SHOCKS, LIVESTOCK ASSET DYNAMICS AND SOCIAL CAPITAL IN ETHIOPIA

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Abstract

This paper uses household survey panel data of 416 rural households to study livestock asset dynamics in the north-east of Ethiopia. The period under examination (1996-2003) was marked by severe environmental shocks, including a series of droughts. Using as point of departure the literature on the evolution of productive assets in the presence of risk, which relates asset paths to initial endowments, we test the hypothesis of wealth divergence and the existence of asset poverty traps. Results indicate rather that livestock asset dynamics are marked by convergence over time. Examining the role of social capital in recovery and growth of households' endowments, both local social relationships as well as 'bridging' social capital seem to have a positive effect on asset holdings directly, as well as indirectly by mitigating the impact of income shocks on livestock capital.

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1. Introduction

As the literature on environmental and economic shocks in the developing world has acknowledged, shocks are often a particularly pernicious phenomenon for the poorest in poor countries. With few good options for shielding themselves from the impact of droughts, death of an economically active family member, or detrimental price changes, in some cases the poorest are said to resort to divesting themselves of their meager assets to stabilize current consumption. This however constitutes a heavy compromise on future consumption when what they are forced to sell are productive assets, and when market failures and transactions costs mean that reaccumulation of assets in good times is extremely difficult. These conditions have inspired research into the existence of 'asset poverty traps' and the conditions under which low-level asset equilibria exist.

The link between shocks and welfare of the poor has also been approached from a recent strand of literature on social capital and development, which has expanded on the insurance role of social networks. The argument is made that the poor rely heavily on informal social ties to insure themselves against the impact of shocks on their consumption flows, as they usually lack access to formal insurance markets or sufficient own savings.

This paper integrates these issues by investigating two key questions. First, it asks whether livestock assets in Ethiopia are characterized by the existence of multiple dynamic equilibria, one of which may constitute an asset-poverty trap. Secondly, it examines whether and to what extent households' social capital affects the evolution of livestock asset holdings over time. Given the importance of idiosyncratic and covariant shocks for asset dynamics as revealed in the theoretical and empirical literature, the role of social capital in mitigating these types of shocks in terms of their impact on asset endowments is explored. The rest of this section will briefly discuss existing empirical and theoretical work pertaining to this topic. The next section describes the data and the setting. Section 3 traces the series of weather-related shocks that the area experienced, as well as describes how livestock assets evolved in the context of these shocks. It also gives the landscape of social institutions and social networks that prevail in the study area. In Section 4 the model and estimation procedure is specified for examining the key hypotheses of this paper, and the results follow in Section 5. The final section concludes.

a. Shocks and asset poverty traps

Recent empirical work in the developing country context (e.g. Lybbert et al. 2004) has found evidence of dynamic asset poverty traps at the micro (household or individual level), manifested in tendencies for households with initially relatively large asset holdings to experience an asset build-up over time up to some wealth level; conversely, asset poor households are bound to see their wealth levels decline toward a stable low level equilibrium. But which forces may underlie such asset dynamics? The literature on missing or incomplete credit markets has shown that this problem often lies at the heart of multiple dynamic equilibria in asset endowments. Investment in capital goods, be they herd, land, or other physical assets require access to credit. There are several reasons why such credit (i) may not be supplied at a price (interest rate) at which making the loan would be profitable to the lender (or at least would leave him indifferent), and (ii) is especially rationed for low-wealth individuals. When suppliers of capital seek to circumvent the information problems which underlie imperfect credit markets through collateral requirements, the direct consequence of such contracts is that those with larger initial wealth will be less constrained to accessing credit for further investment than those with lower initial wealth. When loans obtained are invested and the returns at least partially accumulated, then this together with the information-problem driven necessity for collateral-based lending makes apparent that wealthier individuals are better able to accumulate more wealth over time than asset-poorer persons.

This tendency toward greater inequality over time has been found in empirical work that also accounted for the influence of shocks on differentially endowed individuals (see for example Rosenzweig and Binswanger 1993)). Specifically, the use of productive assets to smooth consumption in the face of climatic and other shocks when formal insurance markets are absent has implications for the time path of these assets (Rosenzweig and Wolpin 1993, Carter and May 1999).

Such explanation of persistent and growing asset inequality over time has been challenged by the suggestion that it is the very dimension of time that will allow the asset poor to catch up with the asset rich through their ability to save. Carter and Zimmerman (2000) contributed to the literature on endowment sensitivity (i.e. the possibility that income distribution impacts aggregate welfare) borne of multiple market failures by adding a temporal dimension. Under this logic, in a world in which the poor are quantity constrained due to their reduced ability to provide collateral in wealth-based credit contracts, through incrementally foregoing some consumption from period to period, they can accumulate wealth, invest that wealth, earn the returns of which again only a portion is consumed and the rest accumulated, etc. When one considers that there are usually diminishing marginal returns to investment, then over time the growth of the assets of the initially wealthy will slow down, so that while both the rich and the poor may be accumulating assets over time, asset inequality must decline, and not increase.

