Growth, Shocks and Poverty during Economic Reform: evidence from rural Ethiopia

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March 13, 2002

Abstract

Using micro-level panel data from villages in rural Ethiopia, the paper studies consumption and poverty changes to analyse the determinants of growth and poverty changes during a period of economic reform (1989-97). Consumption grew and poverty fell substantially, but with diverse experiences across villages and individuals. During this period common and idiosyncratic shocks mattered for consumption, suggesting imperfect risk-sharing, credit and savings opportunities. In the first period considered, 1989-94, the main factors driving income changes are location-specific rural-urban terms of trade changes, linked to economic reform, resulting in changes in the returns to land, labour, human capital and location. In the second period, relative price changes suggest a further impact, although they are less likely to be linked to the reforms. Weather-induced shocks continue to dominate the experiences of many households their experiences. Overall, there is evidence residual growth in this period. Finally, food aid and other safety net policies came into the picture largely after 1994, but little impact on households could be detected in the data. A regression-based decomposition of the changes in poverty shows that the poor have benefited on average more from the reforms than the non-poor households. But the experience of the poor is mixed: one group of the poor in 1989, with relatively good land, labour and location, outperformed all other households, while another group with much poorer endowments and location experienced virtually unchanged and persistent poverty.

JEL Classification: I32, O12, Q12

March 2002 - Paper prepared for the IMF Conference on Macroeconomic Policies and the Poor

First Draft for Comments

1 Introduction

Since 1988, Ethiopia has gradually moved from a communist-inspired controlled economy to a more market-based economy. From 1992, these reforms became part of a structural adjustment program sponsored by the IMF and the World Bank. This paper investigates the impact of the reform program on household consumption and poverty levels in a relatively small number of rural villages in different parts of the country. While only relatively small, the data set used has a number of advantages that allow a unique insight in the evolution of welfare of poverty over time. To mention just a few, first, it is a panel data set, which was started in 1989 at the eve of the first wave of reforms. Data used in this period cover eight years, a sufficiently long time frame to start developing a more comprehensive picture of the impact of reforms over time. Secondly, from each village a relatively large sample of households are included, while data are available at the local level on the evolution of prices and terms of trade to trace and interpret the local impact of the macroeconomic changes. Thirdly, the data is large and comprehensive, including on events, shocks and experiences over the survey period as well as based on longer-term recall - including information on experiences during the (by far largest recent) famine in the mid-1980s. The approach taken is to estimate a relatively simple reduced form model of income and consumption changes, focusing on relative price changes to capture economic reform, while using direct information on shocks. Simulations identify the impact on consumption and poverty of shocks and reform.

The experiences with economic reform in Ethiopia also offer a unique opportunity to study the impact of structural adjustment using real data. First, contrary to most other countries, the reform measures have been implemented in the context of broad macroeconomic stability - in terms of inflation, currency stability and fiscal discipline. As a consequence, when investigating the impact of reforms, the focus can be on the relative price changes and other changes in micro-level incentives on households and activities - thereby focusing on the 'adjustment' element rather than the stabilisation measures. Secondly, other approaches suffer from serious problems and shortcomings. Among these approaches, I will ignore the huge literature on the impact of reform on poverty that is based on poor or no data. Two other approaches deserve at least a comment. CGE-models have been used to study the impact of reform in Africa (e.g. Sahn [1996], but they typically require substantial theoretical structure. For distributional simulations, vast amounts of data are needed, which are typically not available, while key assumptions on modelling the rural economy and missing markets strongly influence results (De Janvry et al. [1991]). Other studies have been based on actual data on mean income growth and poverty, but in discussing the role of reforms have to rely on a narrative rather than statistical analysis to substantiate the links (e.g. Demery and Squire [1996]). While suggestive, they can hardly be seen as strong evidence. The latter approach obviously suffers from the inability to consider counterfactual analysis - what if no reforms had taken place or what if all observed changes are simply linked to good and bad weather?

A study of Ethiopia, with still close to 90 percent of the active population involved in rain-fed agriculture, cannot be done in isolation of the presence of large shocks. In this paper, this issue is tackled upfront. Indeed, the key counterfactual to deal with in the Ethiopian context is whether the observed income, consumption and poverty changes are not simply caused by good or bad weather or other shocks. It is argued that a substantial part of observed poverty is closely linked to fluctuations and possibly permanent effects of large weather-induced shocks as well as other shocks, such as related to illness and pests. This touches immediately on the need to incorporate in an analytical framework issues related to consumption smoothing and risk-sharing: in what way are shocks to incomes reflected in consumption and poverty, and what do the results suggest about imperfections in insurance, credit and savings markets.

The approach taken can be summarised as follows. A first section will present a brief narrative of the key changes in the Ethiopian economy in the 1980s and 1990s, including an identification of the main reform measures and how they are likely to have affected the rural economy. Next, the data used are presented, including the main patterns in consumption and poverty that need to be explained, and the key relative price changes, and their link to economic reform (section 3). In section 4, an analytical framework is presented to identify the impact on incomes of shocks and economic reform. The link between consumption and income changes is explored as well and some hypotheses are put forward to be tested. Section 5 discusses the econometric model used constructed to test the key relationshipsm while the evidence is presented here as well. The link with poverty is also explored here. Section 6 concludes with a discussion of the policy implications of our results.

In Dercon [2002], some of these issues were already explored for the period 1989 to 1995, with an emphasis on the reform program. In this paper, new data are added to the analysis to extend the time period covered, while more attention is paid to the role of shocks and what it means for poverty and policy.

2 Economic Reform in Ethiopia

Ethiopia made a transition away from a totally controlled economy (with accompanying East-German and Bulgarian advisors). Before 1990, the restrictions on and taxation of the rural economy were substantial. Farmers in the main cereal growing areas had to supply a predetermined quota to the government (via a parastatal) at a fixed low price. The rest could be sold to traders. Trade across districts and regions was nevertheless restricted by taxation: when crossing predetermined borders, traders had to sell part of their stock to the government parastatal, again at below market prices, implying a high sales tax. Taxation and levies on rural households (such as infamous war levies and famine levies) were substantial as well. Factor and other markets were restricted as well. Land was (and is) state-owned, and after the first (large scale) land reform in 1976, land continued to be redistributed in these villages . Rural wage and other factor markets were also repressed, while private trade and initiative were all but

encouraged.

Despite a strong discouragement of private sector initiative and widespread nationalisations, war with Somalia and a famine in the mid-1980s, the macroeconomy retained a semblance of stability for a long time. Only after the fall of the Berlin wall were pressures increasing, for example through growing overvaluation of the birr exchange rate. Reforms started in 1990, with substantive liberalisation of food markets. In 1991, the government army was defeated. The takeover resulted not just in a collapse of government revenue collection but also of government spending, despite a few months period of threatening hyperinflation.

Reforms continued with a devaluation of 142 percent in 1992 - which was successfully transformed in a real exchange rate depreciation. No inflationary effects followed from the devaluation, partly helped by good harvests. Close to zero inflation in 1992 and low inflation in subsequent years has meant a strong depreciation of the real exchange rate. Since 1994, adjustment efforts have been sponsored by IMF and World Bank, and further liberalisation has taken place, including related to exchange rate determination, investment and trade liberalisation. Fertiliser markets have also been tentatively liberalised and subsidies were removed. Donor efforts have also contributed to a substantial rise in public investment including long overdue improvements in road infrastructure and rural public services. Finally, a large agricultural production promotion programme was started, focusing on input packages (seeds and fertiliser), increased agricultural credit and extension efforts.

The national accounts suggest a positive impact of these reforms on the Ethiopian economy (table 1). GDP data show first the dramatic collapse around the famine period of 1985, a subsequent recovery but a further collapse around the transition period of the end of the war. Recovery then started and by 1995, the economy was, in per capita terms, more or less back at the level of the end of the 1980s. Subsequent growth has meant that at last Ethiopia has passed its 1982 level of per capita GDP.

This pattern hides some important composition changes in this period. The collapse in overall GDP in the late 1980s can mainly be accounted for by a collapse in government expenditure, driven by a collapse in revenue collection, and a large fall in gross investment. Deflated private consumption per capita continued to rise. By 1997, it was about 18 percent higher than in 1989. Gross investment also recovered fast in this period.

The rural economy was strongly affected by the economic reform programme. First, the effect on food crop prices and marketing were substantial. Food market reform started in 1990 with a removal of the grain quota on farmers, effectively a lump sum income gain. Its effect on food market prices cannot be unambiguously predicted (Azam [1994], Dercon [2002]). Another measure was the relaxation and later abolition of restrictions on private grain trade. Private interregional trade was not banned, with the exception of a few surplus regions (such as Gojjam). When moving grain across regional borders, traders were forced to sell 50 percent or more of the quantity traded to the Agricultural Marketing Corporation, at fixed prices below market prices. When this was

abolished, the impact can be predicted to have resulted lower margins, upward pressure on prices in surplus areas and downward pressure in deficit areas. Table 2 shows evidence that this indeed has happened. Prices in Addis Ababa and in deficit areas remained more or less stable, while margins declined. Producers in surplus areas gained in real terms. In Dercon [1995] this has been studied further and it was found that the main changes can be dated as having occurred during the early liberalisation, even before the end of the war. This movement in prices can therefore be directly linked to the reforms. From the mid-1990s, with a series of good harvests and possibly yield increases linked to the increased input and extension efforts, grain prices appear to have experienced downward pressure across the country.

The devaluation can be expected to have had a large impact on traded non-food crops such as coffee and chat (or q'at, a mild stimulant, popular in the Eastern part of Ethiopia and surrounding countries). However, the effects are more complicated, since, before the reforms, both crops were often smuggled or sold domestically in the parallel market for consumption within Ethiopia. For both crops it meant that devaluation did not change prices by as much as devaluation would have predicted: for chat, which was virtually exclusively smuggled, prices did in fact go down, reflecting the reduction in risk premium with a more liberalised economy Dercon and Ayalew [1995] documents this further for both crops. A coffee boom in 1994-95, during which unit export values rose by up to 65 percent, and a subsequent rapid correction in prices did however cause a further cycle in producer prices unrelated to the reform program.

