Chronic Poverty
Research Centre

Background Paper for the Chronic Poverty Report 2008-09

Growth and Poverty in Rural Ethiopia: Evidence from 15 Communities 1994-2004

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What is Chronic Poverty?

The distinguishing feature of chronic poverty is extended duration in absolute poverty.

Therefore, chronically poor people always, or usually, live below a poverty line, which is normally defined in terms of a money indicator (e.g. consumption, income, etc.), but could also be defined in terms of wider or subjective aspects of deprivation.

This is different from the transitorily poor, who move in and out of poverty, or only occasionally fall below the poverty line.

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This paper studies the process of growth, poverty and poverty persistence in a panel data set covering 15 communities across rural Ethiopia 1994-2004. It describes growth and the evolution of poverty, illustrating both considerable growth and poverty reduction. It highlights the presence of 'chronic' poverty, people that appear poor relatively persistently in the data. Using a statistical dynamic fixed effect growth model, we find that road infrastructure and the (slow) spread of extension services has contributed to this growth, even though a high sensitivity of consumption to rainfall shocks is noted as well. We show that changes in poverty are affected by the same factors. There is no clear evidence that chronically poor are differently affected by these factors in the sample period. However, we can show that there is a 'fixed' latent growth effect that is highly correlated with chronic poverty. It suggests a serious growth handicap for the chronically poor. We also find that chronic poverty and this latent growth effect correlates highly with initial physical assets (such as land or livestock), education and remoteness.

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Table of Contents

Tables

1. Introduction

In 1991, after decades of civil war, the military Marxist-inspired regime of the Dergue came to end with its defeat to a coalition of opposition forces, led by a rebel movement from Tigray. Ethiopia was then one of the poorest countries in the world, and still is. It has only insignificant natural resources, it is highly drought-prone and it has poor economic and political relations with most of its neighbours. Nevertheless, it would be wrong to argue that nothing has happened in this period. The economy has gone through a significant reform programme, reversing some of the extensive and counter-productive components of the control regime in the economy established during the Dergue. Aid increased dramatically, albeit from extremely low levels, resulting in significant investment in health and education infrastructure, as well as in new roads. A series of initiatives to stimulate agricultural productivity growth were taken, including a technology transfer based on extension, fertiliser and HYV seeds. But serious instability remained. Political reform has been slow. After granting Eritrea independence in 1993, relations broke down and by 1998 a bloody, costly war broke out ending with a cease fire in 2000. A serious drought hit the country in 2002, and large scale relief operations, unseen since the 1984-85 famine, took place.

Nevertheless, on average, growth picked up, and, in per capita terms, GDP grew by 2.1 percent per year between 1994 and 2004, albeit with high variability. Despite a number of nationally representative surveys, we do not have a clear idea of the extent of poverty reduction, if any, that occurred in this period. The official figures suggest a slow decline from about 46 percent in 1995/96 to 44 percent in 2000/01, but these figures hide large and rather unexplained variation across regions.[1] The latest 2004/05 national survey with consumption figures may well be of better quality, even though the analysis has not been completed due to recurring problems with data cleaning and processing. Nevertheless, impressions have been created that seem to suggest that a more substantial head count poverty reduction will be reflected in the data, as reflected in World Bank (2006). The participatory poverty assessment and other recent data nevertheless appear not to suggest any strong increase in people's perceived well-being in rural and urban areas (PPA).[2] In any case, despite reasonably high growth in the last 15 years, even the official GDP per capita figures suggest that the level obtained by 2005 are still only about the levels estimated in real terms for around 1970. In other words, Ethiopia has barely recovered to levels from before the revolution in 1974.

1 Many of the researchers that have had access to these data, including some of the authors of this paper, have been concerned with the lack of documentation on the procedures for cleaning and compiling the data series underlying these figures. At least some of us are very concerned that the data do not give a true picture of the changes in this period possibly in aggregate and most likely across regions.

2 Other dimensions of poverty, such as child nutrition and school enrolment, do show considerable progress in recent years. The Welfare Monitoring Data from the Central Statistical Authority suggest that stunting for children under five has declined from 66 percent in 1996 to 47 percent in 2004, and gross primary enrolment rates have gone up from 37 percent to 74 percent.

In this paper, we provide a summary of the evidence on growth and monetary poverty changes in rural Ethiopia, and a narrative on the likely factors that have determined the evolution of poverty and incomes therein. The data used is the Ethiopian Rural Household Survey. This data set is a panel data set covering 15 Peasant Associations, which are local administrative units covering a few villages. The data initially covered 1477 households, which were surveyed 6 times between 1994 and 2004. Even though attrition is present, it has remained limited to about 1-2 percent per year. The communities were chosen to reflect the agricultural and regional diversity and were drawn from the four main regions. In the next section, we discuss the data. In Section 3, we present the basic evidence on poverty and its dynamics, and discuss how this may fit in with other evidence, including perceptions of poverty. We focus on standard period-by-period overall living standards, as well as persistent poverty. In Section 4, we discuss the likely factors explaining this evolution, by presenting a simple model and a regression analysis. In Section 5, we discuss whether the poor and the persistently poor experienced different growth trajectories, and the explanations thereof. In Section 6, this evidence is further interpreted in light of other evidence such as related to the role of market liberalisation, physical infrastructure, the agricultural interventions, land rights and risk and safety nets. Section 6 concludes.

2. Data and setting

Ethiopia is a federal country divided into 11 regions. Each region is sub-divided into zones and the zones into woredas which are roughly equivalent to a county in the US or UK. Woredas are in turn divided into Peasant Associations (PA), or kebeles, an administrative unit consisting of a number of villages. Peasant Associations were set up in the aftermath of the 1974 revolution. Our data is taken from the Ethiopia Rural Household Survey (ERHS), a unique longitudinal household data set covering households in 15 areas of rural Ethiopia. Data collection started in 1989, when a survey team visited 6 Peasant Associations in Central and Southern Ethiopia. The survey was expanded in 1994 to encompass 15 Peasant Associations across the country, yielding a sample of 1477 households. As part of the survey re-design and extension that took place in 1994, the sample was re-randomised by including an exact proportion of newly-formed or -arrived households in the sample, as well as by replacing households lost to follow-up by others, considered by village elders and officials to be, broadly similar to them in demographic and wealth terms. The nine additional PAs were selected to better account for the diversity in the farming systems found in Ethiopia. The sampling in the PAs newly included in 1994 was based on a list of all households that was constructed with the help of the local Peasant Association officials.[3] The sample was stratified within each village to ensure that a representative number of landless households were also included. Similarly, an exact proportion of female headed households were included via stratification.

Table 1: The distribution of households in the Ethiopian Rural Household Survey, by agro-ecological zone

	Population share in 1994 (percent)	Sample share in 1994 (percent)	Number of villages
Grain plough complex: Northern Highlands	21.2%	20.2%	3
Grain plough complex: Central Highlands	27.7	29.0	4
Grain plough: Arsi/Bale	9.3	14.3	2
Sorghum plough/hoe: Hararghe	9.9	6.6	1
Enset (with or without coffee/cereals)	31.9	29.9	5
Total	100	100	15

Source: Dercon and Hoddinott (2004).

Note: Percentages of population share relate to the rural sedentary population; they exclude pastoralists who account for about 10 percent of total rural population.

3 The PA was responsible for the implementation of land reform following 1974 and held wide ranging powers as a local authority. All land is owned by the government. To obtain land, households have to register with the PA and, thus, lists are maintained of the households who have been allocated land. These household lists were a good source of information for the construction of a sampling frame.

Table 1 gives the details of the sampling frame and the actual proportions in the total sample. Table 2 provides some basic characteristics of these localities. Using Westphal (1976) and Getahun (1978) classifications, Table 1 also shows that population shares within the sample are broadly consistent with the population shares in the three main sedentary farming systems – the plough-based cereals farming systems of the Northern and Central Highlands, mixed plough/hoe cereals farming systems, and farming systems based around enset (a root crop also called false banana) that is grown in southern parts of the country. Note that in 1994, the Central Statistical Office collected a data set as part of the Welfare Monitoring System. Many of the average outcome variables, in terms of health and nutrition, were very similar to the results in the ERHS, suggesting that living conditions in our sample did not differ greatly from those found more generally throughout rural Ethiopia (see Collier *et al*, 1997).

For these reasons, it can be argued that the sampling frame used to select the villages was strictly stratified in the main agro-ecological zones and sub-zones, with one to three villages selected per strata. Further, sample sizes in each village were chosen so as to approximate a self-weighting sample, when considered in terms of farming system: each person (approximately) represents the same number of persons found in the main farming systems as of 1994. However, results should not be regarded as nationally representative. The sample does not include pastoral households or urban areas.[4] Also, the practical aspects associated with running a longitudinal household survey when the sampled localities are as much as 1000km apart in a country where top speeds on the best roads rarely exceed 50km/hour constrained sampling to only 15 communities in a country of thousands of villages. Therefore, while these data can be considered broadly representative of households in non-pastoralist farming systems as of 1994, extrapolation from these results should be done with care.

4 Pastoral areas were excluded, in part, because of the practical difficulties in finding and resurveying such highly mobile households over long periods of time.