Another argument making the case against widening asset inequality, prominently in Deaton (1991), suggests that in a dynamic world with risk in the form of stochastic income, even when there is uniformly no access to credit and the only accumulation can take place through savings, risk-averse agents need not modify their productive activities so as to reduce their income fluctuation. Instead, they can maximize their expected income just like a risk-neutral agent would do, and then post facto smooth their consumption through appropriate saving behavior.

While these and other studies constitute a body of literature which delivers conceptual or empirically founded arguments that point toward or away from the existence of asset poverty traps, there is still surprisingly little research on explicit empirical strategies for identifying the existence of asset poverty traps in the microeconomic context (Carter and Barrett 2005 being one of the exceptions). The econometric investigation proposed in this paper, accounting both for the presence of shocks as well as accumulation of productive assets, examines whether the arguments of asset poverty traps and multiple dynamic equilibria hold up or are overturned when the shock directly affects the productive investment process.

b. Social networks as insurance against shocks

In addition to analyzing wealth dynamics among a poor rural population, and the way that shocks may influence these dynamics, the second key goal of this paper is to explore the role of households' social ties and relationships, and the nature of these relationships, for asset holdings over time. Economic work on the role of social connectedness for people's asset accumulation pattern, in particular through the function of social capital as insurance against shocks, is still very scarce. However, the recent and rising attention to the significance of social relationships for economic outcomes, and for economic development in particular, suggests the pertinence of this investigation.

In most rural economies, social networks play a highly important role in mitigating the risks that agricultural households face. With formal insurance and credit markets either absent or inaccessible to poor rural agents, the ties of common experience among members of a kinship group, ethnic group, or village enable households to transcend some of the information problems barring the development of impersonal markets. An often complex system of social exchange is an integral part of rural households' ex ante risk reduction and/or ex post coping strategies. Social networks thus serve an important role in resource allocation and risk management, and in that sense can be treated as an economic asset.

Indeed, anthropologists and sociologists have tended to use a broader definition of assets than economists, a definition that emphasises the critical role that social relations and networks play in periods of economic instability (Berry 1989, Little 1992a). They have shown how gender-based associations (Clark 1994; Goheen 1996), kinship groups (Stone, Stone and Netting 1995), and age-based organizations (Little 1992b) are assets that allow farmers to weather periods of climatic and economic turbulence. Oliver-Smith (1996) provides an overview of the anthropological treatment of the ways in which communities deal with disaster occurrences.

Marcel Fafchamps can be counted amongst those economists that have contributed importantly to understanding how social bonds play a role in economic outcomes (Fafchamps and Minten 1999; Fafchamps 2000). For example, Fafchamps (1992) zeroes in on the mutual insurance character of solidarity networks. In this, the person receiving assistance when adverse unforeseen events strike him is not expected to give back an equivalent amount to the giver at another time, but rather to help others in the network when they are in need. This type of transaction has been coined "generalized reciprocity" (Sahlins 1965). The theory of repeated games is used to understand the functions of the solidarity network: co-operation can be supported if people interact not in a one-shot fashion, but over a long period of time. And indeed a repeated games model is appropriate for weakly mobile people living in close proximity to each other. Coate and Ravallion (1993) formalize this game-theoretic framework and measure the divergence of the outcome from that of first-best risk sharing.

While the explanation based on repeated games emphasises how the nature of social networks can create the incentives for members to co-operate, and insure other members of the group from the effects of risky events through risk-pooling, Stiglitz (1990) and Besley (1995) point to the comparative advantage that nonmarket institutions such as solidarity networks have in terms of their monitoring and enforcement capacity: Individuals who interact in a variety of nonmarket contexts tend to know each other well. Thus, they may have greater ability to monitor each other than do formal insurance institutions. Also, given that social networks create multifaceted bonds between people that go beyond mutual insuring, mechanisms of social control and sanctions exist to limit non-co-operative behaviour.

These kinds of mutual insurance schemes are presumed to be most effective in the face of idiosyncratic risk, such as illness or death of a household member, theft of livestock or other assets, etc. Other social mechanisms to deal with this form of risk include intra-village transfers of assets or food to the affected household (Carter 1997), or provision of a loan, directly or in the form of privileging the afflicted household to receive the payment in a rotating credit group (Besley 1995).

However, social mechanisms also exist in many countries to reduce covariant risk such as the adverse economic effects of climatic conditions or social conflict which affect a whole village. This issue has hardly been explored in the social capital or the risk literature. Where the question receives any mention at all, it is usually suggested that social networks cannot address collectively experienced risk, since shocks that effect one member of a network are likely to affect all. This presumes however that social networks are necessarily localized. They may well frequently be, given the obvious problems of fostering and maintaining ties over large distances. But the existence of social institutions or relationships that traverse space, and their usefulness in controlling the effects of covariant shocks for their members, is an empirical question that merits attention.