During the study period, private sector activities were gradually more and more considered, although few if any explicit measures can be identified that will have had a direct impact on off-farm activities for farmers. Nevertheless, with recovery and growth, and fewer restrictions on the movement of goods and people, trade and small-scale production clearly picked up in most small urban centres. The return to peace in 1991 will have contributed to this as well.

In conclusion, it is likely that economic reform will have substantially changed relatively prices in the economy, not least for food crops. The impact on real food prices is likely to be dependent on whether households and villages are in surplus or deficit areas. The extent of smuggling and parallel market activity before the devaluation in a particular area will be crucial to determine the impact of the real exchange rate depreciation. Off-farm activities also received a boost during this period, encouraged by the reforms, but measuring its impact is complicated due to the role of the peace dividend after the return to peace and security after 1991 (Azam et al. [1994]).

3 Economic reform and the village economy

The data used in this paper is from six communities in rural Ethiopia. In each a random sample was selected, yielding complete information on 354 households (the attrition rate between 1989 and 1994 was about 3 percent, between 1994

and 1997 only about 2 percent)[1]. The villages are located in the central and southern part of the country. In 1989, the war made it impossible to survey any northern villages. Nevertheless, the villages combine a variety of characteristics, common to rural Ethiopia. Four of the villages are cereal growing villages, one is in a coffee/enset area and one grows mainly sorghum but has been experiencing rapid expansion of chat. All but one are not too far from towns, but only half have an all-weather road. The villages were initially selected to study the crisis and recovery from drought and famine in the mid-1980s (Webb et al. [1992]). Details on the survey are in Dercon and Krishnan [1998].

The households in the survey are virtually all involved in agriculture. Almost all have access to land, although with important differences in quality and across villages. On average, about half their income is derived from crops, the rest from livestock and off-farm activities. Most of the off-farm activities (such as selling home-made drinks or dungcakes) are closely linked to the agricultural activities. Alternatives are collecting firewood, making charcoal and weaving.

In this paper, we use data from 1989 and from the revisits during four rounds in 1994-97. The data from 1989 reflect conditions on the eve of the reforms, while the later data are from well into the post-reform period. During this period, the civil war affected the communities relatively little, at least in terms of direct effects. With most fighting in the north of the country, in none of the villages was any fighting or other direct effects from the war reported. Consequently, the direct effects of increased security, such as more opportunities for mobility towards local markets and lower price margins, are unlikely to have been very important.

In this paper changes in food consumption and poverty are as used measures of changing welfare in this period. Non-food consumption data were collected in 1989, so the analysis had to limit itself to food consumption. Data are reported in per adult equivalent and in real terms, in prices of 1994. The food price deflator and any other price data used in this study are based on separate price surveys conducted by the survey team and by the Central Statistical Authority. Nutritional equivalence scales specific for East-Africa were used to control for household size and composition. Since food consumption is unlikely to be characterised by economies of scale, no further scaling is used (Deaton [1997]).

The underlying questionnaire was based on a one-week recall of food consumption, from own sources, purchased or from gifts. Seasonal analysis using the panel revealed rather large seasonal fluctuations in consumption, seemingly linked to price and labour demand fluctuations (Dercon and Krishnan [2000]). Therefore, the data used for the analysis in this paper are for food consumption levels in the same season as when the data had been collected in 1989, as the measure for food consumption in 1994/95. Consequently, only one observation of the three possible data points collected during the 1994/95 rounds is used.

[1] It is worthwhile to comment on the definition of the household used in these 8 years. The household was considered the same if the head of the household was unchanged, while if the head had died or left the household, the household was considered the same if the current household head acknowledged that the household (in the local meaning of the term) is the same as in the previous round.

The data for 1997 are matched to those of 1994/95 in a similar way. The result was three observations on food consumption (1989, 1994/5 and 1997) for each household. Table 3 reports average real consumption per adult for each village. The table suggests substantial growth in mean per adult food consumption in this period: equivalent to more than 9 percent per year. There are nevertheless substantial differences between villages. In all but one, growth was above national growth rates.

Poverty measures reveal also strong improvements during this period. Using a poverty line derived in an earlier study, standard poverty measures of the P_α family are derived as well (Foster et al. [1984]; for the poverty line, see Dercon and Krishnan [1998]). To identify the poor, an absolute, nutrition-based poverty line. It is kept fixed in real terms both intertemporally and spatially. In different areas in the sample it is in the range 35-45 birr per adult per month . This poverty line is applied to the real food consumption data. P-alpha poverty aggregates as in Foster et al. (1984) are used to express different dimensions of poverty. In particular, the head count, the average normalised poverty gap and the average squared poverty gap, are presented. Overall, poverty fell substantially during this period. The headcount declined by 45 percent, the other poverty measures by even more. The different experiences across villages, but everywhere the declines are consistent for the higher order poverty measures. Nevertheless, in three villages poverty remains very high. The pattern over time is rather different across villages. In two villages, poverty by 1994 had increased compared to 1989, to fall later. Note also the poverty elasticities: they are typically relatively small. The overall poverty decreases across the sample are robust to the choice of the poverty line and poverty measures: in Dercon and Krishnan (1998) first order welfare dominance was shown to exist for all reasonable poverty lines.

These declines are somewhat surprisingly high and they definitely do not square with the overall impressions of rural Ethiopia in this period. In general, an improvement in living standards could be expected but the changes involved are likely to be an overestimate. Nationally representative data for rural Ethiopia are only available for 1995 and 2000; provisional estimates suggest some declines in rural Ethiopia but not at this scale. However, the findings on other welfare indicators in the national Welfare Monitoring Survey would not necessarily contradict some substantial improvement (Dercon [2000]). Primary School enrolment, for example, doubled in both gross and net terms between 1994 and 1998. But this only brought net primary enrolment to about 19 percent. For these and other enrolment measures, only by 1997 were the levels from before the 1985 famine reached again. In short, the increases in consumption may be an overestimate, but other indicators suggest substantial upward movement in rural areas. Nevertheless, much of this movement may well be recovery from the lower levels in the late 1980s. Still, a look at the evolution of livestock confirms large positive improvements in this period (table 6). As in many of the poorest countries in the world, livestock far the most important marketable asset and typically accounting for more than 90 percent of the value of assets. In all but one village, livestock values increased considerably during the sur-

vey period - and in terms of standardised units, the improvement is general, since prices for livestock in fact had declined relative to rural consumer prices. In some areas, the increase is substantial; overall the increase is 50 percent in value terms, while in terms of units, a 100 percent increase can be noted. Only in Debre Berhan, where levels were consistently highest, did values not quite increase. The declines in 1994 in two villages coincide also with poverty increases in consumption terms in the same villages. In short, these patterns are consistent with the evolution of poverty and mean consumption.

Both the high consumption and livestock levels may well have been helped by the overall rainfall pattern in this period. Table 7 gives details of the recent rainfall experience in these villages. Rainfall was on average better in more recent rounds, so it could plausibly account for some of the large increases. This will be addressed in the econometric analysis. Note also the large fluctuations in rainfall in some of the villages in this period, and that mean levels in the 1990s have been above 'long-term' levels - which are strongly influenced by the disastrous levels in the early 1980s in these communities (which, in 1989, had been selected because they had been affected by the famine).

The impact of economic reforms on these communities can be investigated by looking at the evolution of the terms of trade faced by these local communities in this period. The key price considered are the terms of trade of their total agricultural output relative to their standard basket of food consumption. Data were not available to study non-agricultural activities. Almost half of average household income comes from other sources than crop agriculture. But, as was mentioned before, most of these activities are closely linked to agricultural activities so returns to these activities are bound to be linked to the evolution of crop prices as well. Table 8 gives the average increase in producer prices in each of the communities, relative to the consumer price evolution. It can be read as the percentage movement in terms of trade, using 1989 terms of trade between producer and consumer goods as a base. The figures reported are percentage changes of the average real producer prices per community for all crops, as well as for sub-groups. Since the reforms generally provide increased incentives for tradable commodities, it is of interest to distinguish them from the price evolution in non-tradables. Even though, as in most African countries, relatively little large-scale international private food trade takes place (even if the markets become liberalised), there is a very active market in most food crops, especially cereals. Internal market liberalisation provides further incentives for trade in these commodities. From the point of the view of the village economy, it would appear appropriate to include those actively traded commodities as tradables. Non-tradables include commodities rarely moved across any large distances, mainly because of high transactions costs due to a low value in relation to weight and volume. In the data, these include root crops such as enset and sweet potatoes.

Three set of results are reported. First, the change between 1989 and 1994/95 - effectively covering the first phase of the economic reform programme with food market liberalisation and devaluation. Secondly, the change between 1994 and 1997 - during the structural adjustment program, although with less

identifiable measures relative to the agricultural sector. Nevertheless, in this period fertiliser market controls were largely removed and the input-cum-extension programme was started. Finally, the overall change in this period is reported as well.

It could be argued that these price changes have little to do with 'structural' changes in terms of trade but rather are a reflection of local circumstances, including weather and other factors. In order to avoid this as much as possible, data were taken from exactly the same months (April-July) in each survey round - effectively in between harvests. As a consequence, inflated or deflated terms of trade due to seasonal factors are not responsible for the observed patterns. Furthermore, although the data used are from one period only, the patterns were checked using data in between rounds. Given the timing of the reforms, mainly regarding crop marketing, the relative price change between 1989 and 1994 is most clearly linked to the reforms, but also the coffee boom took place at the end of this period. During the subsequent period, relative prices have been influenced by the end of the coffee boom, while bumper harvests in 1996 and 1997 are likely to have contributed to the lower prices for some of the main cereals.