Table 2: Characteristics of the sample sites

Survey site	Location	Description	Main crops	Perennial crops?	Mean Rainfall (mm)
Haresaw	Tigray	Poor and vulnerable area.	Cereals	no	558
Geblen	Tigray	Poor and vulnerable area; used to be quite wealthy.	Cereals	no	504
Dinki	N. Shoa	Badly affected by 1984/85 famine; not easily accessible even though near Debre Berhan.	Millet, teff	no	1,664
Debre Berhan	N. Shoa	Highland site. Near town.	Teff, barley, beans	no	919
Yetmen	Gojjam	Near Bichena. Ox-plough cereal farming system of highlands.	Teff, wheat, and beans	no	1,241
Shumsha	S.Wollo	Poor area in neighborhood of airport near Lalibela.	Cereals	no	654
Sirbana Godeti	Shoa	Near Debre Zeit. Rich area. Much targeted by agricultural policy. Cereal, ox-plough system.	Teff	no	672
Adele Keke	Hararghe	Highland site. Drought in 1985/86	Millet, maize, coffee, chat	yes, no food	748
Korodegaga	Arssi	Poor cropping area in neighborhood of rich valley.	Cereals	no	874
Turfe Kechemane	S.Shoa	Near Shashemene. Ox-plough, rich cereal area. Highlands.	Wheat, barley, teff, potatoes	yes, some	812
Imdibir	Shoa (Gurage)	Densely populated enset area.	Enset, chat, coffee, maize	yes, including food	2,205
Aze Deboa	Shoa (Kembata)	Densely populated. Long tradition of substantial seasonal and temporary migration.	Enset, coffee, maize, teff, sorghum	yes, including food	1,509
Addado	Sidamo (Dilla)	Rich coffee producing area; densely populated.	Coffee, enset	yes, including food	1,417
Gara Godo	Sidamo (Wolayta)	Densely packed enset-farming area. Famine in 1983/84. Malaria in mid-88.	Barley, enset	yes, including food	1,245
Doma	Gama Gofa	Resettlement Area (1985); Semi-arid; experienced droughts throughout the 1980s; remote.	Enset, maize	yes, some	1,150

Source: Community survey ERHS, Bevan and Pankhurst (1996), and Dercon and Hoddinott (2004).

An additional round was conducted in late 1994, with further rounds in 1995, 1997, 1999 and 2004. These surveys were conducted, either individually or collectively, by the Economics Department at Addis Ababa University, the Centre for the Study of African Economies, University of Oxford or the International Food Policy Research Institute. Sample attrition between 1994 and 2004 is low, with a loss of only 12.4 percent (or 1.3 percent per year) of the sample over this ten year period, in part because of this institutional continuity.[5] This continuity also helped ensure that questions asked in each round were identical, or very similar, to those asked in previous rounds and that the data were processed in comparable ways.

5 We examined whether this sample attrition is non-random. Over the period 1994-2004, there are no significant differences between attriters and non-attriters in terms of initial levels of characteristics of the head (age, sex), assets (fertile land, all land holdings, cattle), or consumption. However, attriting households were, at baseline, smaller than non-attriting households. Between 1999 and 2004, there are some significant differences by village with one village, Shumsha, having a higher attrition rate than others in the sample. Our survey supervisors recorded the reason why a household could not be traced. Using these data, we examined attrition in Shumsha on a case-by-case basis, but could not find any dominant reason why households attrited.

3. Poverty

In this paper, we will be focusing on poverty defined in terms of consumption. More than any other dimensions of poverty, such as education or child mortality, it tends to be most closely related to changing economic opportunities. It is also the type of poverty that we suspect is most lagging in Ethiopia. Other types of poverty have decreased more rapidly. For example, since 1991, there have been considerable improvements in access to education, with primary gross enrolment rates rising from about 32 percent in 1990, to 37 percent by 1996 and to 61 percent in 2000. The latest figures (for 2004) suggest that it has now increased to 74.2 percent. Primary completion rates are lagging more, but have also picked up from 29 percent in 2000 to 37 percent in 2004. Under five mortality also appears to be on the decline, from 204 in 1990 to 166 in 2000 and currently estimated at 123 in 2005 (World Bank, 2006). Stunting figures for under-fives have also started to decline, from about 66 percent in 1996 to 47 percent, with equally strong declines for boys and girls. In our sampled villages, improvements in enrolment rates, outpacing other improvements, can also be noted.

Consumption is defined as the sum of values of all food items, including purchased meals and non-investment non-food items. The latter are interpreted in a limited way, so that contributions for durables and spending with some investment connotation, such as health and education expenditure, are not included (Hentschel and Lanjouw, 1996). Although there are good conceptual reasons for including use values for durables or housing (Deaton and Zaidi, 2002), we do not do so here; the heterogeneity in terms of age and quality of durables owned by our respondents, together with the near complete absence of a rental market for housing would make the calculation of use values highly arbitrary. Because comparisons of productive and consumer durable holdings between 1994 and 2004 show rising holdings of these durables[6] and comparisons of school enrolment data show significant increases in enrolment, ceteris paribus, our consumption estimates may understate the actual increases in household welfare. These values are expressed in monthly per capita terms and deflated using the food price index with base year 1994.

Estimating levels and changes in poverty requires first setting a poverty line. Here, we use a cost-of-basic-needs approach. Based on the 1994 data, a food poverty line is constructed using a bundle of food items that would provide 2300Kcal per adult per day. To this, we add a non-food bundle using the method set out in Ravallion and Bidani (1994). Dercon and Krishnan (1996; 2003) provide further information on the construction of the poverty line, including details of the food basket and its sensitivity to different sources of data on prices used to value the food basket. The poverty line used in this paper is 50 birr per capita per month in 1994 prices.

6 For example, the percentage of households reporting owning hoes rises from 59 to 79 percent; owning ploughs rises from 79 to 87 per cent; and owning beds rises from 49 to 58 per cent.

Table 3 provides data on mean and median consumption per month per capita, as well as three poverty measures, the head count (P0), the poverty gap (P1) and the squared poverty gap (P2) measure, all belonging to the Foster-Greer-Thorbecke family of poverty measures. Data are presented from 1994, 1995, 1997, 1999 and 2004 (round 1, 3, 4, 5 and 6), thereby excluding the findings from the second round of data collection in 1994, which was mainly meant to provide data on consumption from a different season than most other rounds. As discussed in Dercon and Krishnan (2000), the seasonality of consumption in Ethiopia is high, as reflected in these data,,and since this is not the focus of the paper, the round was dropped from the rest of the analysis. In examining the table, it is important to note that the timing of the 1997 round was also not optimal for comparability – the immediate post-harvest period – and this seasonal consideration together with the fact that 1997 was, in agricultural terms atypically good, has the effect of making the 1997 outcomes look particularly high.

Table 3: Consumption and Poverty

	Mean Consumption per capita	Median Consumption per capita	Head count poverty	Poverty Gap	Squared Poverty Gap
1994	71.1	51.6	0.48	0.21	0.12
1995	62.0	45.3	0.55	0.24	0.14
1997	90.9	70.7	0.33	0.12	0.06
1999	88.3	64.5	0.36	0.13	0.06
2004	91.5	65.1	0.35	0.13	0.07

Calculated from the Ethiopian Rural Household Survey. Head count poverty based on consumption per capita, poverty line 50 birr per month. Consumption in 1994 prices per month. (n=6463)

We can clearly observe considerably lower levels of mean or median consumption per month in the first two years of the survey, compared to 1999 and 2004. Poverty has gone down considerably. The data also suggest that these improvements largely occurred in the 1990s, and not subsequently. Even if we ignore the 1997 data because it is seasonally non-comparable, and a rather exceptional year in agricultural terms, the improvements appear to be clear (including the second round of 1994 would not change this general picture at all).

Consumption growth of the mean was on average 2.6 percent per year, which is not much different from the average rate of growth of GDP per capita (2.1). Even the nature of the fluctuations (1994 and 1995 relatively low compared to 1997, while 1999 and 2004 not very different) are remarkably consistent. But we should be cautious in considering this as a reflection of the national pattern, given that it is not a nationally representative sample. Nevertheless, nationally-applied changes, such as liberalisation, infrastructure investments and agricultural productivity oriented programmes, are likely to have impacted all villages. The

second half of the 1990s was also a period of relatively good weather in most communities, just as in the rest of Ethiopia. The sample also contains a large number of communities affected by the 2002 drought, derailing rural areas across the country, followed by a gradual recovery.

In terms of poverty, the communities experienced large poverty declines, in general. For example, the head-count declined by a quarter, and more for indicators taking into account the extent of poverty. It will remain to be seen whether this general decline will be reflected in forthcoming national data, even though the comparison of the 1995 and 2000 official data suggested smaller poverty declines. The Gini coefficient was also calculated, and, within the data, inequality did not significantly increase during this period (declining from about 0.44 in 1994 to 0.42 in 2004, but generally fluctuating near these values in each round). In short, in our data, growth in consumption was accompanied by substantial poverty declines, especially in the 1990s; while inequality changed little.

It may be argued that this finding does not square with perceptions in Ethiopia in general, nor some other data available, that instead suggest only marginal declines in poverty. The national participatory research on poverty (the PPA) also suggested that poverty declines have been limited. Our data contained some interesting questions and responses that may shed more light on this conflict. In 2004, we asked people to rank themselves (on a scale of 7 steps) as to how poor or rich they were. We also asked, in 2004, at what level they would place themselves thinking back to their circumstances in 1994. We also have the sample's answers to the same question in 1995, i.e. how they described themselves then. Table 4, taken from Dercon and Hoddinott (2006a) gives this evidence and makes interesting reading.