There have been a few notable exceptions to the dearth of empirical work on this topic. Three studies come to mind. Rosenzweig (1988) suggests that kinship ties in India are able to be sustained over space and over time in implicit insurance-based transfer schemes which contribute to consumption smoothing in the face of covariant income risks. Such social transfer schemes are shown to be superior to insurance through (non-socially mediated) credit where risk is spatially correlated, due to the difficulties of honoring intertemporal contracts between agents separated by long distances. The assumption in much of the economics literature that social networks cannot absorb covariant risks is also challenged by Grimard (1997) in his analysis of urban and rural households in Côte d'Ivoire. Grimard investigates the hypothesis that households take part in spatially diversified risk-sharing arrangements with members of their own ethnic group and finds evidence of partial risk-sharing of this nature. Networks bound by ethnicity provide diversification of locally covariant risk as these informal arrangements are extended over space. Finally, Carter and Maluccio (2003) examine in the case of South Africa whether community level social capital may have contributed positively to diminishing exposure to individual covariant shocks and find little evidence of an effect on the latter.

This paper addresses this sparsely researched subject by distinguishing between two different forms of social capital, one of which is more likely to be able to serve as a mechanism to buffer collective risk. In evaluating the dynamics of households' asset holdings in the presence of shocks, it examines whether local and bridging social capital plays a role in protecting these assets, both directly, and/or indirectly by limiting the impact of drought shocks on asset wealth.

2. The Data and Setting

The South Wollo zone is located in the east of Amhara region of Ethiopia, in the north-centre of the country and about 400 kilometers north of Addis Abeba (for map, see Figure 1). The study area is close to the trading towns of Dessie, Bati town, and Kolmbocha, and includes the lowland locations of Oromiya Zone. The household survey covers three rural *weredas* (districts) in South Wollo Zone (Dessie Zuria, Legambo, and Jemma *weredas*) and one rural *wereda* in Oromiya Zone (Bati *wereda*).

The *weredas* are generally highly differentiated in terms of agroecology, production potential and access to infrastructure. The four agroecological zones that the area spans are (i) *Wurch* (very high altitude, high rainfall, occasional frost), (ii) *Dega* (high altitude, moist and low temperature), (iii) *Woine dega* (mid-altitude, sub-moist and medium temperature), and (iv) *Kolla* (low-altitude, semi-arid and high temperature). There is also diversity in terms of which growing seasons yield the bulk of agricultural production. The two seasons are: *Belg* (planting in February/March and harvesting through June - August), and *meher* (planting June – August and harvesting in November-January). Certain areas receive only *meher* or *belg* rains while other areas receive both (see Table 1).

The households in South Wollo Zone are ethnically Amhara, whereas those in Oromiya Zone are Oromos. The vast majority of the households in all communities are Muslim, are sedentary crop farmers and engage in mixed crop-livestock production. Livestock assets are used in a variety of ways, but predominantly, as an input in crop production (livestock dung is used as fertilizer, oxen are used for plowing, etc.). Donkeys and mules are a means of transport of goods and sometimes people. Livestock are also a direct source of nutrition, through the milk, eggs, and meat they provide, though this function is not as important for these study communities in the northern highlands, as they are for pastoralists in the southeast and eastern parts of Ethiopia. Livestock trading is also not a dominant activity for the sample households, and only a small portion of the households report that livestock fattening and selling constitutes a key livelihood.

The panel data resulted from a rural household survey conducted in seven rounds over the period of June 2000 – July 2003 in South Wollo/Oromiya Zones. In addition to the seven time periods, recall questions captured the households' livestock holdings for the years 1996 through 1999, resulting in an additional four rounds of data on herd assets. Initially, 448 households in rural areas were sampled using a stratified sampling technique, in which from the four above mentioned *weredas*, which were selected to ensure agroclimatic diversity, two *kebeles* each were randomly selected. Finally, from each *kebele*, 56 households were randomly sampled. From the 448 households of the first round, 416 remained in the last round. The rate of attrition over these time periods followed the traditional pattern in which attrition increases at a decreasing rate. So 93% of the original households remain for analysis, which constitutes a relatively low attrition rate for this type of survey.

3. Weather Shocks, Livestock, and Social Relations in South Wollo

This section provides a description of the nature and timing of the weather-related shocks households experienced in South Wollo in the late '90s and early part of this decade. This will be overlaid by a brief account of the evolution of households' asset endowments in the form of livestock (and oxen in particular) for the same time period. Finally, a sketch of the key social institutions and extra-village social ties that sample households reported will follow, which provides some background for the empirical approach to assessing social capital as a determinant of asset holdings in the face of the drought shocks.

a. The impact of climatic conditions 1999-2003

In the decade from the mid-1990s until today the study area of eastern Amhara Region in Ethiopia (South Wollo zone and Oromiya zone) has experienced multiple and prolonged droughts and other weather shocks. The massive failure of the short rainy season (*belg*) in the first half of 1999, however, has stood out in this period. National and regional estimates for food relief in 1999 were drastically altered when it was observed that the *belg* season of 1999 was going to be an almost complete disaster. Out of the eight *kebeles* [1], or peasant associations, that comprise the survey area, four rely heavily on the *belg* growing season (see Table 1).

