia	1998-1999	26.33	14.74	5.44	2.29	1.70	0.54	38.36	31.73
Indonesia	1999-2000	14.74	7.19	2.29	1.04	0.54	0.26	31.73	30.33
Indonesia	2000-2002	7.19	7.51	1.04	0.91	0.26	0.18	30.33	34.30
Iran, Islamic Rep.	1986-1990	1.53	1.61	0.32	0.44	0.12	0.23	47.42	43.60
Iran, Islamic Rep.	1990-1994	1.61	0.49	0.44	0.11	0.23	0.05	43.60	43.00
Iran, Islamic Rep.	1994-1998	0.49	0.26	0.11	0.04	0.05	0.01	43.00	44.10
Jamaica	1988-1989	5.02	3.42	1.38	0.32	0.67	0.04	43.16	42.02
Jamaica	1989-1990	3.42	7.72	0.32	3.28	0.04	1.96	42.02	32.90
Jamaica	1990-1991	7.72	4.10	3.28	0.45	1.96	0.07	32.90	41.11
Jamaica	1991-1992	4.10	6.65	0.45	1.03	0.07	0.24	41.11	38.39
Jamaica	1992-1993	6.65	4.92	1.03	1.32	0.24	0.65	38.39	35.67
Jamaica	1993-1996	4.92	3.15	1.32	0.74	0.65	0.33	35.67	36.43
Jamaica	1996-1999	3.15	1.68	0.74	0.43	0.33	0.21	36.43	44.22

Country	Spell	Headcount ($1)		Pov. gap ($1)		Pov. gap squ. ($1)		Gini	
		Start	**End**	**Start**	**End**	**Start**	**End**	**Start**	**End**
Jamaica	1999-2000	1.68	0.41	0.43	0.06	0.21	0.02	44.22	38.82
Jordan	1987-1992	0.00	0.55	0.00	0.12	0.00	0.05	36.06	43.36
Jordan	1992-1997	0.55	0.36	0.12	0.10	0.05	0.06	43.36	36.42
Kazakhstan	1988-1993	0.02	0.37	0.01	0.00	0.01	0.00	25.74	32.65
Kazakhstan	1996-2001	1.87	0.11	0.32	0.02	0.10	0.01	35.32	31.30
Kenya	1992-1994	33.54	26.54	12.82	9.03	6.62	4.50	57.46	44.54
Kenya	1994-1997	26.54	22.81	9.03	5.92	4.50	2.10	44.54	44.93
Kyrgyz Republic	1988-1996	0.00	19.90	0.00	9.62	0.00	6.19	26.01	52.30
Kyrgyz Republic	1993-1997	8.03	1.57	3.28	0.29	1.82	0.10	53.70	40.50
Kyrgyz Republic	1997-1998	1.57	0.22	0.29	0.02	0.10	0.01	40.50	35.98
Kyrgyz Republic	1998-1999	0.22	0.73	0.02	0.18	0.01	0.09	35.98	34.60
Kyrgyz Republic	1999-2000	0.73	1.97	0.18	0.21	0.09	0.04	34.60	30.27
Kyrgyz Republic	2000-2001	1.97	0.86	0.21	0.10	0.04	0.02	30.27	29.03
Lao PDR	1992-1997	7.75	26.33	1.00	6.30	0.23	2.24	30.40	37.00
Latvia	1988-1993	0.03	0.00	0.04	0.00	0.14	0.00	22.49	26.99
Latvia	1993-1995	0.00	1.56	0.00	1.28	0.00	2.46	26.99	30.99
Latvia	1995-1996	1.56	0.94	1.28	0.08	2.46	0.01	30.99	31.60
Latvia	1996-1997	0.94	1.06	0.08	0.11	0.01	0.01	31.60	31.69
Lesotho	1987-1993	30.34	43.14	12.66	20.26	6.85	11.84	56.02	57.94
Lesotho	1993-1995	43.14	36.43	20.26	18.98	11.84	12.42	57.94	63.16
Lithuania	1988-1993	0.08	6.78	0.05	0.87	0.08	0.15	22.48	33.56
Lithuania	1993-1994	6.78	5.90	0.87	1.14	0.15	0.30	33.56	37.33
Lithuania	1996-1998	1.07	0.59	0.50	0.26	0.51	0.24	32.36	32.16