Table 4: Households' perception of poverty status in 2004, in 1994 (as recalled in 2004) and in 1995

	In 2004:		In 1995:
	Just thinking about your own household circumstances, would you describe your household as…?	Ten years ago, would you describe your household as…?	How wealthy do you consider yourself…?
Very rich	0.4	6.2	0.5
Rich	5.9	23.2	5.4
Comfortable	30.4	29.7	19.9
Can manage to get by	29.2	14.9	25.4
Never have quite enough	13.0	8.9	7.9
Poor	19.9	16.6	33.4
Destitute	1.1	0.5	7.6

Source: Ethiopia Rural Household Survey,

Looking at the first column, it is clear that a substantial proportion of households report that they are not particularly well-off: about 35 percent of households report in 2004 to be destitute, poor or never have quite enough. Whilst this percentage is remarkably similar to the percentage of poor measured via consumption, one should realise that these are not necessarily all the same people. The second column gives data on how those sampled in 2004 perceived their poverty in 1994; showing the general reporting of a worsening of circumstances (not unlike that which one often observes in basic, rapid, appraisal-style qualitative reports on poverty). Of our sample, only about 26 percent reported to be poor 10 years earlier, and the reported number of 'rich' or 'very rich' was considerable in this period. This clearly does not square with our quantitative evidence on these communities, nor the qualitative evidence the earlier period. When we asked the same households in 1995 to describe their circumstances, about 49 percent reported to have never quite enough, poor or destitute. This 'panel' of perceptions, contrary to the retrospective evidence, suggests a substantial reduction in poverty; which is surprisingly close to our estimated consumption poverty reduction.

This evidence contains a general lesson: to be careful about mixing quantitative and qualitative evidence, and with believing one to be superior to the other. None of the information is 'wrong' – it just measures something different. It may well be that people do not believe that their economic situation has improved, even if they now mark their situation more favourably than they did in earlier times. In fact, further investigations in Dercon and Hoddinott (2004) suggest that those who perceive themselves to have become better off (based on the retrospective data) not only have a higher present level of consumption and wealth but also have seen their consumption and wealth increase faster than their average community rate. There is nothing 'wrong' or 'right' with this perception, our focus is on a basic monetary/material concept of poverty.

In the rest of the paper, we try to unpack some of the processes behind the changes in consumption and the extent to which they contributed to poverty changes in this period. It is important to note that the data does not simply suggest 'general' growth for all, which lifts everybody up and some above the poverty line. Our data on poverty changes is consistent with other research: while many move out of poverty, others drift into poverty, and, in general, there is much variability in poverty outcomes. For example, about 20 percent are poor in both 1994 and 2004. 27 percent moved out of poverty, and 13 percent moved into poverty. It is always a contentious issue to assess how much of this movement is, in fact, a measurement error, but the econometric approach used in the rest of the paper, which looks for correlates with these movements, will help to show that there is genuine movement, rather than just measurement error behind some of these changes.

There are clearly households in the sample with persistent poverty. For example, Table 5 gives a sense of the number of poverty episodes we pick up for our sample, counting the number of times a household is below the poverty line in consumption terms. Note that since most consumption is in fact food (approximately more than 75 percent), and since, as is customary,

food consumption is measured using a short recall period, it should not come as a surprise that many households were identified at least once above the poverty line. But about 21 percent remained poor throughout or had only once a consumption level above the poverty line, whilst 18 percent were never poor and 22 were poor once. A possible characteristic of 'chronic' poverty is sometimes suggested to be 'three or more times below the poverty line' (Foster, 2007) – on this understanding, it would be about 27 percent of the sample.

Table 5: Poverty episodes 1994 to 2004 (based on 5 rounds)

	Percentage of households (1)	Chronic Poverty Index	Average Squared Poverty Gap per period of poverty
Never Poor	18	0	0
Poor once	22	0.13	0.13
Poor in 2 out of 5 rounds	23	0.32	0.16
Poor in 3 out of 5 rounds	16	0.65	0.22
Poor in 4 out of 5 rounds	14	1.04	0.26
Poor in all rounds	7	1.34	0.27

Source: Ethiopia Rural Household Survey (based on 1187 observation with data in all 5 rounds). Chronic Poverty Index is measure (7) as in Calvo and Dercon, the cumulative sum of the squared poverty index. The final column is the Chronic Poverty Index, divided by the number of periods of poverty.

In Calvo and Dercon (2007), a set of possible chronic poverty measures has been proposed, and its normative characteristics discussed. One such set of measures is the sum of the Foster-Greer-Thorbecke poverty measures. Column (2) gives this based on the within period P2 (severity) of poverty, so the measure is simply the sum of the P2 measures over five periods, given a sense of how bad this ten year period (5 observations) has been. It offers a more comprehensive way of quantifying poverty over time, taking into account the depth of poverty in each period, which simple counting approaches ignore. The final column takes the average of the Chronic Poverty Index, per period of poverty. In other words, it gives a sense of the depth of poverty experienced in each poverty episode by particular groups.

The results are very suggestive. Unsurprisingly, those with more periods in poverty experience more 'chronic' poverty, as measured by the cumulative Chronic Poverty index in column (2). However, the increase is not linear: more episodes do not add to chronic poverty to the same extent. The last column, which gives the average FGT-squared poverty gap index, shows that those experiencing more periods of poverty also experienced the highest severity of poverty, on average. In other words, these people are not just poor more often over these 10 years, their poverty is more severe.

4. Theoretical framework and econometric results

The framework used for the empirical analysis is a standard empirical growth model, allowing for transitional dynamics, inspired by Mankiw *et al*. (1992). We observe i households (i = 1, …, N) across periods t (t = 1, …, T). Similar models were used in some of the work on the ERHS, most notably Dercon (2004), Dercon and Hoddinott (2005) and Dercon, Gilligan, Hoddinott and Woldehanna (2006). Growth rates for household i (ln yit – ln yit-1) are negatively related to initial levels of income (ln yit-1). Let δ represent sources of growth common to all households and X reflect those fixed characteristics of the household, such as location, that also affect growth. Other sources of growth from t to t-1 are exogenous levels of capital stock and access to technologies (kit-1) observed at t-1 both of which are time varying. Lastly, while standard growth models do not allow for transitory shocks such as changes in rainfall (ln Rt – ln Rt-1), we know from previous work with our data (Dercon, 2004; Dercon *et al*, 2005) that such events do have growth effects. One way of thinking about these events is that initial efficiency (the technological coefficient in the underlying production function) may be influenced by period-specific conditions (Temple, 1999) which cause growth rates to deviate from long term trend.

Mindful of the numerous reasons why one should be careful in applying this framework to any context, given the theoretical and empirical assumptions implied by this model (for example, see the reviews by Temple, 1999, or Durlauf *et al*, 1998), and dropping the i subscripts, our basic model is:

$$\ln y_t - \ln y_{t-1} = \delta + \alpha \ln y_{t-1} + \beta \ln k_{t-1} + \gamma(\ln R_t - \ln R_{t-1}) + \lambda X \qquad (1)$$

The focus in the econometric analysis of this paper is to highlight the role played by three factors that may have affected consumption growth in the sample: the expansion in road infrastructure, the extension programme aiming to increase productivity and the role played by the recurrent drought, not least the 2002 drought. We will treat roads and extension as a form of kt-1 with possible subsequent growth effects, and rainfall and other shocks as a source of ln Rt – ln Rt-1.

All households in this sample have access to some sort of road or path. However, the quality of this road varies significantly from all-weather roads suitable for vehicular traffic to mud tracks that can, at best, support foot traffic. The benefits of roads operate through four channels: reducing the costs of acquiring inputs; increasing output prices; reducing the impact of shocks and permitting entry into new, more profitable activities. Given this, and given the data available to us in the survey, we define road access as a dummy variable equalling one, if the household has access to a road capable of supporting truck (and therefore trade) and bus (and therefore facilitating the movement of people) traffic in both the rainy and dry seasons.

Capturing the role played by the agricultural productivity programme is more complicated. The household survey asked households how many times they had been visited by an extension

agent (is this a known term?) during the last main cropping season. Using these data, we create a dummy variable equalling one if the household had received one such visit, zero otherwise. However, it is not a priori clear whether this is the appropriate focus for the role of different programmes for productivity increases. Alongside the extension programme, the 1990s saw a gradual expansion of the input schemes, focusing on supplying fertiliser on seasonal credit. This issue has been discussed at greater length in Dercon and Christaensen (2006a) and in the next section we put the evidence included this section into a broader context.

Figure 4 shows how access to these forms of public investments has changed over the ten year period covered by the ERHS. Initial levels of access to all-weather roads was around 40 per cent, with significant improvements being recorded between 1997 and 1999 and 1999 and 2004. The percentage of households receiving at least one visit from an extension agent triples over this ten year period and it is worth noting that this increase is widely distributed, with 13 of our 15 villages recording an increase in the number of households receiving at least one visit. However, the starting level in 1994 – 5.6 per cent – was stunningly low and most of this improvement occurs between 1994 and 1999. Finally, and for comparison, we added figures for fertiliser use. Fertiliser is arguably one of the key production factors that the extension programme was intended to increase the use of. We do not have access to the application rate data from 2004 for this variable yet, while fertiliser adoption is based on 2003 figures. In any case, it can be seen that adoption and application rates per hectare did not show a strongly increasing trend, despite the spread of the extension programme. This means that we should be cautious about interpreting any finding on the latter.

Table 6: Evolution of roads access, extension, fertiliser use and rainfall

Round	Access to all-weather road	Received at least one extension visit	Used fertiliser in particular year	Fertiliser application in kg per hectare	Percentage change in rainfall relative to previous round
1994	41	5.6	44	35	
1995	41	4.5	37	25	+11%
1997	43	6.8	47	30	+8%
1999	52	12.3	46	32	-13%
2004	68	15.9	45		-2%

Source: Ethiopian Rural Household Survey. Note that fertiliser adoption rate for 2004 is based on 2003 figures

Table 6 also gives data on rainfall, in particular the average percentage change in yearly rainfall of a particular round, compared to the previous round, at the nearest rainfall station near the surveyed communities. As can be seen, in the villages, 1995 was already quite a good year, with 11 percent more rain than in 1994. The background was that in a few villages in the South

in our sample, a drought had taken place leading to local level food security problems in 1994. 1997 was an even better year, with an additional 8 percent of rainfall, compared to 1995. 1999 was in some areas a virtual drought year, although in most areas this was closer to normal, while 2004 was somewhat below normal in most areas. In any case, the data suggests serious variability in rainfall between survey years. Our data show the impact of particular drought years in between rounds of the survey. The most striking one is 2002. In the data, we also asked people to report between rounds whether serious events had occurred that affect wealth or living standards. In the sample, 52 percent reported to have suffered from drought at some point between 1999 and 2004. In the next section, we discuss these types of shocks and the responses, although in the regressions, we only used rainfall to ensure complete comparability between rounds. We also added other types shocks to the regression, including whether a death or a serious illness was experienced, since the last round, as well as whether input price declines or output price increases had affected the household seriously.