The shortages created by this failure were compounded by poor rains of the long rainy season (*meher*) in the latter half of the same year. The 1999 *meher* season yielded only about 40% of normal harvests in six of the eight study *kebeles* (Little et al. 2005). By August 1999 about 90% of the households in the study region were receiving food aid, with the exception of the Jemma district which did not suffer crop losses of great severity. Recovery from the 1999 weather shocks was hampered by the fact that the *belg* season of 2000 was also very poor (75% reduction of normal yields), even though the long-rain *meher* season during that year was only slightly below normal yields. With massive imports of food aid and the recovery of the long rains in 2000, the nutritional status of the area's population had somewhat recovered by August 2000. Thus, the drought of 1999 was a slowly developing event that reached a crisis by March

1999. It was keyed by the failure or near failure of three successive short rainy seasons of the years 1998, '99 and '00. Thus it was mainly those areas which depend heavily on the *belg* season that suffered the most (especially Dessie Zuria and Legambo districts in the study region).

Table 1, which draws on data from the household survey, gives some indication of the impact of rainfall and other shocks on the different *kebeles* for the subsequent years. Especially the long rains of 2001 appear to have provided a reprieve for South Wollo households, although it is mostly those in the Jemma and Bati areas that reported dramatically reduced crop losses in this period, with improvement in crop failure more modest for the originally hardest hit Legambo and Dessie Zuria households.

b. The evolution of livestock assets among rural households in South Wollo

There is wide acknowledgement in the literature that populations in agricultural and agropastoral areas in developing countries draw on their livestock assets to overcome food crises arising from climatic and other shocks, although there is also work that places in doubt that livestock sale is an important coping strategy in times of stress (Fafchamps, Udry and Czukas 1998). Awareness of the sequence of droughts in South Wollo in the late 1990s and early years of this decade, and the fact that livestock is an important part of households' wealth in this area, motivates a closer examination of how livestock assets have evolved over time in light of the prevalence of shocks and a lack of fully adequate formal or informal insurance mechanisms.

Figures 2a and 2b track average oxen and livestock levels over time for wealth quartiles based on the initial period. These figures display an interesting trend from 1996 to 2003. First of all, for the period 1997 through 1999, we find that the asset-richer households appear to have experienced a steady decline in both livestock holdings in general, and also oxen holdings in particular. On the other hand, the asset poorest have seen an increase in their livestock holdings over the same period. As the figures categorize households by livestock ownership quartiles, we can see that across all four quartiles, there appears to be a negative relationship between initial (1996) holdings and changes in holdings. Comparing oxen assets and livestock assets in general, we find that the changes described above are more pronounced for livestock as a whole, which have been aggregated using Tropical Livestock Units [2], than for oxen. This seems to be particularly true for the wealthiest households.

This may suggest that they divested themselves first of other animals before disposing of oxen (or to the extent that the fall in animal holdings is due to death of the animals, that they gave priority to their oxen in terms of feed and other care to increase their oxen's survival chances).

1999 has been a year in which both the *belg* and the *meher* seasons brought severe drought upon the population in South Wollo, as detailed in the previous subsection. The data on asset holdings from 1996 to 1999 help us see the position that households held in terms of animal wealth prior to this devastating drought period. Figures 2a and 2b show, however, that the herd size (both oxen and livestock in general) held by households did not yet reach a trough in 1999, from which they gradually recovered. In fact, the poorest, who have been holding on to their small holdings up to 1999 finally also faced diminishing assets in the year after the severe drought (Figure 2b). For oxen, the fall continues for most households through the end of the year 2000, as can be seen from Figure 2a, whereas the latter half of 2000 already constitutes the first recovery period for livestock in general.

The continued decline after '99 may be attributable to an indirect effect as a consequence of the failed *belg* and *meher* seasons of that year: With failed crops resulting in a stark fall in households' normal source of consumption, they may have sought to stabilize their consumption by drawing down their livestock. This could occur by either slaughtering and eating livestock that are otherwise held as capital goods (as a store of wealth or a source of income through livestock products and services such as transportation, plowing, milk, etc.), or selling them on the market to buy grain foods.

Unfortunately the first five rounds have only information on herd stocks and do not cover the nature of changes in these stocks, such as animal deaths, etc. This would have enabled us to assess the immediate toll, in terms of deaths, that the 1999 *belg* and *meher* seasons' drought took on households' livestock. However, panel data on such livestock transactions are available for the period starting December 2000, so we can at least examine which types of changes in livestock holdings are most responsible for this further draw-down from June to December 2000 and beyond.