Lithuania	1998-2000	0.59	0.53	0.26	0.18	0.24	0.13	32.16	31.85
Madagascar	1980-1993	49.18	46.31	19.74	17.64	10.21	9.02	46.85	46.12
Madagascar	1993-1997	46.31	58.22	17.64	23.47	9.02	12.00	46.12	45.97
Madagascar	1997-1999	58.22	66.03	23.47	29.42	12.00	16.35	45.97	41.80
Madagascar	1999-2001	66.03	61.03	29.42	27.90	16.35	15.70	41.80	47.45
Malaysia	1984-1987	1.96	1.20	0.40	0.17	0.14	0.04	48.63	47.04
Malaysia	1987-1989	1.20	0.93	0.17	0.14	0.04	0.04	47.04	46.17
Malaysia	1989-1992	0.93	0.43	0.14	0.03	0.04	0.00	46.17	47.65
Malaysia	1992-1995	0.43	1.03	0.03	0.11	0.00	0.02	47.65	48.52
Malaysia	1995-1997	1.03	0.17	0.11	0.02	0.02	0.00	48.52	49.15
Mali	1989-1994	16.46	72.29	3.92	37.39	1.40	23.09	36.51	50.50
Mauritania	1987-1993	46.67	49.37	20.77	17.83	12.29	8.58	43.94	50.05
Mauritania	1993-1995	49.37	29.45	17.83	9.48	8.58	4.33	50.05	37.33
Mauritania	1995-1996	29.45	29.11	9.48	9.29	4.33	4.19	37.33	37.71
Mauritania	1996-2000	29.11	25.93	9.29	7.56	4.19	2.95	37.71	39.03
Mexico	1984-1989	13.95	8.32	3.38	2.54	1.09	1.15	46.26	55.14
Mexico	1989-1992	8.32	15.77	2.54	4.13	1.15	1.43	55.14	50.31
Mexico	1992-1995	15.77	8.39	4.13	2.39	1.43	1.00	50.31	53.73
Mexico	1995-1996	8.39	6.46	2.39	1.51	1.00	0.53	53.73	51.86
Mexico	1996-1998	6.46	7.98	1.51	2.07	0.53	0.75	51.86	53.11
Moldova, Rep.	1988-1992	0.00	7.33	0.00	1.35	0.00	0.33	24.14	34.32
Moldova, Rep.	1997-1998	1.86	19.77	0.41	5.72	0.18	2.48	30.99	37.77
Moldova, Rep.	1998-1999	19.77	32.24	5.72	9.93	2.48	4.32	37.77	36.86
Moldova, Rep.	1999-2001	32.24	21.78	9.93	5.67	4.32	2.22	36.86	36.18
Mongolia	1995-1998	13.92	27.02	3.06	8.08	0.98	3.40	33.20	30.27
Morocco	1985-1991	2.04	0.14	0.70	0.03	0.50	0.01	39.19	39.20
Morocco	1991-1999	0.14	0.56	0.03	0.08	0.01	0.02	39.20	39.46
Nicaragua	1993-1998	47.94	44.71	20.41	16.64	11.19	8.23	50.33	55.13
Niger	1992-1995	41.73	60.56	12.46	33.96	5.29	23.73	36.10	50.61
Nigeria	1986-1993	65.72	59.19	29.62	29.25	16.71	18.27	38.68	44.95
Nigeria	1993-1997	59.19	70.24	29.25	34.93	18.27	21.24	44.95	50.56

Country	Spell	Headcount ($1)		Pov. gap ($1)		Pov. gap squ. ($1)		Gini	
		Start	End	Start	End	Start	End	Start	End
Pakistan	1987-1990	49.63	47.76	14.84	14.57	6.04	6.04	33.35	33.23
Pakistan	1990-1993	47.76	33.90	14.57	6.35	6.04	3.01	33.23	34.22
Pakistan	1993-1997	33.90	6.82	8.45	0.99	3.01	0.27	34.22	27.43
Pakistan	1997-1999	6.82	13.36	0.99	2.36	0.27	0.71	27.43	32.99
Panama	1979-1989	0.00	11.81	0.00	5.39	0.00	3.26	48.74	56.57