A number of econometric issues need to be resolved before the analysis can be attempted. A brief discussion is reported in the appendix to this paper, and ignored in the main text. More details can also be found in Dercon, Gilligan, Hoddinott and Woldehanna (2006). Table 6 shows the results of estimating (1) using a GMM-IV-HFE for growth in consumption (expressed per annum). It also shows the results using as dependent variable the change in poverty status (whether the household is poor at t minus whether the household is poor at t-1). The last outcome is not, strictly speaking, a direct product of a growth regression. Rather, it can be thought of as an extension of the consumption growth regressions. While these growth regressions show the average effect of public investments across the whole sample, the poverty regressions give us, in a crude way, insights into the distributional effects of these investments – specifically whether they are of sufficient magnitude to pull poor households out of poverty. The left hand side takes on three values: 1, 0 or -1, depending on the direction of the change (into poverty or out of it).

Table 7: Instrumental Variables – Household Fixed Effects: Determinants of crop consumption growth and change in poverty status

	Annualised Growth in Consumption per capita	Change in Poverty Status
	(1)	(2)
Log consumption (IV)	-0.365 (9.03)**	-0.148 (3.64)**
Access to all-weather road	0.159 (5.14)**	-0.067 (2.11)**
Received visit from extension officer	0.071 (1.91)*	-0.098 (2.54)**
Rainfall shocks	0.173 (4.37)**	-0.057 (1.70)*
Input price shocks	-0.116 (0.89)	-0.046 (0.39)
Output price shocks	0.069 (0.41)	-0.079 (0.48)
Death shocks	-0.149 (1.80)*	0.071 (0.98)
Illness shocks	-0.108 (1.14)	0.084 (0.99)
Diagnostic statistics		
F stat on first stage instruments	87.64**	87.64**
Cragg-Donald F stat	103.00**	103.00**
Hansen J test	4.59	0.89
Sample size	4771	4771

Notes:

1. Lagged endogenous variables are expressed in real per adult equivalent terms. 2. Instruments for lagged endogenous variables are lagged log livestock units per adult equivalent, lagged log number of adult equivalents and lagged log cultivable land per adult equivalent. 3. A dummy variable if survey conducted in post harvest period is included but not reported. 4. Absolute values of z stats in parentheses; 5. * significant at 10% level; ** significant at 5% level. Source regressions (1) and (2): Dercon, Gilligan, Hoddinott and Woldehanna (2006).

The regression results suggest impacts in the expected directions. Roads, extension and some shocks matter. As other studies have found, consumption is sensitive to rainfall and cannot be kept smooth in the face of it. This regression suggests that 10 percent more rainfall increases consumption by 1.7 percent. Rainfall is therefore one crucial source of variability. Of the other shocks, only death shocks appear to be significant – seemingly contributing to 15 percentage point losses in growth. Roads appear to have mattered a lot in terms of explaining differential growth. Those with access to a road appear to have almost 16 percent higher growth per year

than those without. Given the nature of the overall growth (a few percent per year in per capita terms), this is clearly a crucial factor explaining divergence between communities. Another way to look at the evidence is that the data in Table 6 suggests that a 27 percent increase in numbers of households with good roads, from 1994, constituting a growth acceleration of about 4 percent in our sample. As the poverty regression shows, road access has contributed to poverty reduction. Finally, we find positive growth and negative poverty impacts from extension services. Of course, by 2004, we are still talking only about 16 percent of the households but for them it appears to have contributed to consumption growth and poverty declines. Between 1994 and 2004, it contributed to about 0.7 percent higher growth, relatively small but nevertheless significant.

We need to be careful in the interpretation of these regressions, not least in terms of policy. A typical objection may be that roads may be built in rich areas, or extension may take place in areas with good agricultural potential. This is not a problem for our analysis: by using changes in consumption and poverty, we effectively control for fixed 'placement' effects (fixed factors that not only determine who gets roads or extension, but also consumption and poverty directly). However, time-varying heterogeneity may still be a problem: roads may be built, and extensions services may be targeted to, areas with high growth potential. Furthermore, as already mentioned, we should be cautious about the nature of the agricultural productivity programme. Finally, risk may have longer term effects not captured in the regression, and safety net policies have long been used to address shocks and their implications, so a more complete assessment would need to take into account evidence on these programmes.

In the Section 6, we provide further evidence of the impact of policies and risk on consumption and poverty, on the basis of other research on the same data set. We do this in order to assess the robustness of our findings and of our interpretations thereof. First, however, in Section 5, we explore the relevance of this evidence on growth for the chronically (or persistent) poor.

5. Growth and the Chronically Poor

Whilst Table 7 provides suggestive evidence on the determinants of the growth process in this period, it is of interest to explore whether the 'persistent' or 'chronically poor' faced similar conditions. This is explored in Table 8. First, we investigate whether those observed as being 'chronically poor', in the sense of experiencing at least 3 periods of poverty in the five years of data, behaved differently from those who were not categorised as such. In other words, did they experience another growth trajectory because they cannot benefit from roads or extension services, for example, in the same way, or is their growth trajectory different because they simply had fewer roads or extension services (or more negative shocks)? To explore this, we interact these independent variables (and the shocks) with whether the household was 'chronically poor' in this period. As this variable is an outcome of the whole period, we should be cautious in interpreting the results, as we are faced with a simultaneity problem. However, it can at least offer suggestive evidence on the differences between the chronically and non-chronically poor during this period, in terms of their growth behaviour.

The results suggest that those experiencing more systematic, chronic poverty, in the form of three or more documented periods below the poverty line, have not been following a different growth trajectory in nature. The only significant effect that we could find when using the interaction terms is that the 'chronically' poor had somewhat lower sensitivity to rainfall.[7] But for the core variables used to capture the growth process – the role of infrastructure and extension – we find no significant differences between the chronically poor and the rest. However, as the interaction variable uses information that is the outcome of the growth process (consumption levels at t+1, t+2, etc), the results need to be treated with caution.

Table 8: Instrumental Variables – Household Fixed Effects: Did the chronically poor face different determinants of consumption growth?

	Annualised Growth in Consumption per capita with chronically poverty interaction effects	Annual Annualised Growth in Consumption per capita with 'low endowments' interactions	Annual Annualised Growth in Consumption per capita with 'low endowments and remoteness' interactions
	(1)	(2)	(3)
Log consumption (IV)	-0.353	-0.359	-0.355
	(8.55)**	(8.81)**	(8.53)**
Access to all-weather road	0.162	0.188	0.200

7 One possible explanation is that because their level of consumption is lower, they can bear less downside risk, and they are engaged in activities that are low risk at the cost of lower returns, limiting the fluctuations ex-post in consumption.

	(4.60)**	(4.18)**	(4.89)**
Received visit from extension officer	0.094	0.073	0.087
	(1.81)*	(1.29)	(1.84)*
Rainfall shocks	0.239	0.433	0.361
	(4.06)**	(6.03)**	(6.03)**
Input price shocks	-0.245	-0.185	-0.199
	(1.43)	(0.92)	(1.05)
Output price shocks	-0.148	-0.029	-0.01
	(0.70)	(0.06)	(0.03)
Death shocks	-0.060	-0.161	-0.059
	(0.53)	(1.54)	(0.54)
Illness shocks	-0.159	-0.141	-0.132
	(1.23)	(1.05)	(1.06)
Access to all-weather road	-0.012	-0.015	-0.036
	(0.17)	(0.26)	(0.63)
Received visit from extension officer	-0.042	0.008	-0.015
	(0.55)	(0.10)	(0.20)
Rainfall shocks	-0.143	-0.341	-0.297
	(1.71)*	(3.95)**	(3.57)**
Input price shocks	0.189	0.118	0.129
	(0.68)	(0.42)	(0.46)
Output price shocks	0.470	-0.007	-0.01
	(1.21)	(0.01)	(0.03)
Death shocks	-0.193	0.03	-0.198
	(1.15)	(0.18)	(1.15)
Illness shocks	0.117	0.122	0.088
	(0.58)	(0.62)	(0.44)
Sample size	4578	4578	4578

Notes: Specification as in Table 7, column (1). See relevant footnotes. Absolute values of z stats in parentheses; 5. * significant at 10% level; ** significant at 5% level. (1) interactions are whether the household is chronically poor, defined as three or more times poor in the sample. (2) interactions are whether the household is below the median for livestock per capita and for land holdings per capita. (3) below median for livestock per capita and for land holdings per capita, and below primary or no education, and 'remote': either far from town (highest quartile in terms of furthest distance to town) or no access to road for trucks/bus.