Figures 3a-c track the net forms of accumulation by initial wealth of households. As expected, excess births over deaths are highest for the initially wealthiest quartile nearly throughout the entire three-year period, and they are lowest for the asset-poorest quarter of households. Interestingly, a similar pattern is observed for market based de-accumulation, livestock sales net of purchases. Net sales are low but steadily increasing for the group of initially poorest households, and is relatively high for the richest group. Net borrowing is quite small in magnitude for all household groups, but it appears that mostly the middle-range households are borrowing from the wealthiest as changes in the formers' net borrowing moves counter to changes in net borrowing by the wealthiest quartile.

In sum, it can be said that while we do not have herd transaction data for the time period in which a form of convergence may be most dramatically observed, 1996 to 1999, wealth-differentiated behavior after this period in terms of livestock sales and purchases, borrowing and lending, and experience with animal births and deaths suggests that a higher rate of net sales by those with initially greater assets may be the main contributor to asset convergence across time, with convergence checked somewhat by virtue of the fact that wealthy households experience asset increases from high natural growth in stocks, a source of growth that appears to be important in overall livestock accumulation. This at least tentatively suggests that less poor households could afford to engage in consumption-smoothing behavior, ensuring a more steady stream of consumption at the expense of drawing down on their wealth, whereas the poorest quartile, owning on average less than one TLU, refrained on disposing of their already minimal holdings.

c. Social capital and social institutions

In the South Wollo area there are a variety of social institutions that are diverse in purpose, membership size, and importance in communities. The institution that is the most ubiquitous is the *kire* (also referred to as *iddir* in some *kebeles*, although there are some differences between *kire* and what is usually meant by *iddir* in the study area), which has as its main function the provision of financial and in-kind support for a household in which a family member or a key animal such as an ox dies or has to be slaughtered.

The assistance usually takes the form of coverage of funeral costs in the case of a household member. In the case of livestock, the *iddir*/*kire* members buy the meat of the slaughtered ox from the household, and sometimes lend to the household for free an ox for plowing land for one season, so that the asset loss does not result in an income shock for that season. However, the economic strain to the household upon the death of an economically active household member, or the consequences of the death of an ox after the current season, are not necessarily relieved through *kire* support. In some villages in the study area, the *kire* also functions as an institution that resolves conflict between neighbours and within the village in general.

In those *kebeles* with a sizeable Christian population, the *mehaber* and the *senbete*, which are religious institutions, are present. These institutions have no explicitly economic or insurance purpose; their main function is to create and strengthen ties between Christians. In the case of the *senbete*, members rotate in bringing food and drinks to be consumed by the priests after mass each week, and *mehaber* members seek to honor the saints by gathering at a member's house on a saint's day every month, with the (rotating) host providing food for the guests.

Two other important community based institutions are *debo* and *wonfel*. These have as their prime purpose the exchange of labor support on the farm, especially during harvest. *Debo* is a form of festive labour, where a person will provide food and drink for a large work party in order to carry out a time-sensitive agricultural task. No reciprocity is expected. *Wonfel* on the other hand involves smaller work parties, usually with the direct expectation of reciprocity among the members. People practice reciprocal labor to plant and harvest in a timely fashion, thus limiting the risk of crop loss. *Wonfel* is more common than *debo*, as can be seen in Table 2.

In addition to these social groups, in which participation ranges from widespread (e.g. *kire*) to moderate (e.g. *debo*), there are also some institutions such as the *iqqub* that are more exclusive in the context of rural South Wollo. A form of rotating savings and credit association, the *iqqub* consists of members who know each other very well, as a substantial amount of trust and information about a person's reliability is necessary for the financial transactions that take place in such a group to proceed smoothly. In the South Wollo study region such activities are rarer than in urban areas, usually because the necessary frequent contributions to the pool may be too large for the very poor, require having savings in the form of cash, and adherence to a strict contribution schedule on a weekly or monthly basis prevents using resources flexibly in order to cover food or other shortages in the face of a shock.

The value of such ties for mutual insurance, then, may arise more or less directly from the purpose of the social institution in question, such as in the case of labor pooling groups like *wonfel* and *debo*. Or it may establish itself indirectly as households are more likely to have success calling on others to help them get through shortages if they know these people have ties with them that go beyond mutual assistance agreement.

To the extent that these shocks are covariant, there usually must exist some degree of diversity among households tied to each other through the bonds of social institutions or other social relations for these relations to be useful as an insurance mechanism. Section 1b discussed one source of diversity, namely spatial distance (see also Table 4). Another source is differences between households in economic activity, as a particular form of shock may affect one economic activity more than another. We are able to capture the former from the household survey, while lack of information about characteristics (other than location) of people the households are socially connected to prohibits direct testing of the hypothesis that social networks diverse in livelihood are more valuable as source of insuring against covariant shocks.

4. Variables, Model Specification and Estimation Procedure

This section lays out the conceptual empirical framework for addressing the questions posed at the outset: Do asset paths in northern Ethiopia reflect the existence of multiple dynamic equilibria, one of which constitutes an asset poverty trap? And: To what extent does households' social capital affect the evolution of livestock asset holdings over time and pose a buffer against idiosyncratic and covariant risk?