Panama	1989-1991	11.81	11.81	5.39	5.20	3.26	3.03	56.57	56.82
Panama	1991-1995	11.81	7.38	5.20	2.57	3.03	1.19	56.82	57.06
Panama	1995-1996	7.38	7.92	2.57	2.81	1.19	1.32	57.06	56.31
Panama	1996-2000	7.92	7.20	2.81	2.28	1.32	0.95	56.31	56.56
Paraguay	1990-1995	4.93	19.36	0.85	8.27	0.23	4.65	39.74	59.13
Paraguay	1995-1997	19.36	16.50	8.27	8.21	4.65	5.40	59.13	57.72
Paraguay	1997-1998	16.50	15.88	8.21	7.95	5.40	5.27	57.72	56.52
Paraguay	1998-1999	15.88	14.86	7.95	6.80	5.27	4.26	56.52	56.85
Peru	1986-1994	1.14	9.40	0.29	2.00	0.14	0.57	45.72	44.87
Peru	1990-1996	1.35	8.88	0.48	3.02	0.34	1.65	43.87	46.24
Peru	1996-2000	8.88	18.07	3.02	9.14	1.65	6.28	46.24	49.82
Philippines	1985-1988	22.76	18.20	5.34	3.57	1.67	0.93	41.04	40.63
Philippines	1988-1991	18.20	19.77	3.57	4.23	0.93	1.20	40.63	43.82
Philippines	1991-1994	19.77	18.36	4.23	3.85	1.20	1.07	43.82	42.89
Philippines	1994-1997	18.36	14.40	3.85	2.85	1.07	0.75	42.89	46.16
Philippines	1997-2000	14.40	15.48	2.85	2.98	0.75	0.76	46.16	46.09
Poland	1985-1987	0.21	0.16	0.14	0.10	0.20	0.13	25.16	25.53
Poland	1987-1989	0.16	0.10	0.10	0.08	0.13	0.14	25.53	26.89
Poland	1989-1998	0.10	0.46	0.08	0.25	0.14	0.30	26.89	31.60
Poland	1993-1996	4.11	0.09	1.54	0.05	0.79	0.06	32.39	32.66
Poland	1998-1999	0.46	0.61	0.25	0.54	0.30	1.05	31.60	32.90
Romania	1989-1992	0.25	0.34	0.29	0.23	0.79	0.36	23.31	25.46
Romania	1992-1994	0.34	2.81	0.23	0.76	0.36	0.43	25.46	28.20
Romania	1998-2000	1.39	2.14	0.89	0.59	1.29	0.33	31.19	30.25
Russian Federation	1993-1996	6.08	6.97	1.17	1.70	0.30	0.56	48.34	46.15
Russian Federation	1996-1998	6.97	12.66	1.70	3.46	0.56	1.27	46.15	48.67
Russian Federation	1998-2000	12.66	6.14	3.46	1.19	1.27	0.31	48.67	45.62
Senegal	1991-1994	45.38	22.32	19.96	5.68	11.18	2.14	54.14	41.28
Slovak Republic	1988-1992	0.00	0.00	0.00	0.00	0.00	0.00	19.54	19.49
Slovak Republic	1992-1996	0.00	0.49	0.00	0.06	0.00	0.01	19.49	25.81
Slovenia	1987-1993	0.02	0.04	0.02	0.04	0.06	0.10	23.60	29.18
South Africa	1993-1995	10.02	6.28	1.42	0.56	0.27	0.07	59.33	56.59
South Africa	1995-2000	6.28	10.71	0.56	1.74	0.07	0.37	56.59	57.77
Sri Lanka	1985-1990	9.39	3.82	1.42	0.67	0.27	0.23	59.33	30.10
Sri Lanka	1990-1996	3.82	6.56	0.67	1.00	0.23	0.26	30.10	34.36
Thailand	1981-1988	21.64	17.85	5.40	3.64	1.78	1.00	45.22	43.84
Thailand	1988-1992	17.85	6.02	3.64	0.48	1.00	0.05	43.84	46.22
Thailand	1992-1996	6.02	2.20	0.48	0.14	0.05	0.02	46.22	43.39