Before returning to columns (2) and (3) in Table 8, and in order to get around these problems, we explore in Table 9 the initial (1994) characteristics of those households who subsequently were observed to face 'chronic poverty'. This is done by regressing whether a household is chronically poor in 1994-2004 (with three or more episodes of poverty) on a set of households and community characteristics in 1994. While we have to be careful to attach causality, as unobserved heterogeneity cannot be controlled for, as it is based on cross-section data, the

results are nevertheless suggestive. In terms of household characteristics, we include levels of land per capita (in natural logarithms of hectares per capita)[8], education of the head (whether primary or more had been completed, and whether some level of primary education at least had been completed)[9], household composition (the number of adults above 15 years of age, the number elderly above 65, children below 5 and children between 5 and 15, all disaggregated by sex), and the sex of the head (male equals one).[10] Table 9 reports the marginal effects of probit regressions being observed of the chronically poor in our villages. The first column controls for village dummies, i.e. fixed effects, absorbing any factors contributing to village-wide chronic poverty. The advantage is that the household level effects can be estimated without bias related to inter-community heterogeneity (e.g. such as climatic conditions or access). The second column controls for these factors explicitly, thereby unpacking the community-wide determinants of chronic poverty. As it is a cross-section regression based on 15 communities, the degree of freedom to identify the community-wide variables are limited. We experimented with different possible characteristics, and the factors that were both stable across specifications and left the household characteristics unaffected are included in Table 9: distance in kilometres to the nearest town, whether the road was capable to handling trucks and buses, the coefficient of variation of yearly rainfall (based on typically about 25 years of data) and village-wide averages of endowments in terms of mean land holdings per capita, and mean number of male and female adults per household in the village.[11] As a cross-section regression, this does not control for other unobserved heterogeneity, so the interpretation has to be done cautiously. Nevertheless, the results are interesting.

With or without village fixed effects, the marginal effects of the household characteristics are similar. However, the village fixed effects (not reported) are suggestive in themselves. Compare two households, one living in in Sirbana Godeti (not far from the large trading town Debre Zeit) and the other living in Gara Godo (an enset growing village in Wolayta), but with otherwise the same household characteristics. Then table 9 suggests that the latter are 80 percent more likely to be chronically poor than the former. One household characteristic that appears significant is education: of those households, surveyed in 1994, with heads that had completed primary education, the probability of being found chronically poor in 1994-2004 was more than a fifth

8 Less than two percent of our sample reported to have no land at baseline, usually households that set up independently before receiving land from the local government (Peasant Association), and sharecropping on other people's land. To account for this, while allowing logarithms to be taken, we added 0.01 to everybody's land holdings, as if they have a small garden plot of 10 by 10 square meter, which in practice most people have around their house, although farmers usually do not count these when reporting their land.

9 Education levels are extremely low in this sample (and in Ethiopia by the early 1990s): 9 percent of the household heads completed at least primary education, while 15 percent had some incomplete primary school education. The rest had never attended school.

10 Livestock is not included, not because it did not matter, but in terms of all the relevant effects, it appeared to cause multicollinearity with land (as per capita livestock and ln land per capita have a correlation coefficient 0.76 in the data). If either was included without the other, the effects were virtually identical, while both resulted in insignificant results.

11 The village-wide mean values of land per capita and adults per household were relevant for the stability of the results on other village-wide variables, probably reflecting relative land and labour scarcity.

lower than those without such heads. Land matters as well, although not as much in percentage terms: doubling land (which implies increasing land by just under one standard deviation in the land distribution) would reduce the probability of being chronically poor by about 5 percent. There are surprisingly strong effects of having children: they increase the likelihood of being found chronically poor in this period, with children below 5 and especially girls adding most. We explored whether this effect is due to the use of a poverty definition based on consumption per capita, which would 'penalise' families with children relatively more by understating their likely consumption, as children have lower basic food needs. However, even using consumption per adult as the basis for poverty showed the same effect, even if all children and not just younger children were similarly costly in terms of increasing the likelihood of being chronically poor. As economies of scale are also possible, we have to be careful not to attach too much importance to this result, but the sheer size makes scale economies not a very plausible: ceteris paribus, another child appears to increase the probability of being found 'chronically poor' by up to 8.4 percent.

Turning to the community characteristics in column (2), the role of road access and distance to towns is striking: having a good road reduces the likelihood being found chronically poor by 37 percent, while a reduced distance to the nearest small town by about 12 kilometres (which is moving from the 75 percentile to the 25th percentile) also brings down the probability of being chronically poor by about 38 percent. Rainfall variability, the simplest measure of 'risk' faced by different communities, is also found to be highly significant, but its impact is actually relatively small: moving from the 75th to the 25th percentile would reduce the probability of being chronically poor by about 1 percent. Finally, it should be noted that the land result reported earlier is relative, as villages in the sample with more land per capita (possibly a sign of poor land quality or agro-climatic conditions, sustaining low population densities) are more likely to have high chronically poverty. Also, villages with higher relative numbers of female adults (in the sample a sign of high past involvement in conflict resulting in a high male death rate, e.g. in the Tigrayan villages, as well as some of the Oromo villages) appear much more likely to be chronically poor. As mentioned before, with only 15 communities, we have to be cautious with attaching to strong an interpretation to these results. Column (3) reports an alternative way of exploring the correlates of chronic poverty, using the index that takes into account the severity of poverty in each period. In terms of the factors that matter, the results are (surprisingly) similar adding credence that these factors matter for different ways of looking at poverty persistence.

Table 9: Correlates of chronic poverty and the fixed effects of the growth model

	Chronically Poor Probit with village dummies dF/dx	Chronically Poor Probit dF/dx	Chronically Poor Index Tobit	Fixed 'growth' effect OLS
	(1)	(2)	(3)	(4)
Education primary or more	-0.211	-0.209	-0.268	0.052
	(3.75)**	(3.89)**	(4.66)**	(2.00)*
Sme educ., below primary	-0.022	-0.024	-0.100	0.004
	(0.46)	(0.56)	(2.39)*	(0.21)
Ln land holding p.c. in ha	-0.048	-0.058	-0.095	0.052
	(2.19)*	(2.84)**	(4.89)**	(4.08)**
Sex of head	-0.017	-0.01	-0.034	-0.017
	(0.34)	(0.22)	(0.83)	(0.78)
No. female adults 15-65	0.011	0.007	0.048	-0.017
	(0.63)	(0.46)	(3.32)	(1.62)
No. girls 5-15	0.067	0.056	0.027	-0.036
	(3.91)**	(3.52)**	(1.84)	(3.72)**
No. girls below 5	0.112	0.097	0.105	-0.026
	(4.28)**	(3.97)**	(4.83)**	(1.43)
No. females >65	0.029	0.014	0.022	-0.014
	(0.49)	(0.25)	(0.46)	(0.55)
No. male adults 15-65	-0.001	0.005	0.002	-0.029
	(0.05)	(0.30)	(0.12)	(3.27)**
No. boys 5-15	0.054	0.046	0.070	-0.039
	(3.20)**	(2.91)**	(4.85)**	(3.89)**
No. boys below 5	0.084	0.07	0.109	-0.013
	(3.22)**	(2.85)**	(4.88)**	(0.68)
No. males >65	-0.046	-0.029	-0.031	0.007
	(0.54)	(0.36)	(0.43)	(0.24)
Village characteristics				
Distance to nearest town in km		0.032	0.030	-0.005
		(9.64)**	(10.43)**	(3.68)**
Coefficient of variation of rain		0.008	0.008	-0.002
		(4.29)**	(4.82)**	(2.63)**
Road accessible to trucks/buses		-0.374	-0.361	-0.01
		(8.24)**	(8.66)**	(0.43)

Ln mean land holding p.c.		0.152	0.253	-0.056
		(3.18)**	(5.64)**	(2.57)*
Mean no. of male adults per hh		0.132	0.193	-0.025
		(1.18)	(1.87)	(0.49)
Mean no. of female ad. per hh		0.511	0.938	-0.155
		(4.91)**	(9.93)**	(3.47)**
Constant			-1.058	0.532
			(9.14)**	(9.81)**
Village dummies included but not reported	x			
Diagnostic statistics				
R2 or Pseudo R2	0.359	0.284	0.277	0.202
Sample size	1102	1125	1125	1125

Notes:

Absolute values of z stats in parentheses; * significant at 10% level; ** significant at 5% level.

(1) +(2) marginal effects from probit regression with dependent variable whether chronically poor defined as three or more times poor in the sample 1994-2004. Marginal effects for discrete variables are changes from zero to one); for continuous variables they are changes by one. (3) Tobit regression unconditional marginal effects base on chronically poverty index, column (2) in table 5. (4) OLS regression of fixed effect from table 6, column (1), retrieved using xtivreg command in STATA, given the household specific constant growth rate between 1994 and 2004. Sample restricted to households for which chronically poverty is fully defined. (1), (2) and (3) use characteristics in first year of the data, 1994. (4), in keeping with logic of fixed effects model gives mean values across the sample period.