Figure 4 constitutes one way in which asset dynamics can be illustrated and analyzed, and the findings of this paper will later be represented in similar asset-space [3]. The graph maps expected future assets of households against current asset holdings. This solid curve suggests the existence of multiple dynamic equilibria, pointing to an increasingly unequal wealth distribution over time, as well as the existence of an 'asset poverty trap'. For households with low asset endowments (between A^{lo} and A^{thr}) in the current period, expected asset holdings in the next period will fall.

On the other hand, relatively wealthier households (with assets between A^{thr} and A^{hi}) can expect to have even greater wealth in the future. If asset paths follow this pattern, then there is an unstable wealth equilibrium, A^{thr}, that can be identified as a threshold level such that if a shock or other occurrence pushes a household with assets slightly above A^{thr} to wealth below that threshold, it can expect to face a decline over time toward a substantially lower endowment level, A^{lo}, which can be described as an asset poverty trap. Barring this shock, the household's endowments would have instead converged toward the high stable equilibrium asset level, A^{hi}. In contrast to this scenario, if instead asset paths are better represented by the dashed curve, neither the proposition of expanding wealth inequality over time, nor that of the existence of multiple dynamic equilibria with a divergence-inducing asset threshold can be made as immediately.

There are important implications that arise from the nature of asset dynamics in developing countries. If, for example, there is evidence of multiple dynamic equilibria of the type represented by the solid curve in Figure 4, there is a case to be made that policy interventions that seek to limit the erosion of household assets in poor communities place a relatively large emphasis on helping households in the middle asset range (around A^{thr}) protect or enhance their wealth holdings. On the other hand, if wealth evolution is more accurately characterized by the dashed curve, a focus away from the lowest-wealth and toward less poor households in asset building interventions is less easily justified.

a. Variables and Structural model

The data set provides variables that allow us to distinguish different facets of social ties. In particular, a useful way to classify (the economic value of) social relationships, especially in this context, rests on the different forms of insurance that such relationships may be able to provide. One type measures the extent to which a household is strongly connected with others within the village, presumably with other households which share similar social characteristics and livelihoods, which allows stronger bonds to develop. This can be termed 'bonding' social capital. The other measure establishes the reach of social ties: how spatially far-flung a household's connections with others are. This refers to 'bridging' social capital.

The first set of relationships may help a household when it is struck by an individual shock. On the other hand, having geographically dispersed ties may become useful when the household's asset base is affected by covariant shocks that reduce incomes of many others in the community. Two key dummy variables will serve as proxies for different types of social capital. The first captures whether any member of a given household participates in a social institution. These include the religious institutions senbete and mehaber, the burial society *iddir* or *kire*, rotating savings and credit societies (*iqqub*), and labor parties (*debo* and *wonfel*), and whether they have either received *or* provided credit to either family members, other kinfolk, neighbors, or social institutions such as *iddir* and *iqqub*. The second variable proxies bridging social capital.

It captures if the household either received *or* sent remittances to other people located far away, and if it offered or received any other form of assistance to/from people who reside outside of the household's village.

We considered also using information that reflects a household's investment in social capital, drawing on data on household expenditures on social activities such as wedding, funeral, religious festivities, etc. However, this kind of measure has critical problems. It may be too closely related to income measures, and instrumenting it using variables other than the social capital measures above (since it is their impact on assets that is of interest) proved difficult since no suitable variables are available. But more importantly, expenditure data is available for too few of the rounds to be able to derive certain postestimation statistics that are critical to the empirical analysis (discussed in the next section). Finally, the link between social investment and social capital is not necessarily a linear or proportional one (see Mogues and Carter (2006)).

In order to test the hypotheses laid out in Section 1 and illustrated by the figure above, we use a dynamic model that controls for household heterogeneity:

$$y_{ivt} = \phi_{iv} + \sum_{k=1}^{3} \gamma_k {y_{ivt-1}}^k + \alpha S_{ivt} + \eta L^h_{ivt} + \eta_V L^v_{ivt} + \alpha_L L_{ivt} S_{ivt} + \boldsymbol{x}'_{\boldsymbol{ivt}} \boldsymbol{\beta} + \varepsilon_{ivt} \qquad (1)$$

$$\text{with } E(\varepsilon_{ivt}) = 0,\ E(\varepsilon_{ivt}\varepsilon_{jws}) = 0 \ \forall \text{ i≠j or t≠s},\ \text{var}(\varepsilon_{ivt}) = \sigma^2_\varepsilon,$$

where y_{ivt} is the stock of animal assets (aggregated using Tropical Livestock Unit (TLU) factors) that household *i* in village *v* holds at time t; *S* is one of the measures of social capital; L^h_{ivt} and L^v_{ivt} refer to variables that correspond respectively to idiosyncratic and covariant shocks, as will be elaborated in Section 5b below; and $\boldsymbol{x}_{ivt}$ is a vector of other control variables.