Thailand	1996-1998	2.20	0.00	0.14	0.00	0.02	0.00	43.39	41.36
Thailand	1998-1999	0.00	2.02	0.00	0.06	0.00	0.00	41.36	43.53
Thailand	1999-2000	2.02	1.93	0.06	0.05	0.00	0.00	43.53	43.15
Trinidad and Tobago	1988-1992	2.25	3.95	0.20	0.99	0.02	0.43	42.60	40.27
Tunisia	1985-1990	1.67	1.26	0.34	0.33	0.13	0.17	43.43	40.24
Tunisia	1990-1995	1.26	1.02	0.33	0.19	0.17	0.07	40.24	41.66
Tunisia	1995-2000	1.02	0.32	0.19	0.07	0.07	0.03	41.66	40.81
Turkey	1987-1994	1.49	2.35	0.36	0.55	0.18	0.24	43.57	41.53
Turkey	1994-2000	2.35	0.87	0.55	0.21	0.24	0.10	41.53	40.03
Turkmenistan	1988-1993	0.00	20.65	0.00	5.30	0.00	1.84	26.39	35.38
Uganda	1989-1992	39.18	30.54	15.00	9.60	7.57	4.22	44.36	43.19

Country	Spell	Headcount ($1)		Pov. gap ($1)		Pov. gap squ. ($1)		Gini	
		Start	End	Start	End	Start	End	Start	End
Uganda	1992-1996	30.54	23.68	9.60	5.95	4.22	2.16	43.19	37.40
Uganda	1996-1999	23.68	26.85	5.95	7.74	2.16	3.20	37.40	43.11
Ukraine	1988-1992	0.06	0.02	0.07	0.01	0.19	0.01	23.31	25.71
Ukraine	1992-1999	0.02	2.92	0.01	0.62	0.01	0.26	25.71	28.96
Ukraine	1995-1996	2.06	0.00	0.64	0.00	0.39	0.00	39.29	33.18
Uruguay	1981-1989	0.91	0.58	0.50	0.34	0.56	0.40	43.65	42.33
Uruguay	1989-1996	0.58	0.56	0.34	0.18	0.40	0.12	42.33	43.76
Uruguay-Urban	1996-1998	0.56	0.61	0.18	0.20	0.12	0.12	43.76	45.18
Uruguay-Urban	1998-2000	0.61	0.20	0.20	0.05	0.12	0.02	45.18	44.56
Uzbekistan	1988-1993	0.00	3.28	0.00	0.46	0.00	0.11	24.95	33.27
Uzbekistan	1998-2000	19.16	17.32	8.12	4.26	4.70	1.86	45.35	27.03
Venezuela, RB	1981-1987	7.52	6.60	1.46	1.04	0.38	0.22	55.82	53.45
Venezuela, RB	1987-1989	6.60	2.95	1.04	0.87	0.22	0.45	53.45	44.08
Venezuela, RB	1989-1993	2.95	2.66	0.87	0.58	0.45	0.22	44.08	41.68
Venezuela, RB	1993-1995	2.66	9.43	0.58	2.86	0.22	1.31	41.68	46.84
Venezuela, RB	1995-1996	9.43	14.69	2.86	5.62	1.31	3.17	46.84	48.79
Venezuela, RB	1996-1997	14.69	9.65	5.62	2.88	3.17	1.27	48.79	48.80
Venezuela, RB	1997-1998	9.65	14.31	2.88	6.58	1.27	4.08	48.80	49.53
Vietnam	1993-1998	14.63	3.08	2.55	0.48	0.65	0.10	35.68	35.40
Yemen, Rep.	1992-1998	3.55	10.21	1.11	2.30	0.67	0.85	39.45	33.44
Zambia	1991-1993	64.64	73.57	38.91	42.66	28.78	29.55	60.05	52.61
Zambia	1993-1996	73.57	72.63	42.66	37.75	29.55	23.88	52.61	49.79
Zambia	1996-1998	72.63	63.65	37.75	32.65	23.88	21.07	49.79	52.60
Zimbabwe	1991-1995	33.32	56.12	8.96	24.17	3.34	13.04	39.42	50.12

Note: Start- or end-years specified with a 0.5-digit were rounded up for the calculation of the spell length.