The results are generally consistent with the earlier predictions. In the first period, until 1994/95, the abolition of the quota system and market reform appear to have resulted in increases in real producer prices: they have increased on average by about 26 percent. As was discussed before, surplus areas are likely to have benefited from the liberalisation of regional trade and the national evidence had pointed to higher producer prices in surplus areas. Incentives for non-tradable crops have strongly decreased, in line with an increased market-orientation after liberalisation. In one village, prices moved quite differently in Gara Godo. Located in a densely populated area, with overall relatively good road linkages, liberalisation appears to have brought down producer prices. Contrary to the other villages, most of whom are in or not far from surplus areas, it is a deficit area. The decline is less for the main cereals relative to non-tradables, but still substantial. Terms of trade for coffee, traditionally an important cash crop in the area, moved very favourably, partly influenced by the coffee-boom of 1994-95, but also benefiting from the devaluation. However, in the real producer prices faced by the households in the sample this is not reflected, simply because a virtual harvest failure occurred in 1994 due to pests and drought at a crucial point in the growth cycle . Finally, chat, another important export crop in Ethiopia, is quite important in Adele Keke, but its terms of trade actually fell in the period 1989-94. As discussed before, this crop was rarely traded via the official channels and therefore its price has generally reflected the black market exchange rate, so that the devaluation has had little impact. Increased production and reduced rents from smuggling may well have depressed the prices somewhat. Still, it leaves these prices in real terms at about three times the levels of the early 1980s. Overall, the terms of trade moved favourably for all but one village in this period.

The second period data suggest that 'on average' there was no change, when considering an index based on all crops - i.e. no further overall shift in prices in

favour of rural areas. Prices went down for export crops (due to the end of the coffee boom and expanding supply for chat), while the main staples increased further relative to rural inflation (which typically was close to zero between 1994 and 1997 even though in 1995 prices had first increased with a Southern drought and crisis). Food prices experienced a correction in two areas - where they had initially increased substantially. Overall between 1989 and 1997, terms of trade moved in favour of rural producers, except for in areas where nontradables were important or where previously smuggled export crops were dominant - where prices may well have declined after liberalisation. The movement was especially large in villages within or near cereal surplus areas.

A central question in much of the debate about the effects of market reform and increased incentives is whether farm households are actually responding to the changes in real producer prices. In Dercon [2002] this question is addressed in more detail. First, households switched away from the quota crops, suggesting that the system encouraged sub-optimal production choices. Area allocated to cash crop generally expanded. For example, quite a few farmers in Gara Godo planted new coffee in the early 1990s. Chat did not expand much further in these villages, in line with the stabilisation of the price.

As was argued before, direct measures of price changes for non-agricultural activities are not readily available. However, since most of the off-farm activities are linked to agriculture, price changes may well have gone in the same direction. In any case, there is evidence that more households became involved in off-farm activities. The expansion is largest for casual wage labour and especially crafts for sale and trading. There is also a move away from basic gathering activities to activities requiring more investment and skill.

Other changing conditions should also be taken into account when trying to explain welfare outcomes. In the first period, until 1994, village characteristics hardly changed. But after 1994, road and transport investment increased. Community level interviews confirmed that in three villages (Debre Berhan, Adele Keke and Korodegaga) road infrastructure and the availability of motorised transport increased considerably in this period.

In conclusion, growth and poverty reduction appears to have taken place in most of these villages, but not in all to the same extent. In general, real producer prices have increased substantially on average in the first period of reforms, and did not systematically declined afterwards. But the pattern is not the same for all crops and for all villages. However, the changes are consistent with expected food price changes after liberalisation and the effect of the devaluation, given widespread parallel markets. Next, the question arises whether the relation between growth, reforms and poverty can be understood or whether it is spurious.

4 Theoretical framework

In this section, a relatively simple framework is developed that will allow the empirical study of the impact of the economic reform programme on households,

controlling for the role of shocks and other factors. In order to achieve this, first, a model of farm income generation is developed. Households have some fixed inputs and can acquire some other inputs to produce output. Households in the sample have access to some land which cannot be traded. Rural wage labour markets are also underdeveloped - in fact, rural wage labour was illegal before the reforms. In the data, more than 90 percent of the labour transactions observed after the beginning of the reforms involve reciprocal labour sharing, so net transfers are very limited. Infrastructure and location are also considered fixed production factors. For simplicity, it will be assumed that the fixed household level inputs coincide with the household's endowments (such as land, land quality, labour or human capital) and their presence is equivalent to assuming missing markets for these production factors, while some inputs such as fertiliser or seeds are bought. It is assumed that the household produces some composite output.

A profit function (i.e. gross farm income minus expenditure on variable inputs) is helpful to separate the role play by changing prices in the economy from other factors. Let the household's production function be described by $q = g(k, x)$, in which q is total output, x is a vector of n variable inputs, k is a vector of j fixed inputs. The household is assumed to face output price p and a verctor of input prices p^x and maximises its farm income. Assuming a Cobb-Douglas production function, $q = ax^{\alpha}k^{\beta}$, the profit function y can be obtained in a straightforward way. Expressed in logarithms, it can be written as:

$$\begin{aligned} \ln y &= a^* + \sum_j b_j^* \ln k_j + d^* \ln p + \sum_n f_n^* \ln p_n^x \\ \text{with } a^* &= \frac{1}{1-\sum_n \alpha_n} \ln a + \frac{\alpha_n}{1-\sum_n \alpha_n} \ln \alpha_n + \ln(1 - \sum_n \alpha_n), \\ b_j^* &= \frac{\beta_j}{1-\sum_n \alpha_n}, d^* = \frac{1}{1-\sum_n \alpha_n}, f_n^* = \frac{-\alpha_n}{1-\sum_n \alpha_n} \end{aligned} \tag{1}$$

Stochastic factors - such as bad weather - are obviously bound to affect farm incomes. Assuming multiplicative risk (and an ad-hoc assumption about the way risk affects optimal decisions), it can be introduced as a shifter u in (1). During a period of reform, quite a few elements of (1) may change. First, it is likely that input and output prices are changed, affecting incomes. Secondly, households may have expanded or reduced some of their fixed inputs. For example, the available labour or human capital may have changed. Thirdly, over a number of years, there may have been some changes in the technology employed, encouraged by the reforms. The simplest change to consider would be a change in a - a general outward shift of the production function. Alternatively, the technology may have shifted in favour of some factors. More realistically, since the model assumes the production of one composite commodity, relative output and input price changes may have induced a shift in the optimal portfolio, implying some changes in the optimal technology used (such as more intensive in

some variable or fixed production factors).

Considering periods t and $t+1$ (for example, before reforms and after), and denoting $\triangle$ as the difference in values between $t+1$ and t, differences in farm incomes profits over time can be described as:

$$\triangle \ln y = \triangle a^* + \sum_j b_j^* \triangle \ln k_j + d^* \triangle \ln p + \sum_n f_n^* \triangle \ln p_n^x + g^* \triangle u \qquad (2)$$

in which a key assumption is that any shifts in the underlying production function are in a, the technology factor of the production function - and not in the exponents on inputs (α and β). This will be tested below further.

Poverty statements are more appropriately made relative to consumption and not income. How (2) is related to consumption obviously depends on the functioning of credit, savings and insurance markets[2]. Without formally developing a model, standard results can be used to investigate different scenarios to explain observed consumption changes, borrowing from insights from the consumption smoothing literature under risk [Deaton (1992)]. If credit, savings and insurance markets are entirely missing, then (2) could also be seen as a model of consumption changes. Alternatively, with perfect credit and insurance markets, only permanent shocks and changes should matter. Suppose one can assume that the 'structural' changes during reform are permanent. If households prefer flat and smooth consumption (e.g. if households have rates of time preference equal to interest rates, and if they are risk averse), then (2) would be an appropriate model to explain consumption but g^* would be expected to be zero and b^*, d^* and f^* would close to the values obtained in the income change estimations. If credit markets are missing, but savings is possible, then b^*, d^* and f^* would still be significant (although not necessarily close to the values in the income model, for example due to precautionary savings), but the impact of shocks would now be asymmetric: 'good' shocks would largely be saved, but when bad shocks occur (especially with some regularity), then downward shocks should *at least on average* have a larger impact than upward shocks. This would be especially prevalent if households are 'impatient', i.e. have a relatively high rate of time preference relative to returns to savings, since then savings are very costly (Deaton [1991]). There is another implication as well in this case: recent history will matter. Even though households have incentives to use savings to smooth consumption, keeping savings comes at the cost in terms of current consumption. So assets for smoothing purposes will not be held in amounts *necessarily* sufficient to cope with repeated crises, so conditional on current shocks, consumption may well be lower if shocks in the recent past have been negative as well[3]. The asymmetry of good and bad shocks will be less pronounced if income

[2] Consistent income data for the different rounds are not (yet) available, so using (3) with incomes and then constructing a model linking consumption and income changes was beyond the scope of this paper.

[3] Note that this does not mean that 'long term' history matters. In fact, one of the key characteristics of a model with impatience and a 'long' life-cycle (as in Deaton [1991]) is that the asset accumulation process has no history but has a tendency to revert to zero holdings. If households have a finite life-cycle and are patient relative to interest rates, accumulation will

has a high degree of autocorrelation - in that case less smoothing will take place (Deaton [1991]]). Similarly, if asset markets are imperfect, for example due to positive covariance between asset prices and incomes, so that asset sales when required for smoothing are costly, then it can be shown that savings become rather ineffective because too costly to buffer consumption (Dercon [2000]).