The choice of transformations of the one-period lag used in this model reflects the minimum-order polynomial necessary to test for the presence of a nonlinear asset path as shown in Figure 4. More specifically, of interest here is to determine whether indeed there is at least one high and one low level stable equilibrium along with one unstable equilibrium, which constitutes the threshold asset level such that, if a household falls below this threshold, its livestock assets can be expected to decline over time toward the low stable level. Such dynamic equilibria exist if there are multiple roots for the equation in y_{ivt-1}:

$$0 = (\gamma_1 - 1)y_{ivt-1} + \gamma_2 y_{ivt-1}^{\;2} + \gamma_3 y_{ivt-1}^{\;3} + \tilde{\boldsymbol{z}}_{\boldsymbol{ivt}}'\boldsymbol{\delta} \tag{2}$$

where $\tilde{\boldsymbol{z}}_{\boldsymbol{ivt}}$ incorporates all the terms other than those involving livestock assets. Consistent estimation of (1) using a procedure detailed in 5b below will produce the estimated coefficients and therefore estimates of these roots. As Figure 4 makes clear, the divergence/poverty trap hypothesis requires that

$$\gamma_1 + 2\gamma_2 y_{ivt-1} + 3\gamma_3 y_{ivt-1}^{\;2} \leq 1 \tag{3}$$

evaluated at some small and some higher root, and

$$\gamma_1 + 2\gamma_2 y_{ivt-1} + 3\gamma_3 y_{ivt-1}^{\;2} \geq 1 \tag{4}$$

evaluated at a root located between the previous two, if at least three roots exist. If there are only two roots, it is only necessary to find condition (4) at some root and (3) at the other. Finally, if there is only one root and (4) holds there, one can expect divergence in asset holdings and increased asset inequality over time. If on the other hand (3) holds there, that suggests, at the observed wealth levels in the study area, convergence over time toward a stable equilibrium. In the latter case, this equilibrium can be estimated and compared against livestock asset holdings that are deemed to represent an asset poverty line for a rural economy such as South Wollo.

Given the time path of livestock assets described in this model, a positive effect of a household's social capital on livestock holdings, i.e. $\alpha > 0$, would suggest that the dynamic relationship mapped in Figure 4 would be shifted upward, indicated by the dashed curve. This means that with strong social ties and relationships, a household's asset growth (loss) over time will be larger (smaller). This however also has implications for the equilibria, as seen in the figure. The stable equilibria are both higher, and the unstable threshold equilibrium would be lower. The latter means that in the presence of high social capital, a household is less likely to find itself on the downward-spiraling asset path as it takes having a lower herd stock to cross the threshold that leads to the asset poverty trap.

Also of particular interest here is how social capital may or may not help households protect their assets in the face of shocks. Therefore, S_{ivt} is interacted with the idiosyncratic and the covariant shock variables L^h_{ivt} and L^v_{ivt}. In particular, variables measuring 'bridging' social capital are interacted with measures of covariant shock to be able to examine if indeed bridging social capital is able to mitigate the detrimental effect of negative covariant shocks on assets. Similarly, measures of bonding social capital are interacted with the income shock variables, as their effect on limiting exposure to risk, if there is such an effect, would be predominantly present with respect to individually experienced risk.

b. Estimation Procedure

The choice between modeling the unobserved ϕ_i as a fixed unknown parameter versus as a random variable is made based on a number of factors.[4] The fact that we are interested in making inferences about the population from which the sample is based would suggest a random effects approach, as well as the fact that a fixed effects model makes impossible the estimation of certain variables of interest that may be time-invariant. Also, given that the estimation of the individual effects themselves is not of interest to the research questions at hand (however, the first moment of their distribution is, as will be clear in the discussion of the results), treating ϕ_i as a random variable means that the estimation procedure will not entail a loss in a lot of degrees of freedom and the concomitant loss in efficiency in estimating the other parameters, especially given this data structure with relatively fewer time periods and a large cross-section.

However, a traditional random effects estimation imposes a restriction on the explanatory variables that naturally cannot hold in a dynamic specification, namely that of strict exogeneity. At least as important a criterion for ruling out a random effects estimation arises from the question whether there is reason to suspect that unobserved heterogeneity captured by ϕ_i may be correlated with one or more of the regressors. While in many applications this is a significant possibility, in a dynamic model it is once again a certainty, to the extent that the effect helps explain the dependent variable.