In short, we find that chronic poverty is correlated to a number of household and community endowments (including: education, productive assets such as land, as well as factors affecting 'remoteness' such as distance to towns and road access). With this data, we can revisit Table 8, and again ask whether the estimated growth relationship really is not different for the chronically poor and the rest. As the regression in Table 8, column (1), was flawed due to endogeneity problems, we follow another approach. If we divide the sample on the basis of 1994 characteristics, that we know are subsequently correlated with chronic poverty, can we detect different trajectories? This is done in Table 8, columns (2) and (3). Even though there is some element of arbitrariness in dividing the sample, the results are remarkably robust across specifications. Column (2) defined 'chronically poor' as those with relatively low productive assets (below the median in both land and livestock per capita). This would make about half the sample as 'chronically poor' (compared to 37 percent using the definition of three or more times poor). Column (3) restricts this further by excluding from those below the mean in both land and livestock, also those with at least primary education, and by restricting the chronically poor to those that are also either not having access to a good road for trucks and buses, or those who are living far from a town (in the highest quartile in terms of distance to town in the sample). These restrictions result in approximately 38 percent being chronically poor. These are not necessarily the same as those included in our earlier definition of the chronically poor, but there is a significant correlation between the numbers on these indicators and those on the chronically

poor definition used earlier (34 percent and 41 percent for the definitions used in (2) and (3)). The results are remarkably stable across the three specifications in Table 8: roads and extension appear significant in this period, but not differently so for the 'chronically' and 'non-chronically poor'. Rainfall appears to have been less significant for the chronically poor.[12]

On the basis of the evidence, are the chronically poor then just like the others, only poorer? Will growth, for example via the expansion of roads and extension services then lift them up as fast as it will aid the non-poor? Table 10 shows poverty, road access and extension access for the chronically poor versus the rest of the sample. Head count poverty among the chronically poor has been falling gradually, from peaks in early year where most of the 'chronically poor' where also observed to be below the poverty line. Poverty amongst the other groups was falling to lower levels till 1997. It has increased since, but to levels higher than those of 1994. The (slow) expansion of extension is correlated with this, while for the non-poor road access improved gradually. Strikingly, by 2004, both access to roads and to extension is not different for the chronically and non-chronically poor. As the statistical exercise in Table 7 linked the importance of initial levels of roads to their subsequent impact on growth, then, according to the models in Tables 7 and 9, the recent expansion (between 1999 and 2004) of roads for the chronically poor is likely to result in a further considerable improvement in living standards for the chronically poor in years post 2004.

Table 10: Evolution of roads access, extension, fertiliser use and rainfall

Round	Head count Poverty		Received at least one extension visit		Access to all-weather road (trucks/buses)	
	Chronically poor	Non-chronically poor	Chronically poor	Non-chronically poor	Chronically poor	Non-chronically poor
1994	0.83	0.27	0.05	0.07	0.26	0.54
1995	0.93	0.33	0.02	0.06	0.26	0.54
1997	0.70	0.12	0.06	0.08	0.23	0.59
1999	0.68	0.17	0.16	0.11	0.25	0.72
2004	0.62	0.19	0.15	0.15	0.68	0.70

Source: Ethiopian Rural Household Survey

But this is not the whole story. The models in Tables 7 and 9 are fixed effects models, implying that they control for household heterogeneity in the underlying growth rate. In other words,

12 Combined with the results in Table 9, a risk-related explanation could be proposed. As risk mattered to explain who is chronic poor (with the coefficient of variation of rainfall significant), the chronic poor may have made decisions to become less sensitive to risk. However, this can only be speculation without further investigation, beyond the scope of this paper.

beyond the factors modelled, each household has its own 'unexplained', latent part of growth. These fixed effects can be trivially estimated from the regression results in linear models, as effectively all coefficients needed to identify the fixed effects are estimated. Using model (1) in Table 7, we find that the average fixed effects for the chronically poor is -15.4 percent per year, while for the non-chronically poor it is 9.2 percent per year; these means are strongly significantly different from each other at 1 percent and less. In other words, for the same values of shocks, or roads or extension visits, the growth difference between these two groups is estimated to be almost 25 percent. In general, the correlation between the fixed effect and whether one is chronically poor or not, or with the chronic poverty index that allows for the severity of chronic poverty, is very high (respectively -0.47 and -0.50). In other words, the chronically poor face a serious growth deficit, making catching up with the rest very difficult – in terms of time-varying characteristics, they need much 'better' values to obtain the same level of growth as the non-chronically poor.

What determines this fixed effect? As it is possible to retrieve the fixed growth effect from the regressions, it is also possible to study some of the correlates of this fixed effect. However, as this is a cross-section, one needs to be cautious not to over-interpret the results. The results are reported in the last column in Table 9.[13] The most striking result from said table is that the main correlates for lower chronic poverty are the correlates for a higher fixed effect. For example, moving from the 25th to the 75th percentile in terms of distance to town would cost 6 percent in latent growth. Strikingly, unlike remoteness, access to roads is not a significant part the latent growth effect. In sum, the evidence suggests that the chronically poor tend to have the same return from growth stimulating factors, such as improved infrastructure or extension. Overall, however, the chronically poor appear to start from a serious growth handicap, linked to physical assets, education and remoteness, contributing to poverty persistence, and being left behind, in relative terms. This fixed growth handicap is the micro-econometric equivalent of showing 'club' convergence, whereby the initial characteristics matter permanently for long-term outcomes.

13 As the 'fixed effect' estimator is obtained by subtracting all time invariant information from time variant information, the fixed effect itself contains all this time-invariant information, including the mean levels of all time variant variables in the sample period. As a result, it is closer to the spirit of the fixed effect estimator to correlate the fixed effect with household and community level means across the entire sample period, rather than just the initial period. This is done in Table9.

6. Further interpretation and conclusions

The regression analysis above tells us something about the factors that appear to have contributed to the growth in consumption and poverty reduction. Rainfall shocks caused variability, but extension and especially road infrastructure appear to be rather strongly correlated with growth in consumption and poverty reduction, at least in our sample. In Dercon, Gilligan, Hoddinott and Woldehanna (2006), it is shown that these results are robust to a wide number of econometric robustness tests. Other research has helped to provide further evidence and means of interpretation of these findings, and will be taken in turn.

6.1 Roads

Much of the earlier work on the ERHS had found these strong correlations between road infrastructure and consumption and poverty. For example, Dercon (2006), focusing on the period 1989 to 1995 in the 6 villages of the ERHS for which data for 1989 was also available, found that road and access to towns together were the most important factors explaining consumption growth in this period, and crucially for poverty reduction: those with poor road infrastructure and urban links stayed behind in this initial period of recovery from the worst times of the 1980s. Furthermore, Dercon (2004), focusing on the same communities until 1997, used estimators allowing for dynamic heterogeneity, so that placement effects are better addressed but the coefficient on the micro-growth regression is very close to those obtained for the full sample and all rounds in Table 7.

Better roads in these localities make it easier for households to access local market towns which are in turn linked to larger urban centres. Dercon and Hoddinott (2005) document the myriad economic links between these survey sites and these market towns. They show that in 2004, roughly half of households purchasing inputs for crops in the Meher (long rain) and Belg (short rain) seasons do so in local market towns. About 40 per cent of households purchase inputs for livestock, such as feed, in these localities. Four crops are grown widely in this sample (teff, wheat, maize and eucalyptus), and there is considerable variation in location of sale: ranging from 24 per cent (eucalyptus) to 59 per cent (wheat) being sold in local market towns. Most notably, the vast majority of livestock and livestock products are sold in local market towns. Artisan products made by villagers (particularly by women), such as handicrafts, are typically sold in local market towns. Lastly, more than half the purchases of goods for consumption occur in local market towns. Dercon and Hoddinott (2005) also show that improvements in road quality increase the likelihood of purchasing crop inputs such as fertiliser (by 29 to 34 per cent, depending on the season) and, for women, selling artisan products (by 39 per cent). In other words, the growth impact of roads appears to work via impacts on both agricultural and non-agricultural activities.

The presence of these growth effects from good roads also has to be understood in the context of the economic context of the 1990s and beyond. During this period, domestic market liberalisation took a firm hold, after the repression of market activity in the 1980s. The high effects from roads, observed in Table 7, are then difficult to disentangle from the direct impact from improved market opportunities, which roads allow people to take advantage of. In Dercon (2006), an analysis was presented that specifically tried to disentangle the role played by the market liberalisation between 1989 and 1994. Market liberalisation is identified via relative price changes in the net terms of trade faced by farmers, allowing for differential impact for deficit farmers. It is found that relative price changes, linked to devaluation and food market liberalisation, on average moved terms of trade in favour of most of the rural areas covered, but, as is to be expected, not all. It is found that the relative price changes are the single most important factor explaining (relatively large) poverty reductions in this period in the sample, while also helping to explain why some farmers appear to have lost in this process. In any case, while road access is correlated with favourable price movements, the results also suggested that better road access provided an alternative route for local growth and poverty reduction beyond effects captured by producer prices.

6.2 Agricultural productivity programmes

Understanding why agricultural extension has positive impacts is trickier because, apart from the 1999 survey round, we have little direct information on exactly what information is imparted by agents to farmers. The 1999 survey asked farmers to describe the two most important activities of extension agents. Being a source of information about the usage of modern inputs was ranked by 62 per cent of respondents as being the most important activity and a further 10 per cent of respondents listed this as their second most important activity. A source of knowledge about new cultivation practices was listed by 16 per cent of households as extension agents, while 46 per cent listed this as their second most important activity. Further, amongst households using a modern input such as fertilisers, 56 per cent reported that they were encouraged to do so by extension agents. We also computed Pearson correlation coefficients for the use of fertiliser and receipt of at least one visit by an extension agent. In 1994, this relationship was weak, with the Pearson correlation coefficient equalling 0.07. However, by 2004 this association appeared much stronger with the Pearson correlation coefficient equalling 0.27 and being significant at the 1% level. Given this, drawing implications from our results on agricultural extension should be done cautiously. Some of the effect may represent transfers of technology or knowledge, while some of the effect may reflect the influence that extension agents have in terms of increased use of fertiliser and other inputs.

The lack of systematic increase in fertiliser also illustrates the weaknesses of these programmes in creating durable growth effects. In Dercon and Christiaensen (2006a), the

impact of fertiliser on poverty has been analysed further, and it was found that between 1994 and 1999, fertiliser is correlated with higher consumption levels, controlling for fixed effects and village-level time varying fixed effects (i.e. time dummies . Just as in the regressions in Table 7, this means that all fixed household characteristics, such as wealth or access to good quality land, are controlled for, reducing some of the concerns for 'placement' effects (so that fertiliser use is endogenous to poverty and consumption). Furthermore, the village-level time-varying fixed effects control for price or other village-wide effects. But in simulations, they can show that given the variability of fertiliser use, the role of fertiliser in explaining poverty changes is significant but quantitatively very limited.