Most models of consumption smoothing and the role of risk assume that income risk is exogenous; the discussion above is not different in this respect. But households can to some extent influence their degree of income risk taking if they are better or worse protected from low consumption outcomes. More specifically, if credit and insurance is missing, but savings are possible, then it can be shown that households may well enter more risky activities with better returns when their asset position is more favourable (Eswaran and Kotwal [1989], Morduch [1992]). The result will be a higher sensitivity of *incomes* to recent and cumulative shocks (and not just consumption). If credit markets are imperfect, cumulative shocks will therefore have a further impact on consumption, although it will be impossible to identify this effect without estimating income models.

In conclusion, (2) can be used to analyse the link between changes in fixed endowments, prices and shocks on consumption. While shocks will influence incomes, their impact on consumption will provide suggestive evidence on the joint functioning of credit, insurance and asset markets. A number of hypotheses on the role of recent and longer-term information on shocks and on the asymmetry of the impact of shocks can be tested. Since livestock levels in table 8 suggested very low average livestock holdings in the first period (1989), the role of both short term and long term shocks may well be an important issue in our data.

The econometric model used will therefore be based on the following equation:

$$\triangle \ln c = \triangle a^* + \sum_j b_j^* \triangle \ln k_j + d^* \triangle \ln p + \sum_n f_n^* \triangle \ln p_n^x + g^* \triangle u_s + h^* \triangle u_l + \varepsilon \quad (3)$$

with c consumption and ε is an error term, while u_s is a measure of recent stochastic factors (e.g. last year's rainfall level) and u_l is a broad measure of recent history of stochastic factors (e.g. the rainfall of the last 3-5 years). Other tests can be nested in this specification - including asymmetry, by overidentifying (3) with measures of changes in stochastic factors, truncated to 'bad' shocks only (e.g. measures of bad rainfall, ignoring above normal rainfall). Recall that 'growth' of consumption is captured by a shift in the technological factor a, reflected in $\triangle a^*$. Other changes in the underlying production function due to 'structural' change can also be tested. For example, changes in β (the exponent on fixed factors, see (1)) can be tested, by testing changes in b^*. The change in values of b^* between t and $t+1$ can be tested by adding initial levels of k_j at period t.

occur and in due course, households will built up assets sufficient to avoid liquidity constraints. Note that in our sample, most households were having close to zero assets in 1989 (table 8).

Estimating (3) provides estimators of the different elasticities relative to prices and changes in fixed inputs, controlling for heterogeneity in the form of household fixed effects. Provided that price changes can be linked to the reform programme, this allows a direct assessment of whether any observed changing income levels can be traced to the reforms. A simple means of presenting these results is to calculate (using the estimates from (3)) the contribution of each of these factors to explaining mean income changes, similar to a Oaxaca-Blinder decomposition (Oaxaca (1973), Blinder (1973)). In particular, (3) can be summed for all hosueholds i in the sample, and each term then divided by the sum of changes in log of consumption. When (3) is estimated using a method imposing that the expected error term is zero, this provides an exact decomposition of the changes in consumption during the period under investigation.

To focus our attention on what has been happening at the lower end of the distribution, one can use these results to assess the extent to which these same factors can explain the experience not just of the 'average' household but also of the poor. This is not self-evident. A poverty index is in general not a linear function of real incomes; consequently, changes in real incomes are not linearly related to changes in poverty. For example, the poverty gap index is for each poor individual linear in real incomes, but non-linear as an aggregate measure. When considering changes over time via particular factors, the group of poor and non-poor may change as well, so that there is no simple, exact way to link the effects of growth to the effects on poverty. The standard approach to study the effects of changes over time of particular factors on poverty is to construct the counterfactual consumption distribution (via micro-simulations) and then to calculate the difference in the poverty indicator between the original and the counterfactual distribution (e.g. Bourguignon et al. [2001]).

However, it is possible to derive a simple analytical result that describes the calculations one implements during such micro-simulation exercise given the questions asked in this paper. In principle, any counterfactual can be simulated and its impact assessed on any poverty index. However, suppose we are specifically interested in investigating the contribution to poverty changes of some variables crucial in explaining growth. Since (3) considered changes in the natural logarithm of consumption, let us use a poverty index that is defined in log income as well. Furthermore, let us consider an additive separable poverty index, which for the each poor person is linear in log incomes. The normalised poverty gap, defined over the log of income as the underlying household welfare measure, satisfies this property. This is effectively the same as the Watts index of poverty. The approach is discussed in detail in Dercon [2002]; the main points are discussed in the appendix.

5 Specification and results

In this section, the variables used in the econometric are first discussed and then the estimation results are presented. The basis of the regression is equation (3).

Since consumption is on the left hand side, as was discussed before, coefficients should nevertheless not necessarily be expected to be similar to those of the underlying income model. All value data are in real terms, i.e.deflated by a area specific food consumption price index. Introducing time subscripts t, and i to denote households, changes in the log of consumption between $t+1$ and t are estimated using the following model:

$$\triangle \ln c_{it} = \triangle a_i^* + \sum_j b_j^* \triangle \ln k_{jit} + d^* \triangle \ln p_{it} + \sum_n f_n^* \triangle \ln p_{nit}^x + g^* \triangle u_{sit} + h^* \triangle u_{lit} + \varepsilon_{it} \tag{4}$$

Using (4) on the data requires careful justifications for the inclusion of the right hand side variables. First, land and labour supply available to the household will be considered as fixed inputs, meaning that labour and land markets are assumed missing. As was discussed before, land is a non-tradable in Ethiopia. Land is state owned and allocated to peasants by a local council, who cannot buy or sell it. Land rental was illegal until the 1990s, but even afterwards cultivated land and land owned remain closely correlated . Wage labour, whether in agriculture or otherwise, remains relatively rare. Rural wage labour markets remain underdeveloped, even though probably increasing compared to the repression of this activity before 1989. Informal labour transactions take nevertheless place in the village, in the form of labour sharing arrangements ('debbo' or 'wenfel'). However, these arrangements are largely reciprocal, so own labour remains the basis of these transactions, limiting the scope for relative factor equalising trade within villages. Consequently, both factors are therefore considered fixed. Labour considered will include first distinguish male and female adults. Human capital present in the household was measured as the number of person years of formal education present among the members in the household. In any case, these values are very low. The average educational level per adult in the sample is less than 6 *months* per adult. Less than 5 percent of the heads of the household were educated in 1989.

Land holdings are not homogenous across the sample. There are substantial differences in soil fertility and agricultural potential within and across communities. However, since a difference model is used this is not a problem. Land holdings were measured and remeasured in each round. During this period, there is no explicit large scale redistribution of land, but substantial changes in individual land holding plot levels are possible, since in at least one of the communities considered, households used the change in regime in 1991 to effectively disband the state-owned cooperative and grab the land. In two other communities, new land was brought in cultivation as well. Nevertheless, there appears to be a larger change in landholdings than can be accounted for by these factors. Given the typical problems with measuring land, and since in Ethiopia, there are numerous local measurement units for land, which differe across communities, one should be aware that measurement error is very likely to be particularly a problem for these data, with well-known econometric implications.

Another fixed input considered is infrastructure. In community surveys any changes in road presence and quality were investigated, and especially after 1994, substantial road repair programmes were started. Three out of six villages considered in this period report increased access to improved road and transport infrastructure serving the village. This information is incorporated in the analysis.

The most important direct result of the reform programme, especially in the first period, appears to have been the changes in agricultural output prices, with improving terms of trade for five out of six communities considered in the first period of reforms (1989-94). This price change will be included in the analysis (see table 6). Note that these prices changes are calculated on a farm-specific basis. We have detailed data on land allocation on each farm in 1994. Combining this with information on 'typical' harvests per land area in each village gave us weights for a household-specific producer price index[4]. Prices for specific producer price surveys in each period can then be aggregated in a household-specific price index and its percentage changes are used in the analysis.

Crop production is obviously not the only source of income - in fact substantial shares of income come from livestock, wage and business incomes. Unfortunately, no information was available on these terms of trade. This may not necessarily be a serious shortcoming, since many of these activities, especially the business activities, are very closely linked to agriculture anyway (such as beer brewing, or selling crop residue as animal feed). However, many of these activities typically involve some trading with urban areas, so the shadow output prices may well be proxied by inclusion of infrastructure or distance variables. When unpacking the community fixed effects, these variables will be included to capture this. Similarly, although very few purchased inputs tend to be used in both farm and off-farm activities in our specific villages, they should also be included. Again, no data are available on this. Nevertheless, since they tend to be supplied via nearby urban centres, the relative movement of these input prices may well be captured via the inclusion of the infrastructure and distance variables. As a consequence, the interpretation of any effects on these variables will have to be done with care.

The model will first be estimated using community level time-varying fixed effects, which will gradually be unpacked. As argued before, shocks and negative events, both in the recent past as over longer periods may well have an impact on consumption changes if credit and insurance markets are not perfect. A number of common and idiosyncratic shocks are included. Total rainfall in the last 12 months before the survey round is used as the 'recent' rainfall experience, while the average yearly rainfall in between the survey rounds (up to five years), but excluding the last year, is measuring the medium term experience. To test for asymmetry, I experimented with different definitions of 'bad' - in the end, simply looking for different effects if the change in rainfall is negative rather than

[4] Since in some villages in 1994, harvests were zero for some crops, it was decided to use information on reported 'normal' harvests from community surveys to form these weights.

positive provided similar results to alternative definitions, so this is reported here.

Idiosyncatric shocks are also available. Data include a farm-specific index of non-weather related self-reported shocks. The index is a simple average of eight questions related flooding, plant pests, animal trampling etc. The higher the index, the better. Another shock is whether livestock had problem obtaining grazing or water, or suffered from disease. Serious problems were given double the weight of moderate problems. The overall index is scaled so that 0 is normal and lower values imply a shock. The higher the index, the better. Consequently, nonnegative coefficients on all these variables are expected. Finally, we also have information on *serious* illness episodes for adults in between rounds. The measure is simply the number of adults reporting such problem per household. Its possible endogeneity can be tested.

Data are also available on whether households benefited from the existing safety nets in the form of food aid or food-for-work. On average 17 percent of households in the sample receive food aid in one form or another. But coverage varies widely and changes considerably over time. For example in Dinki, one of the villages with relatively high persistence in poverty, food aid was given during one round to 98 percent of households in the sample, but never before or afterwards. Coverage within villages is also not at all constant. More details on these programmes are in Dercon and Krishnan [2002]. We test whether any changes in coverage of these programs in this period has an impact on households, using simple information on whether the household itself, or the village it is living in, has benefited from these programmes. Note that if placement of these programmes was linked to household characteristics, then in the fixed effect formulation there should not be a problem. Below some discussion will be presented on what if changing characteristics are affecting placement, so that programme placement effects are still relevant even in the fixed effects estimation.

Table 9 gives the estimation results. All results are based on a difference model; standard errors are robust and control for clustering per village. Each difference model was also estimated using a random effects estimator, but they were never found to be significantly different from zero. The first model includes the household level variables, including idiosyncratic shocks, but uses time-varying village dummies to capture any community-wide effects. The results suggest that labour endowments matter, while idiosyncratic shocks appear to

matter (but not with strong significance). The low coefficients on the land variables may well be linked to likely high measurement error in this variable, reducing the coefficient on land. Most of the action appears nevertheless to be in the time-varying dummies (not reported in the table), with rather different underlying effects. Next we will try to unpack these time varying effects. Note also that a restriction on the equality of male and female adults cannot be rejected. In the rest of the regression analysis, I will simply use the total number of adults in the household (even if the sum of all adults is not quite the restriction tested, the idea remains the same). Model 2 reports these results.

In model 3, time-varying community level information is introduced[5]. A community fixed effect (or better: fixed growth effect) is introduced as well. A separate time trend was insignificant throughout. Better prices, recent rainfall shocks and past rainfall shocks are all strongly significant. With consumption on the left hand side, this does seem to confirm that the relative price change in the economy has had an important impact, but also that households are not able to smooth consumption. If credit markets had been perfect and if the reform had been unexpected then the significance of the coefficient on the prices in the regression suggests that households considered the reforms to be permanent. With imperfect credit markets, the effect on relative prices could also be considered a current shock. It could be argued that the relative price change in the second part of the period considered (1994-97) have less to do with structural change than with shocks. As a consequence, with perfect credit markets, one could expect to have a larger response to the reform-induced relative price change (provided it was unexpected). With imperfect credit markets, households would respond similarly to both shocks, unless one was more predictable than the other (so that some action was taken to pre-empt the problem when it occurs, for example saving more or less in the last period). It may well be argued that the reform shock became relatively predictable (if only since change was on the cards), but the shock in the second period is a real 'surprise'. In that case, the impact on consumption on price changes in the second period is likely to be higher. Overidentifying model 3 to test this, by introducing a price change term multiplied by a dummy for the second period, suggests that the latter story may be the more plausible one in the dat: (i.e. imperfect credit markets but with some predictability of the reform and its impact on relative prices). The implied coefficient in the second period is double the size of the price coefficient for the first period, but the effect is only significant at 17 percent.

The strongly significant effects on the rainfall variables are striking. A one percent lower rainfall in the last year would reduce consumption by one percent, while there is also evidence of persistent effect, in that past rainfall matters for the consumption growth path. Finally, note that improved access through better roads and transport increases increased consumption, even though the effect is only significant at 13 percent in this regression.

As was argued before, if credit markets are imperfect, it is likely that bad shocks will matter more for consumption than 'good' shocks. In the data, some evidence for this could be found. Introducing negative recent rainfall shocks as an additional variable in model 3, it was found to be strongly significant, while the overall effect (i.e. the coefficient on Δ(% rain last year) became insignificant (t=0.90). This suggested that a model with only 'bad' recent rainfall shocks would be a superior representation. No such effect could be found for bad 'medium run' rainfall. So model 4 was estimated to take these findings into account. As can be seen, the responsiveness on bad shocks is higher than the overall effect found in model 3 (as could be expected). Note that in model 3

[5] Recall that the crop price index is household specific, but for obvious reasons it will be strongly correlated among households. Introducing the index while keeping the time-varying dummies in the regression did imply rather insignificant results.

and 4, strong 'residual growth' effects can be detected in this period via the village dummies, not captured by rainfall or changing access. These effects are also significantly different by location.

The question arises whether we can unpack these effects further using community level and other characteristics. In the relatively small data set, this becomes more difficult, but the results are at least suggestive. For this purpose levels of land, adults in the household and education stock at the beginning of each period were introduced in the regression, as well as whether the village was connected with a reasonable road[6]. Together they result in quite significant results, even though the labour variable is not relevant. The interpretation suggests that growth rates are higher in households with more land, more education and with access to road infrastructure. The constant also becomes insignificant in model 5, suggesting a more a parsimonious interpretation as in equation 6. Note that the coefficient on road infrastructure may simply be a proxy for more advantageous terms of trade for off-farm activities, or lower margins on inputs such as fertiliser. To what extent can this factor be related to the economic reform program? The encouragement of private activities are likely to have improved the terms of trade for rural households - in terms of less transactions costs for licenses, harassment, etc. However, the increased security after the end of the war in 1991 is also likely to have had an impact. If the changes have more to do with the economic reform program, then one may expect larger or at least not lower effects in the second period considered - since much of the encouragement started well after the end of the war. If it is a pure peace dividend, then one may expect the larger ('once-and-for-all') effect around the time of the return to peace - or in the first period considered (1989-1994). A test whether the coefficient on whether there is a good road connection from the village suggests that in the second period it is larger (about 50 percent higher than in the first period), even though its significance is only 15 percent. Still, this seems like evidence in favour of a 'reform' interpretation.

Overall, these regressions present some very suggestive evidence. First, the relative prices, largely linked to the reform programme, appear to have been relevant for consumption growth. Shocks, especially and most significantly bad rainfall shocks and medium term rainfall experience appears to matter as well. Asset changes, including land and labour availability changes, seem to matter as well. Improved road access in three villages also contributed to growth, adding 31 percent to consumption over the period considered. Household and community level residual growth rates are considerable but differ nevertheless considerably in the sample. The evidence suggests that initial land holdings, access to roads and education result in much higher growth rates than otherwise. For example, access to roads adds 37 percent on average in each period. But shocks are able to strongly reduce consumption levels, especially rainfall shocks. One percent less rain reduces consumption by between one and two percent, while a lower average rainfall in recent years of one percent would

[6] Distance to the nearest town was also introduced. In some formulations it was significant and of the expected sign but in this data set the quantitative contribution of this effect to explaining observed changes was very small.

reduce consumption by up to one percent.

How have policy changes, asset changes and shocks interacted in this period to obtain the observed growth rates? Table 10 does a simple decomposition of the regression model 6, in terms of the percentage contribution of each factor in explaining the average change in consumption in the sample. The results are suggestive about the way the reform programme has influenced the local economy, and the role of shocks in this respect as well. Over the entire period, consumption growth has been most strongly influenced by growth, not directly explained by changes in assets, relative price changes or rainfall, but by some 'residual' process - although as was argued above it can still be interpreted as related to improving prices. It is striking that the most important factor has been the differential growth rates between areas with road access and those without: 80 percent of total growth can be accounted for by this factor. Note also that bad rainfall shocks reduced real consumption growth by 54 percent. Most other factors are relatively less important. In the first period, 1989 to 1994, a similar pattern emerges, at least regarding road access. In this period, returns to mobility due to the start of the reform programme and due to the end of the war had clearly increased considerably - accounting for more than 70 percent of total growth. In this period, 33 percent of growth can however also be directly linked to the improving agricultural terms of trade. In the second period, no substantive terms of trade changes induced by policy came about. Instead, road improvement programmes and more generally the development of more transport links clearly benefited these respective communities substantially. The change in infrastructure and the increased return to existing infrastructure together seems to account for more than 130 percent of the total change. Note that the fact that road access continued to play a similar role in explaining the growth experience after 1994 suggests also that the earlier effects of road access were not just the consequence of a peace dividend alone, but may well be linked to the generally improved market orientation of the economy[7] The generally better weather conditions between survey rounds in this period contributed as well but can only account for a small part of the change.

Bad weather in some areas caused a considerable break on growth in consumption, while idiosyncratic shocks together accounted for about -20 percent as well. There is evidence of asymmetric effects of shock - even though the evidence for rainfall was not extremely strong, only negative short-run shocks mattered for consumption. This does not necessarily mean that positive shocks do not contribute to income, so the growth implications may be less relevant than may seem at first. An *income* model would have to be estimated to establish whether there are any persistent or permanent effects on income from these shocks. Increasing returns to education appear to play a considerable role, even though low educational levels mean that only a very small group will have benefited from this. Overall, the evidence suggests that increased returns to land, to education and to location, and improvements in access can account for most

[7] A test fpr the differential impact of access to road in the first period relative to the second period showed no significant differences.

of the growth, with the relative crop price change being important in the first period as well. It also means a diverging experience, not least between villages: not all villages have road access, while some households only have limited land and no education. They are unlikely to be able to take full advantage of the changed circumstances. The presence of an impact of medium run rainfall on top of a large initial impact of changing rainfall suggests a further hinderance for a smooth consumption growth path.