This variability of uptake is further discussed in Dercon and Christiaensen (2006b). Fertiliser is a high return but high risk technology. More specifically, substantial working capital has to be invested, which, on average, yields high returns, but if the harvest fails, these costs are substantial. It is found that there is strong correlation between a farmer's recent wealth position combined with their ability to cope with risk on the one hand, and the uptake of fertiliser. In other words, consumption risk if the harvest fails is high, farmers do not want to expose themselves to this risk, and so settle for the less risky strategy of not using fertiliser. This is not addressed by the particular fertiliser programmes run in this period: fertiliser was offered on credit, but repayment of these loans was harshly enforced even if the harvest failed. The policy implication is that it would have made a lot of sense to offer forms of insurance on these loans, e.g. some drought insurance, whereby repayment could be delayed or cancelled in case of serious (local or national) droughts. No scheme was operational during for example the 2002 drought, and possibly affected future uptake of modern inputs considerably.

6.3 Risk and safety nets

The role of risk is not confined to input adoption or causing variability in outcomes related to rainfall. Dercon, Hoddinott and Woldehanna (2005) analysed the variety of shocks affecting households in more detail, focusing on the last two rounds, 1999 and 2004. In the survey in 2004, people were asked whether their household had experienced a serious loss of income or wealth during the last five year. The three most important shocks reported, by the 95 percent of households reporting at least one serious shock, are listed in Table 11. It can be seen that there is quite a variety of shocks that are reported, even though drought tops the list, closely followed by a death in the close family.

Table 11: Household self-reports of the worst shocks experienced between 1999 and 2004

Most commonly reported worst shocks	Percent
Drought	46.8
Death of head, spouse or another person	42.7
Illness of head, spouse or another person	28.1
Inability to sell outputs or decreases in output prices	14.5
Pests or diseases that affected crops	13.8
Crime	12.7
Difficulty in obtaining inputs or increases in input prices	11.3
Policy/political shocks (land redistribution, state confiscation of assets, resettlement, villagisation, or forced migration, bans on migration, forced contributions, or arbitrary taxation)	7.4
Pests or diseases that affected livestock	7.0

The links between these shocks and the consumption outcomes in 2004 (controlling for the consumption position in 1999) was explored in a regression not dissimilar to the regression for the full sample in Table 7. It was found that drought had a significant impact, leading to consumption decreases by about 16 percent ceteris paribus. Other shocks mattered as well in this period, with effects of approximately similar order of magnitudes occurring when output prices collapsed for some (most notably for maize prices in 2003), or when non-agricultural activities were affected by a drop in demand. Shocks resulting from the illness of a close family member were also found to be significant.

This does not only suggest that shocks cause some fluctuations in household consumption outcomes with implications for poverty. Given that we are dealing, in this analysis, with a five year period during which shocks occur, it also means that there is no full recovery from some of these shocks. For example, the main drought period was 2002, so it means that 2 years later, consumption was still considerably lower due to the drought shock, and recovery is not (yet) accomplished in this period. In other words, there is some persistence. This result is reminiscent of another finding using a sub-sample from 6 villages for which data was available from 1989 (and using data from 1989, 1994 and 1997). Dercon (2005) showed in a specification, again similar to the model in Table 7, that there was a negative persistent effect of rainfall shocks occurring in the preceding interval between data point (for example, growth in 1994 to 1997 is affected by shocks occurring between 1989 and 1994). Furthermore, there is a long-term persistent growth effect from the famine in 1984-85: those who are found to have been seriously affected by this famine had 10-15 percentage points lower growth per annum in the 1990s than the other households, considerably increasing their likelihood to remain poor. Risk is not therefore not just causing fluctuations in outcomes, but contributes to a serious persistence in poverty. The evidence in Dercon and Christiaensen (2006) reinforces this even more, since they show that the uptake of a high return input (fertiliser) – one possible way of earning more

income and helping to be lifted out of poverty – is considerably hindered by the fear of a poor consumption outcome in the next period due to risk. So risk is contributing further to the persistence in poverty, by encouraging the avoidance of risky activities (even if they have a high mean return).

This also suggests that from a policy point of view, the performance of any measure that decreases negative shocks to incomes and/or consumption due to risk is crucial. In Ethiopia, there is a long history of safety nets in the form of food aid and food-for-work, and in our villages, schemes have been active over the course of the survey, allowing an assessment of their contribution to the reduction of poverty and to the amelioration of incomes and livelihoods. Based on the data from the early rounds of the survey (1994-95), Dercon and Krishnan (2003) found that the presence of food aid or food-for-work programmes in a particular village was not easily predicted: programmes appeared to come in, at times allocating support to large numbers of people, and then, despite continuing high poverty or poor rains, no programme could be detected in the data. Food-for-work programmes appeared to be better targeted across villages than food aid distribution programmes. Within villages, the targeting towards poorer groups appears more effective for food aid, than for food-for-work programmes. Finally, there is evidence of village-wide spill-over effects: food aid and food-for-work programmes have a consumption effect beyond the direct beneficiaries. The effect cannot be explained by relative price changes (for example, food becoming cheaper). This would be consistent with the existence of mutual support systems in the community (Dercon and Krishnan, 2003). It would also suggest that the impact of poor targeting is reduced, since there are local mechanisms to compensate for this poor targeting.

Gilligan and Hoddinott (2006) apply specific evaluation techniques into the issue of food-aid and food-for-work focusing on the experience during the 2002 drought and crisis, and its impact on consumption 18 months later. Food-for-work appears to have benefited households in the middle and upper tail of the consumption distribution, while free food distribution benefited the poorest. Both programmes contributed to growth in food consumption. The results in their paper support the presence of accumulated and persistent effects of food aid received in the first 12 months after the drought. Just as drought can have persistent effects (as in Dercon, Hoddinott and Woldehanna, 2005 and Dercon, 2005), so too can providing support during drought.

6.4 Land

A final crucial policy issue, not well captured by the regression analysis above, relates to land. Land has long been one of the most sensitive political issues. Since the land reform in 1976, all Ethiopian land has been state-owned, while farmers are offered user rights to land via their local Peasant Association. All sales, mortgaging or exchange of land is illegal. After the first land redistribution, land continued to be regularly redistributed, including to newly-formed households. This structure was confirmed in the new constitution of 1996, even though a

commitment was made to make land rights more long term, while sharecropping and rental, widely practiced throughout the country, were made legal. Nevertheless, land tenure insecurity remained, especially after the relatively large scale land reform in Amhara region in 1997/98, when land was redistributed to ex-soldiers and others. Furthermore, a diverging pattern becomes plausible since the implementation of land policy was made a regional matter after 1996. The result is that people's ability to plan in the long-term on their land is curtailed, with likely implications for long-term investment patterns. The ERHS has been asking questions on these matters since 1997 to the panel households, and the results are remarkable. Even though the 1996 constitution promised long-term user rights, with the right to inherit or pass on the land rights to others, as long as it was not via a market transaction, most households still consider themselves only to have limited transfer rights. Dercon and Krishnan (1996) reported that farmers only considered that about 55 to 60 percent of the plots they were cultivating had some security of tenure in terms of transfer rights in 1997, 1999 and 2004 (Table 9). In 1999, 12 percent of households expected to lose land in the next five years; by 2004 this figure was 6 percent. There is also an increasing deviation between regions in perceived rights. In Amhara Region, a sixth of the farmers expected to lose land in the next five years in 1999. These perceived risks are not imaginary. By 2004, about 43 percent of the households in the sample had reported to have lost land since 1976, with 71 percent of the households in the sample in Amhara region reporting to having lost land. 20 percent of the households in Amhara Region in the sample were for the first time targeted during a land reform and lost land between 1997 and 1999.

Table 12: Household level mean transfer right and risk of expropriation perceptions

		Ethiopia	Tigray	Amhara Region	Oromiya Region	SNNP Region
Transfer Rights (% land with right)	1997	0.59	0.54	0.29	0.75	0.67
	1999	0.55	0.72	0.58	0.50	0.54
	2004	0.57	0.53	0.61	0.66	0.49
Threat of expropriation (% reporting)	1999	0.12	0.10	0.17	0.14	0.07
	2004	0.06	0.10	0.08	0.07	0.03
Land lost during land reform (cumulative percentage of households)	1995	0.34	0.43	0.51	0.34	0.20
	1999	0.42	0.44	0.71	0.36	0.23
	2004	0.43	0.44	0.71	0.41	0.25

Number of observations: 1041 with complete information. Threat of expropriation gives the percentage of households reporting that they expect to lose in land redistribution in next five years). Land lost during land reform reports the percentage of households in the sample that report to have lost land during periods of land reform since 1976. Cumulative percentage up to year reported.

The resulting tenure insecurity has been shown to have impact on investment. Ayalew, Dercon and Gautam (2006) show that in the four villages most suitable for perennial crops in the ERHS, limited transfer rights have a strong effect. Controlling for a variety of controls (including household fixed effects, and time-varying fixed effects at the village level), it was found that being able to move the sense of transfer right security up to 100 percent from the current levels could result in about 25 percent more land allocated to (rather profitable) perennial crops such as coffee and chat. Given the predominance of coffee as the prime source of export earnings, this suggests an important source of inefficiency contributing to low incomes and poverty. Note that, if the constitutionally promised 'long-term security of tenure' can be delivered in a credible way, these results do not necessarily suggest that land titling and/or privatisation are key.