The presence of such large role for weather shocks in explaining consumption changes suggest deficient credit and insurance institutions for common risk, and serious problems with using savings to smooth consumption. In Ethiopia, large government/donor programmes have set up food-for-work and food aid programmes to deal with some of the hardship related to this. Can we detect any impact of this aid programme on household consumption? In Dercon and Krishnan [2002] this question is explored further using a larger data set, but it is worth to briefly explore this here. A simple test is to introduce information on whether households have been benefiting from food aid/food-for-work in the consumption growth regressions. Model 2, with time-varying community effects is most appropriate to test the impact on consumption. Note that this is a fixed effects regression, so that any programme placement problem due to 'fixed' characteristics would affect our test. Introducing a dummy to signify participation in any of the periods, the effect was found to be insignificant (t=-0.30). Arguably, programme placement may happen due to time-varying reasons. By estimating the fixed effects version of model 2 (i.e. a double difference), at least some specific form of heterogeneity can be addressed. But even in this case, the coefficient on the aid variable proved insignificant (t=0.08). It may however be argued that a better test would be to see whether sensitivitiy to negative shock changes for someone receiving food aid, i.e. interacting it with the 'bad' shock. Again, no signficant results can be detected[8]. If there is an effect from these programmes, then it is likely to be more indirect

Finally, the regression results are used in combination with the approach outlined in appendix 1 to decompose the total poverty decline observed during the period 1989 and 1997, and the two sub-periods. Tabel 11 gives these results. As was mentioned in the appendix, this is not an exact decomposition, so a residual term is likely to appear (as was found). These results accentuate the earlier findings even more: poverty declines where largely driven by large increases in returns to roads versus a large impact from bad rainfall shocks and other locality specific factors. These increased returns to road or other locality specific factors, on top of the relative price change in the first part of the period considered suggest that reforms contributed most significantly to the observed

[8] These results are very similar to Dercon and Krishnan (2002) who study an additional ten commuinities in Ethiopia. There it was however found that if programmes are in the villages, then even if not all have access to the programme, everybody gains somehow from them - for example via some risk sharing arrangement. Introducing this idea in model 4, we find that the impact of bad shocks is almost halved (to be more precise, for village with food aid, the impact of a bad shock is 0.84, while for those without aid the impact is 2.21. The effect for villages with food aid is only significant at 21 percent. Still, it suggests that food aid has some beneficial impact but not directly from targeting individuals but from coverage of villages.

poverty reduction. But the vulnerability to rainfall shocks implies that relatively poor rains in the first period considered resulted in a strong weakening of this growth record.

The findings confirm also that those with poor access to road infrastructure would have a hard time to 'grow' out of poverty. A closer look at the data confirmed this. Virtually all the action in terms of poverty reduction occurred in areas with good or improving road infrastructure and within communities those with relatively 'poor' characteristics, in terms of land, labour or education. The emerging story is then that the reform program could allow part of the poor in 1989 - roughly half of them - to grow out of poverty. These households typically had enough labour and land, some educated members, and access to roads; if not, then they struck it lucky with very good rainfall in the first part of this period. For the other group only very favourable shocks could lift them out in this period - otherwise, their poor endowments in terms of location, labour and land meant that they could hardly benefit in this period.

6 Conclusion

This paper tried to disentangle the effects of the economic reform program in rural Ethiopia from rainfall and other shocks, and other changing circumstances. The results are consistent with the fact that reform program played an important role in helping some of the poor to grow out of poverty. Poverty reduction in this period is impressive in these villages - surely far better than typically in Ethiopia in this period. The fact that they started at an extremely low base after the disastrous 1980s in these areas (so that in the beginnning of the survey period, assets stood typically at zero) may have contributed to these impressive growth rates. Economic reform was important for both mean growth as for growth in consumption by the poor. The most important factors appear to be related to road infrastructure and access.

A worrying fact is nevertheless that growth is not fully inclusive. Of those poor in 1989, mainly those with fairly good endowments in terms of land, labour, education and access to roads and town managed to fully benefit from the improved incentives. They account for most of the observed poverty declines. One way of interpreting this is that economic reform allowed them to unlock their natural potential to florish in a market economy. The reverse side of this success is the failure of households with relatively 'poorer' endowments to lift themselves out of poverty in this highly favourable climate of (mainly) improving terms of trade and (mainly) well above average rainfall. In 1999/2000, during the drought, the sample was reinterviewed and the data will be available in the near future for further research. The extent to which both the households that improved between 1989 and 1997 and those that did not improve have been able to weather this crisis is going to be an important indicator of the sustainability of these consumption gains.

This is even more a concern since the findings also highlighted the high sensitivity to rainfall and to a lesser extent other shocks in a country like Ethiopia.

In this paper, the resulting high fluctuations in consumption from rainfall stood out. Not only recent rainfall but also the experience in the recent past matter. It can be suspected (but remains to be proven) that this sensitivity regularly destroys resources for growth. The findings in this paper paint a bleak picture of the role of the current safety nets in tackling this. No impact on consumption or consumption sensitivity to shocks could be detected, despite the fact that almost a fifth of the household are typically covered by some food aid program. Results in Dercon and Krishnan (2002) confirm this finding, although there the finding is supplemented with some effect via the presence in the village of programs - as if informal sharing arrangements and/or trickle down mechanisms manage to compensate for poor design and targeting via some 'crowding in' process.

Safety nets are unlikely to be best solution, as the experience shows. The seemingly ineffectual way in which savings are used to buffer consumption suggest that other routes must be explored. This is especially so since the standard concern about the inability to use savings effectively, related to inflation and macroeconomic instability, does absolutely not apply to Ethiopia. More attention to get asset and food markets to work smoothly is sorely needed.

(Appendix and tables in separate file)

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Appendix 1 Linking poverty and growth - simulating the impact of variables

Formally, denote $\ln Y_{it}$ as y_{it}, z as the log of the poverty line, q_t as the number of people falling below the poverty line in the current period and n as the total number of individuals which are all observed over time[1]. If we order all individuals from poor to rich in each period, then this measure can be defined as:

$$P_t = \frac{1}{n}\sum_{i=1}^{q_t}\frac{z - y_{it}}{z} \qquad (A.1)$$

Let us consider two periods of time, 0 and 1, and introduce a specific counterfactual, in which the change of income over time is equal to X_i. For example, this could be the change in real income stemming from the actual change in one of the fixed endowments in (3) in the main text, or $X_i = \beta^*_{jt+1}\Delta \ln k_{ij}$. It is then possible to calculate the counterfactual real income for person i, y_{i1}^*, as:

$$y^*_{i1} = y_{i0} + X_i \qquad (A.2)$$

Given this change, the number of poor will change. It is possible that some become poor and others escape poverty. Let us call the actual and counterfactual number of poor in period 0 and 1 respectively q_0 and q_1^*. We can then define the change in poverty between period 1 and 0 as:

$$P_1^* - P_0 = \frac{1}{n}\sum_{i=1}^{q_1^*}\frac{z - y_{i1}}{z} - \frac{1}{n}\sum_{i=1}^{q_0}\frac{z - y_{i0}}{z} \qquad (A.3)$$

Let us now order the individuals, so that the poor in both periods are from i=1,... q^*_{11}, those moving into poverty i=q^*_{11}+1,…q^*_{01} (i.e. non-poor in period 0 and poor in period 1), those moving out of poverty ranked i=q^*_{01}+1, …q^*_{10}, and finally, those non-poor in each period as i=q^*_{10}+1,…n. Then, (3) can be written as:

$$P_1^* - P_0 = \frac{1}{n}\sum_{i=1}^{q^*_{11}}\left(\frac{z - y^*_{i1}}{z} - \frac{z - y_{i0}}{z}\right) + \frac{1}{n}\sum_{i=q^*_{11}+1}^{q^*_{01}}\frac{z - y^*_{i1}}{z} - \frac{1}{n}\sum_{i=q^*_{01}+1}^{q^*_{10}}\frac{z - y_{i0}}{z} \qquad (A.4)$$

i.e. the change in the gap consist of the change of the gap of those poor in both periods, plus the gap of those poor in the second but not in the first period, minus the gap in the first period of those leaving poverty[2]. Dividing the left and right hand side of (A.4) by (P_1^*-P_0) yields a decomposition in terms of

[1] In this exposition, I do not consider attrition in the panel. As has been discussed before, in the data set used, attrition rates were very low in the period considered.

[2] As suggested earlier and using the notation as before, the Watts poverty measure is defined as:

$$W_t = \frac{1}{n}\sum_{i=1}^{q_t} z - y_{it}$$

so that the decomposition in (A.3) is in practice a decomposition of the Watts poverty measure. Just as the squared poverty gap, it is convex in levels of real income, implying that income levels far below the poverty line have a higher weight than levels closer to the poverty line, unlike the poverty gap, which is linear in levels of income.

the contribution to the total poverty change of those staying poor, those becoming poor and those leaving poverty. Note that this is an exact decomposition.

This can be rewritten in terms of changes in real income. The part in brackets in the first term of (A.4) is directly defined in terms of $y_{i1}^* - y_{i0} = X_i$. We can also pre-multiply the terms within the summation sign for each of the two subsequent terms by $\frac{y_{i0} - y_{i1}^*}{y_{i0} - y_{i1}^*}$. Slightly rewritten, (A.4) becomes:

$$P_1^* - P_0 = \frac{1}{n}\sum_{i=1}^{q^*_{11}}\left(\frac{y_{io} - y_{i1}^*}{z}\right) + \frac{1}{n}\sum_{i=q^*_{11}+1}^{q^*_{01}}\left(\frac{y_{io} - y_{i1}^*}{z}\right).\left(\frac{z - y_{i1}^*}{y_{io} - y_{i1}^*}\right) - \frac{1}{n}\sum_{i=q^*_{01}+1}^{q^*_{10}}\left(\frac{z - y_{i0}}{y_{io} - y_{i1}^*}\right)\left(\frac{y_{io} - y_{i1}^*}{z}\right) \quad \text{(A.5)}$$

or

$$P_1^* - P_0 = \frac{1}{n}\sum_{i=1}^{q^*_{11}}\left(\frac{-X_i}{z}\right) + \frac{1}{n}\sum_{i=q^*_{11}+1}^{q^*_{01}}\left(\frac{-X_i}{z}\right)\left(\frac{z - y_{i1}^*}{y_{io} - y_{i1}^*}\right) - \frac{1}{n}\sum_{i=q^*_{01}+1}^{q^*_{10}}\left(\frac{z - y_{i0}}{y_{io} - y_{i1}^*}\right)\left(\frac{-X_i}{z}\right) \quad \text{(A.6)}$$

This expression suggests (rather self-evidently) that when calculating the total counterfactual poverty change, for households who leave or enter into poverty, only the real income change up to or counting from the poverty line will be taken into account, while for those staying poor, their entire real income change is relevant. This allows us to define the share of the real income change that has to be taken into account as:

$$s_i^* = 1 \quad \text{for } q_i \in \{1,\ldots q^*_{11}\}, \quad \text{(A.7a)}$$

$$s_i^* = \frac{z - y_{i1}^*}{y_{i0} - y_{i1}^*} \quad \text{for } q_i \in \{q^*_{11}+1,\ldots,q^*_{01}\} \text{ and} \quad \text{(A.7b)}$$

$$s_i^* = \frac{z - y_{i0}}{y_{i1}^* - y_{i0}} \quad \text{for } q_i \in \{q^*_{01}+1,\ldots,q^*_{10}\} \quad \text{(A.7c)}$$

Note that these shares s_i^* are dependent on the specific counterfactual studied (i.e. they are endogenous). Furthermore, they are all between zero and one.

Using (A.7a), (A.7b) and (A.7c), (A.6) can be rewritten as:

$$P_1^* - P_0 = \frac{1}{n}\sum_{i=1}^{q^*_{10}} s_i^*\left(\frac{-X_i}{z}\right) \quad \text{(A.8)}$$

Equation (A.8) is only of limited interest: if only one factor is considered in the counterfactual, the equation only describes what in practice is calculated via simulations. Calculating the weights s_i^* is probably more time consuming than calculating the change in poverty directly from the derived and the actual distribution. Furthermore, (A.8) is restricted to very specific poverty measures, while micro-simulations can handle any measure. Nevertheless, (A.8) becomes more interesting when X is itself determined by different variables.

Simulating and decomposing the impact of a group of variables

Consider a counterfactual that consists of two parts (V and W), and assume that for each i, $X_i = V_i + W_i$. Now (A.8) can be used to study the contribution of each factor V_i and W_i in the total counterfactual change. For a given total change in real income *(i.e. for a given total counterfactual)*, the shares s_i^* will be constant, so that (A.8) can be written as:

$$P_1^* - P_0 = \frac{1}{n}\sum_{i=1}^{q^*_{10}} s_i^*\left(\frac{-V_i}{z}\right) + \frac{1}{n}\sum_{i=1}^{q^*_{10}} s_i^*\left(\frac{-W_i}{z}\right) \qquad \text{(A.9)}$$

This implies that for a given total change, the contribution of different factors to the change in poverty can be written derived from (A.9). In particular the contribution of factor V_i given total change X_i, $\theta(V|X)$ can be defined as:

$$\theta\left(V_i \middle| X_i\right) = \frac{\frac{1}{n}\sum_{i=1}^{q^*_{10}} s_i^*\left(\frac{-V_i}{z}\right)}{P_1^* - P_0} \qquad \text{(A.10)}$$

Note that these contributions sum to one, but also that they are always defined relative to a particular total counterfactual change. For example, let us define P_1^V (P_1^W) as poverty in period 1 when V (W) has been added to y_{i0}. Even though $(y_{i0} + X_i) = (y_{i0} + V_i + W_i)$, it can be easily seen that:

$$P_1^* - P_0 \neq (P_1^V - P_0) + (P_1^W - P_0) \qquad \text{(A.11)}$$

In other words, the total poverty change due to adding V and W both to real income is not simply equal to the poverty change induced by adding V and W separately. Obviously, this means that the decomposition has to be carefully interpreted. (A.9) and (A.10) will be used below to interpret the contribution to poverty changes of different elements linked to economic reform.

Linking poverty and growth - an overall assessment

The decomposition described above provides a simple way of assessing the contribution of different factors to a particular counterfactual poverty change. One counterfactual is of particular interest for the current research: assessing the contribution of different factors to the *actual observed* total change in poverty (P_1-P_0). With an appropriate residual term (ε_i), equation (3) (in the main text) provides a prediction model for changes in real income for each person, based on different factors. Or, more in general, suppose $X_i = V_i + W_i + \varepsilon_i$. Equation (A.9) can then be rewritten as (dropping asterisks, since the counterfactual considered is the actual change in poverty):

$$P_1 - P_0 = \frac{1}{n}\sum_{i=1}^{q_{10}} s_i\left(\frac{-V_i}{z}\right) + \frac{1}{n}\sum_{i=1}^{q_{10}} s_i\left(\frac{-W_i}{z}\right) + \frac{1}{n}\sum_{i=1}^{q_{10}} s_i\left(\frac{-\varepsilon_i}{z}\right) \qquad \text{(A.12)}$$

Equation (A.12) provide then simple ways of describing the contribution of these different factors (and

the error term) to the observed poverty changes, using shares s_i based on the *actual* observed poverty transitions.

Equation (A.12) shows a direct link between changes in individual consumption over time and the poverty outcome. Furthermore, replacing the income change by the predicted contribution of different factors and dividing each term by the total poverty change gives the contribution of these factors to the change in poverty. For example, let $\theta_{\Delta pi}$ be the contribution of changes in output prices to the total poverty change and $\theta_{\Delta ki}$ be the contribution to the total poverty change of changes in particular endowments k, then using (A.12) and the econometric model in the main text, they are defined as:

$$\theta_{\Delta p_i} = \frac{-\frac{1}{n}\sum_{i=1}^{q_{10}} s_i \varphi^*_{t+1} \Delta \ln p_i}{z.(P_1 - P_0)} \qquad \text{(A.13a)}$$

$$\theta_{\Delta k_i} = \frac{-\frac{1}{n}\sum_{i=1}^{q_{10}} s_i \beta^*_{t+1} \Delta \ln k_i}{z.(P_1 - P_0)} \qquad \text{(A.13b)}$$

The overall result is a decomposition of the poverty gap into the effects of changes in fixed endowments, changes in input and output prices, and random events, *for a given total change in poverty*. The decomposition will now be applied to data related to 1989 and 1994/95, before and after a major set of reform measures was implemented. The decomposition of consumption income changes is exact when using an estimation method which impose that that the sum of the residuals is zero, such as OLS. But the proposed decomposition is done on a sub-sample only, so that this property does not hold. Consequently, decompositions based on (A.17) are not exact and the contribution of the error term will have to be added:

$$\theta_{\varepsilon} = \frac{-\frac{1}{n}\sum_{i=1}^{q_{10}} s_i \varepsilon_i}{z.(P_1 - P_0)} \qquad \text{(A.13c)}$$

Tables

Table 1 GDP per capita and other macroeconomic indicators 1982-1998 (1989=100)

	real GDP per capita[a]	real consumption per capita[b]	real gross capital formation per capita[c]
1982-1984	103	110	101
1985-1987	93	100	92
1988-1990	101	101	111
1991-1993	92	104	70
1994-1996	99	114	117
1997-1998	106	118	128

Source: International Financial Statistics, International Monetary Fund

[a]GDP per capita in constant 1980/81 prices[3].

[b]Private consumption in national accounts per capita, deflated by GDP deflator. Deflated by consumer price index, the outcome is very similar, except for a stronger recovery in 1997-98.

[c]Government revenue, government consumption and gross capital formation per capita, deflated by the GDP deflator.

Table 2 The evolution of real teff prices

	Price per kg*	Local price as a percentage of the Addis Ababa Price								
		Deficit regions			Surplus regions					
	Addis Ababa	Dire Dawa	Dessie	Harar	Ambo	Debre markos	Assela	Hos-aenna	Ne-kempte	Shash-emene
1987-89	1.48	119	91	130	73	52	72	61	67	74
1990-92	1.45	119	93	118	82	75	86	72	77	87
1993-95	1.31	119	103	120	92	88	93	82	86	95

Source: calculated from Agricultural Marketing Corporation data files.

*=wholesale price per kg, in constant 1990 prices, using Consumer Price Index as a deflator (source of the CPI: International Financial Statistics, International Monetary Fund)

Note that 'deficit' are towns in typically net importing regions; 'surplus' are towns in typically net exporting regions.

Table 3 Changes in food consumption per adult equivalent (between 1989 and 1997) (in birr, 1994 prices) (n=344) (6 birr » 1 US $ in 1994)

	DINKI	DEBRE BERHAN	ADELE KEKE	KORO DEGAGA	GARA GODO	DOMAA	ALL
mean food consumption 1989	50	53	64	37	27	25	42
mean food consumption 1994	62	96	108	40	20	80	64
mean food consumption 1997	62	162	123	65	73	49	88
yearly growth mean (%)	3.0	14.9	8.5	7.1	13.3	8.8	9.7

Source: own calculations from Ethiopian Rural Household Survey.

[3] Population figures are a problem in Ethiopia for this period. The war during the 1980s and suspicions about ethnic manipulations has meant that there are problems with the 1984 census estimates. The secession of Eritrea in 1993 complicates intertemporal estimates of GDP and population. A population census took place in 1994 resulting in a downward revision of the population figures. Different sources (such as the US Bureau of Census, the IMF and the World Bank) give different time series. A revision of the procedures governing the calculation of GDP complicates intertemporal comparisons further. As a result, other sources have different long-term series on GDP per capita. For example, World Bank series suggest a deeper collapse in 1985-87 but also a stronger recovery in 1997-98 to levels above the 1982-84 level.