7. Conclusion: Sources of Growth

This paper has discussed growth and the changes in poverty in 15 communities, studied as part of the Ethiopian Rural Household Survey. While the communities were chosen to broadly represent socio-economic diversity across regions and the country, it is not a nationally representative survey. Nevertheless, the dearth of alternative data makes the ERHS unique in its ability to analyse the broad patterns of growth and poverty, and its determining factors. Growth and poverty reduction in these communities was substantial, although much deep poverty remains. Econometric analysis of its determinants suggests that the gradual improvement of the road infrastructure, and, to a lesser extent, the programmes to deliver more extension services are among the positive sources of growth. A high sensitivity to rainfall and other shocks remains present nevertheless.

Unpacking these effects further has highlighted the mechanisms by which improved roads may well have assisted the growth of both agricultural and non-agricultural activities. The evidence on the way the extension programme may have helped growth is less clear, given the relative stagnation and inter-year variability of the adoption of fertiliser. Risk has been shown to have continually been a growth-dampening factor, pushing farmers away from certain high return technologies. Growth is also dampened by the persistent effects of drought and other shocks. The presence of safety nets, while not necessarily well-targeted, has had some clear benefits on consumption, persisting beyond immediate impact. Their lack of coverage, as reflected in imperfect targeting but also in the continuing high sensitivity of consumption outcomes across communities, remains a concern. The inefficiencies linked to the continuing sense of insecurity regarding land policy adds further concern, and a sense of considerable rural potential that remains repressed.

In sum, growth in these communities has been considerable, not unlike the growth in GDP, even if other data sources have not quite confirmed these patterns. But the growth we are observing is not a period of rural transformation ready to accelerate into Asian-style large scale growth and poverty reduction. Despite the relative success, one cannot but be reminded that GDP per capita in real terms is currently only just about back at the levels of the early 1970s, before the 1973 drought and the long period of political turmoil and economic stagnation that set in soon after. Also in our communities, despite high growth, there is no clear sign of rapid transformation. A simple final table illustrates this well, by showing the income shares from broad groups of income sources, including crops, forms of wage employment, self-employment (including processing of agricultural sources, such as livestock products or non-agricultural activities, such as selling charcoal or trading) and transfer incomes (including private but in terms of magnitude mainly ‘public’ transfers from food-for-work or food aid). Income from the sale of livestock is not included since all areas covered are mixed-farming areas, and livestock sales are mainly asset transactions, and not regular sources of incomes.

Table 13: Income shares by source of activity 1994-2004

	Crop income	Wage income	Self-employment	Transfers
1994	65	5	25	4
1995	72	4	13	11
1997	78	4	16	2
1999	79	8	7	7
2004	67	5	19	8

Source: ERHS. Self-employment includes incomes from processing agricultural products (livestock, beer) and non-agricultural activities such as trading or selling firewood and charcoal.

Table 13 shows remarkable stability, despite this period of growth. Even though there is more variety at the level of particular communities, this is not the kind of data expected from a rural economy transforming away from agriculture into more productive and high return non-agricultural activities. Even within agriculture, there is little change over time in the relative importance of crops in most areas as well, and so there was no systematic shift towards more profitable new growth crops. Growth and poverty reduction has been obtained, more via a gradual if significant increase in returns to all activities, rather than transformation. It is likely that this will have to change to allow a further acceleration of growth and poverty reduction to take place.

Specific attention was paid in this paper to the chronically poor – those in poverty for much of the period considered in this paper. Focusing on those households who were observed to be below the poverty line three or more times across the six rounds of the survey, we find that this correlates closely with particular characteristics in the baseline of the survey: lack of physical assets, education, and 'remoteness' in terms of distance to towns or poor roads appear to correlate well; life cycle or demographic effects, in the form of being observed with children in the baseline, seems to matter as well. The chronically poor appear to be sensitive in a similar way to the rest of the sample in terms of the return to roads or extension services. However, their 'fixed' or 'initial' conditions, as reflected in the estimated latent growth related to time-invariant characteristics, suggest that they face a considerable growth handicap compared to the rest. This 'fixed' growth effect correlates also well with the characteristics of the chronically poor during the sample period. Chronic poverty, as reflected in poor initial assets and remoteness, appears to be correlated with a divergence in living standards over the sample period.

Appendix 1: Econometric concerns

Before estimating equation (1) using the data described in sections 3 and 4, there are a number of empirical issues that require consideration. First, note that we do not have evenly spaced observations over time. This can be thought of as a missing data problem – that is, how do we estimate (1) when we are missing data for 1996, 1998 and 2000-2003? To see how this might affect our model, writing (1) for growth between t-1 and t-2 would give:

$$\ln y_{t-1} - \ln y_{t-2} = \delta + \alpha \ln y_{t-2} + \beta \ln k_{t-2} + \gamma(\ln R_{t-1} - \ln R_{t-2}) + \lambda X \quad (2)$$

Suppose now we only observe t-2 and t. Then adding up (1) and (2) and dividing by two gives us:

$$(\ln y_t - \ln y_{t-2})/2 = \delta + \alpha(\ln y_{t-1} + \ln y_{t-2})/2 + \beta(\ln k_{t-1} + \ln k_{t-2})/2$$

$$+ \gamma(\ln R_t - \ln R_{t-2})/2 + \lambda X \quad (3)$$

Our left hand side is the average growth rate (also equal to $\ln y_t^{1/2} - \ln y_{t-2}^{1/2}$) while the right hand side consists of a number of complicated terms, with the exception of the last term, which is the yearly average of the rainfall change (or the total change divided by two). Extending this to p-periods in between this becomes:

$$(\ln y_t - \ln y_{t-p})/p = \delta + \alpha(\ln y_{t-1} + \ldots + \ln y_{t-p})/p + \beta(\ln k_{t-1} + \ldots + \ln k_{t-p})/p$$

$$+ \gamma(\ln R_t - \ln R_{t-p})/p + \lambda X \quad (4)$$

This presents problems for estimation for the lagged dependent variable, and all time varying 'level' variables (such as infrastructure at k). However, if one is willing to acknowledge that changes are still relatively slow so that $\ln y_{it-1} \approx \ln y_{it-p}$ and similarly for k, then the p-period average is approximated by the initial level at t-p. Then the regression to be estimated is:

$$(\ln y_t - \ln y_{t-p})/p = \delta + \alpha \ln y_{t-p} + \beta \ln k_{t-p} + \gamma(\ln R_t - \ln R_{t-p})/p + \lambda X \quad (5)$$

All changes are expressed in averages per period (divided by p) and all level variables remain as they are, defined at t-p. The constant (and the fixed effects) are not affected. Our next step is to introduce a disturbance term, ε_{it}, into (5). ε_{it} has two parts, a time invariant component (μ_i) and a time varying component (u_{it}). The time invariant component can be thought of as capturing all characteristics of the village and household not observed by us which do not change over time while u_{it} is white noise disturbance. Including these yields

$$(\ln y_t - \ln y_{t-p})/p = \delta + \alpha \ln y_{t-p} + \beta \ln k_{t-p} + \gamma(\ln R_t - \ln R_{t-p})/p + \lambda X + \varepsilon_{it-p} \quad (6)$$

However, this disturbance term introduces further complications. First, there are good a priori reasons to believe that E(ln yt-p εit-p) ≠ 0. To see why, note that ln yt reflects growth in ln y between periods t and t-1 and that ln yt-1 reflects growth in ln y between periods t-1 and t-2. εit-1 enters into the growth regression for (ln yt – ln yt-1) and εit-2 enters into the growth regression for (ln yt-1 – ln yt-2). If there is any serial correlation in the disturbance terms, E(εit-1 εit-2) ≠ 0 and so E(ln yt-p εit-p) ≠ 0. Making matters worse, note that a standard question in estimates of models like (6) is whether there is conditional convergence in the household data: a negative estimate for α would suggest convergence, allowing for underlying differences in the steady state. Unobserved village or household characteristics play a role in determining these steady states so that there is correlation between ln yt-p and μi and therefore between ln yt-p and εit-p. Second, as discussed in the introduction, E(kt-p εit-p) ≠ 0 because E(kt-p μi) ≠ 0. In the case of roads, it is simply not tenable to believe that they are randomly scattered across the countryside. In the case of extension, if the government extension services is selected 'better' for assistance – for example, based on unobserved land fertility or entrepreneurship – or is such farmers were seeking out extension agents, this would be reflected in our model by correlation between characteristics of these farmers such as kt-p and ln yt-p that are observed, and are themselves correlated with these unobserved characteristics.

Given these concerns, we estimate (6) using an instrumental variables (IV) – household fixed effects (HFE) estimator. We do so using Generalised Methods of Moments (GMM) so that these estimates are both consistent and efficient (Wooldridge, 2002).[14] The household fixed effects dimension of our estimator means that we difference all left and right hand side components of (6) by their mean. In so doing, unobserved, time invariant household characteristics are differenced out, as are the observed, time invariant household characteristics, X. We instrument ln yt-p using time-varying household characteristics observed at time t-p. These are log fertile land holdings, log number of adult equivalents and log number of livestock units. Again thinking of the discussion of Solow-type growth models, these can be thought of as household characteristics which influence how close the household is to the steady state. There are two additional advantages of this approach. First, should there be any attrition bias brought about by the influence of time invariant household characteristics on attrition, household fixed effects estimation will also address this (though, as noted in footnote 3, we do not believe such attrition is a concern). Second, the use of IV will reduce attenuation bias from measurement error in the regressors. In Dercon, Gilligan, Hoddinott and Woldehanna (2006) these concerns are all taken up and addressed.

14 Note that in the case of the poverty status regressions, we estimate these as linear probability models. While it is technically feasible to estimate logit models with fixed effects, doing so carries several costs. First, the estimation of these automatically drops all observations where poverty status does not change leading to a selected sample. We cannot use GMM so estimates derived from these models are not fully efficient and the estimated coefficients are not readily interpretable in terms of their marginal effects. Given this, we follow the lead of Hyslop (1999) and use a linear probability model.

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