Table 4 Poverty between 1989 and 1997 (n=344)

	DINKI	DEBRE BERHAN	ADELE KEKE	KORO DEGAGA	GARA GODO	DOMAA	ALL
Head count 1989	0.42	0.33	0.41	0.73	0.81	0.86	0.61
Head count 1994/95	0.57	0.25	0.17	0.63	0.94	0.39	0.51
Head count 1997	0.38	0.02	0.05	0.28	0.61	0.51	0.31
Poverty Gap 1989	0.15	0.12	0.10	0.39	0.47	0.44	0.29
Poverty Gap 1994/95	0.18	0.06	0.04	0.22	0.53	0.23	0.22
Poverty Gap 1997	0.09	0.00	0.00	0.07	0.26	0.20	0.10
Squared Poverty Gap 1989	0.07	0.06	0.04	0.24	0.31	0.26	0.17
Squared Poverty Gap 1994/95	0.08	0.02	0.02	0.10	0.34	0.16	0.12
Squared Poverty Gap 1997	0.03	0.00	0.00	0.03	0.14	0.14	0.05
Percentage change							
Head Count	-9	-95	-88	-61	-25	-40	-49
Poverty Gap	-35	-97	-95	-82	-44	-54	-64
Squared Poverty Gap	-52	-99	-99	-89	-55	-52	-70
Poverty elasticity at mean[a]							
Head Count	-0.34	-0.47	-0.95	-0.83	-0.15	-0.42	-0.45
Poverty Gap	-1.31	-0.48	-1.02	-1.11	-0.25	-0.56	-0.59
Squared Poverty Gap	-1.91	-0.49	-1.07	-1.21	-0.32	-0.54	-0.64

Source: own calculations from Ethiopian Rural Household Survey.

[a]The poverty elasticity is calculated as the ratio between the actual percentage change in poverty and the growth in mean consumption between 1989 and 1997.

Table 6 Rainfall 1989 and 1997

rainfall in particular period as a percentage of the mean	DINKI	DEBRE BERHAN	ADELE KEKE	KORO DEGAGA	GARA GODO	DOMAA	ALL (weighted)
1988-89[a]	-13	+6	-7	+22	+5	-13	+2
1993-94	+16	+7	+13	-19	-8	+16	+4
1996-97	-23	+4	+52	+32	+7	-23	+10
1985-89[b]	+5	-1	+5	+16	+7	-6	+4
1990-94	-6	-2	+17	+21	-7	+6	+4
1994-97	+6	-15	+18	+48	+9	-2	+8
Average level (mm)[c]	1664	919	632	672	941	1117	1009

Rainfall in nearest rainfall station, based on data from the National Meteorological Office, Addis Ababa. Data are percentages of the mean rainfall.

[a]Rainfall in the 12 months preceding the survey. Expressed as a percentage deviation from the mean

[b]Average yearly rainfall covering the years before the interview.

[c]Relative to the mean (based on available observations, typically the last 15-20 years).

Table 7 Real producer prices (Percentage increases relative to 1989[a])

	DINKI	DEBRE BERHAN	ADELE KEKE	KORO DEGAGA	GARA GODO	DOMAA	AVERAGE
1994-1989							
All crops	+28	+21	+12	+65	-37	+35	+26
Tradables[a]	+28	+23	+15	+65	-12	+49	+31
Non-tradables[c]			-38		-77	-23	
Food	+31	+21	+25	+65	-37	+35	+28
Coffee					+49		
Chat			-9				
1997-1994							
All crops	+34	+15	-16	-17	+8	-33	+0
Tradables[b]	+34	+15	-20	-17	+2	-34	-1
Non-tradables[c]			+95		+38	-33	
Food	+33	+15	-7	-17	+8	-33	+2
Coffee					-29		
Chat			-40				
1997-1989							
All crops	+70	+39	-4	+36	-28	-7	+20
Tradables[b]	+70	+39	-5	+36	-10	-1	+23
Non-tradables[c]			+21		-68	-48	
Food	+75	+39	+18	+36	-28	-7	+24
Coffee					+6		
Chat			-45				

Source: ERHS and Central Statistical Authority

[a]Percentage changes in terms of trade, based on the movement of producer prices relative to consumption price inflation. The producer prices for different crops are weighted using the contribution to total crop income in 1994 of each crop (including production for home consumption), with different weights for each household. The reported figures are based on the producer price indexes, averaged across households in each community and across the sample. Producer prices for all indexes were taken from publications on rural producer prices at the sub-regional level, collected by the Central Statistical Authority. To achieve maximum comparability, only consumer prices collected by the Central Statistical Authority were used as well. Data were compiled for the same months so that differences do not reflect seasonality.

[b]Tradables: regularly traded food and cash crops in Ethiopia, i.e. most cereals and cash crops.

[c]Non-tradables: crops such as enset and sweet potatoes.

Table 8 Livestock Holdings per adult equivalent (in livestock units and in values, deflated by consumer prices of 1994)

	DINKI	DEBRE BERHAN	ADELE KEKE	KORO DEGAGA	GARA GODO	DOMAA	AVERAGE
Livestock values							
1989	461	1598	138	178	98	4	427
1994	272	1402	200	438	64	158	454
1997	592	1381	314	820	126	248	634
Livestock units							
1989	0.43	1.53	0.14	0.18	0.11	0.01	0.41
1994	0.38	1.55	0.27	0.65	0.14	0.32	0.60
1997	0.62	1.81	0.40	1.01	0.29	0.43	0.82

Livestock units are standard tropical units of different types of livestock, calculated on the basis of oxen=1, cows=0.70, bulls=0.75, horse=0.5, goat=0.1, sheep=0.1 and other similar values.

Table 9

Econometric model real income function. Dependent variable: change in log consumption (N=344 groups, two observations per group) Robust standard errors corrected for village cluster effects.

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6		sample
	Coeff	p-value	coeff	p-value	coeff	p-value	coeff	p-value	Coeff	p-value	coeff	p-value	mean
Constant	0.09	0.13	0.13	0.05	-0.13	0.08	0.22	0.02	0.34	0.30			1
Δ ln (land in ha + 0.1)	0.03	0.42	0.03	0.42	0.03	0.48	0.03	0.49	0.06	0.03	0.07	0.01	0.14
Δ ln (male adults+1)	0.20	0.13											0.07
Δ ln (fem adults+1)	0.20	0.05											0.01
Δ ln (adult equiv.)			0.41	0.04	0.43	0.03	0.43	0.03	0.42	0.06	0.40	0.03	0.01
Δ ln(yrs adult educ+1)	0.01	0.96	0.01	0.92	0.03	0.68	0.02	0.71	0.05	0.34	0.07	0.34	0.08
Non-rain shocks (1 is best)	0.21	0.22	0.21	0.19	0.09	0.63	0.10	0.57	0.17	0.34	0.04	0.87	-0.23
Livest. shock index (1 is best)	0.18	0.22	0.23	0.16	0.16	0.30	0.17	0.257	0.24	0.14	0.14	0.25	-0.15
adults serious illness	-0.13	0.19	-0.15	0.21	-0.15	0.19	-0.14	0.20	-0.13	0.20	-0.07	0.40	0.34
better road access (1 if yes)?					0.31	0.13	0.35	0.08	0.27	0.05	0.31	0.03	0.23
Δ (% real prod prices)					0.52	0.00	0.41	0.00	0.41	0.00	0.46	0.00	0.12
Δ ln (rain last year)					0.96	0.00							0.03
Δ ln (rain last year) bad only							1.86	0.00	1.77	0.00	1.43	0.00	-0.12
Δ ln (rain since last wave)					0.79	0.01	0.93	0.01	1.05	0.00	0.89	0.00	0.02
dummy Debre Berhan					0.72	0.00	0.40	0.01					0.17
dummy Adele Keke					0.40	0.00	0.27	0.01					0.12
dummy Korodegaga					0.44	0.00	0.52	0.00					0.26
dummy Gara Godo					0.52	0.01	0.29	0.05					0.16
dummy Domaa					0.45	0.00	0.42	0.00					0.14
ln (land) at t									0.06	0.16	0.08	0.05	0.31
ln (adult equiv) at t									-0.00	0.99			1.60
ln (yrs adult educ) at t									0.08	0.11	0.13	0.12	0.71
Any road infrastructure?									0.21	0.10	0.37	0.00	0.71
	including time-varying village dummies (not reported)		*including time-varying village dummies (not reported)*										
Adjusted R squared		0.168		0.175		0.168		0.169		0.160		n.a.	

Table 10
Decomposition of real consumption growth in percentages (based on model 6).

	1989-97	1989-94	1994-97
changes in land	3	7	-2
changes in adults	1	12	-11
changes human cap	2	11	-9
changes in road infrastructure	21	0	46
crop price changes	17	33	-2
short run rainfall (bad)	-54	-49	-57
medium run rainfall	6	0	17
shocks on farm	3	3	2
livestock shocks	-6	-7	-5
adult illness	-8	-4	-12
initial level of land	8	7	8
initial level of education	27	15	41
road access	80	73	86
total	100	100	100

Table 11 Decomposition of poverty gap. (Percentage point contribution to total growth.) (based on model 6)

	89-97	%	89-94	%	94-97	%
changes in land	-0.004	6	-0.004	10	0.001	-2
changes in adults	0.001	-1	0.009	-23	-0.007	16
changes human cap	-0.002	3	-0.007	17	0.004	-8
changes in road infr	-0.013	20	0.000	0	-0.013	28
short run rainfall (bad)	0.055	-87	0.037	-92	0.019	-42
medium run rainfall	-0.011	17	0.001	-3	-0.012	26
shocks on farm	-0.002	3	-0.002	5	-0.001	1
Livestock shocks	0.004	-7	0.003	-8	0.002	-4
adult illness	0.007	-11	0.002	-5	0.004	-9
initial level of land	-0.003	5	-0.003	6	-0.002	5
initial level of educ	-0.023	37	-0.008	19	-0.015	32
all weather road	-0.060	95	-0.041	100	-0.027	59
crop price changes	-0.012	19	-0.017	42	0.000	-1
residual	-0.022	35	-0.013	32	0.002	-3
Actual poverty decline	-0.086		-0.041		-0.045	
Predicted poverty change	-0.063	100	-0.027	100	-0.046	100