An estimation method that avoids having to treat ϕ_i as a fixed effect and yet produces consistent and efficient estimators has been suggested by Arellano and Bond (1991). It involves first-differencing in order to remove the unobserved household-specific effect, and the use of instruments for those variables, including the lagged dependent variable, that cannot be assumed to be strictly exogenous. For easy illustration of this procedure, we will group the variables, referred to as $\boldsymbol{w}_{it}$ and the lagged livestock variable $y_{it}{}^{k}$, into those for which the looser assumption of sequential exogeneity conditional on the unobserved effect will be used — that is, after accounting for household-specific effects, the error term is uncorrelated with current or past values of the explanatory variables, but may be correlated with their future values — and those that will be taken to be strictly exogenous ($\boldsymbol{z}_{it}$), i.e.

$$E(\varepsilon_{it} \mid \boldsymbol{z}_{i1},...,\boldsymbol{z}_{iT}, y_{i1}{}^{k},..., y_{it-1}{}^{k}, \boldsymbol{w}_{i1},..., \boldsymbol{w}_{it}, \beta_i) = 0\,;\ k=1,2,3. \tag{5}$$

First-differencing gives

$$\Delta y_{it} = \Delta \boldsymbol{z}_{it}^{\prime} \boldsymbol{\delta}_1 + \sum_{k=1}^{3} \gamma_k \Delta y_{it-1}{}^{k} + \Delta \boldsymbol{w}_{it}^{\prime} \boldsymbol{\delta}_2 + \Delta \varepsilon_{it} \,. \tag{6}$$

The choice of instruments at time t is guided by candidate instruments' lack of correlation with the error term, strong correlation with the variables to be instrumented for, and limiting loss in degrees of freedom. The latter is an issue in panel data since the transformations of the lagged dependent variables are well instrumented for by further lags (or their differenced counterparts). This however limits the number of periods that will be actually available in the panel data estimation. Fortunately, the dataset has available four periods on livestock assets followed by another seven periods of a more complete panel, as discussed in Section 3b. Therefore, these four periods' worth of livestock information serve well as a source of instruments while their use as instruments do not remove time periods from the panel data estimation. The other sequentially exogenous variables $\boldsymbol{w}_{it}$ can also be instrumented by their own lags as well as the vector $\boldsymbol{z}_{it}$. Instruments are employed using the generalized method of moments system.

5. Results

a. Nonparametric estimation of asset dynamics

First, a nonparametric estimation of the dynamic path of livestock asset holdings allows us to make an initial exploration of the relationship of assets over time before imposing parametric structure. In order to examine the impact of current on future asset ownership for different stretches of time, two estimations of the following model are conducted:

$$y_{it} = g^{(j)}(y_{it-j}) + \varepsilon_{it} \tag{7}$$

in which $j=1$ and $j=3$, that is, the impact is assessed of current on future asset holdings one time period and three time periods later. $g^{(j)}()$ is estimated using the LOESS method, a regression by local fitting, in which for each value y_{it-j}^{0} the observations that are in the neighborhood of y_{it-j}^{0} are used to predict y_{it}^{0} by minimizing a weighted average of squared residuals, where the weights vary inversely with the distance of each observation from y_{it-j}^{0}. [5]

The results are shown in Figure 5, where the solid curve represents the one-period and the dashed curve the three-period relationship. Figure 5 suggests a dynamic relationship that is not characterized by divergence arising from an asset threshold such that households which find themselves above this threshold will move to a high stable equilibrium and those that fall below the threshold will tend to move to a lower-level equilibrium. Instead what this nonparametric estimation shows is a situation of convergence over time. Given that the curve intersects the 45^{o} line once and from above, there is only one stable equilibrium toward which even the initially asset-rich will be pulled over time.

The dashed line representing the more long-term of current and future assets is even flatter, suggesting that this trend is even more pronounced over longer periods of time. The stable equilibrium in the larger lag estimation is at the same level as that indicated by the short-lag estimation, around 3 ½ TLUs.

b. Parametric estimation of asset dynamics

This bivariate relationship over time, however, hides the potential impact of other key variables that could be underlying households' asset accumulation and decumulation decisions, as well as exogenous factors that directly determine livestock size, such as weather and other shocks. Therefore, we model the time evolution of livestock in the context of these variables. As mentioned, of special interest is the extent to which covariant and idiosyncratic shocks as well as social capital may affect assets.

Tables 5a and 5b give the results of the dynamic panel estimation, with the former including direct social network effects on assets, and the latter including indirect effects, through potential mitigation of the impact of shocks on assets. Specification A in Table 5a includes only a 3rd order polynomial function of lagged assets as explanatory variables (drawn in Figure 6), to serve as a comparison with the nonparametric estimation displayed in Figure 5. The dashed steep curve shows a similar scenario of convergence over time of households' livestock holdings toward a stable equilibrium, even though this equilibrium is somewhat higher in the case of the parametric estimation (at approximately 4.2 TLUs). As can be seen from the lagged livestock coefficients of the full regressions, columns B through E, including the effect of key variables such as land holdings, shocks, and food aid dramatically transforms the pure effect of previous livestock levels on current ones. As can be seen, much of the relative persistence of asset stocks reflected in the omitted variables regression of the first column is removed after controlling for these factors.

This can be better seen graphically. The solid curve in Figure 6 presents the dynamic asset path having accounted for other assets, food aid, etc. This is a graphical representation for the specification that includes covariant shocks, individual shocks, and bridging social capital (column C(ii) of Table 5a). Therefore, holding the levels and impact of other variables constant across households, next period's assets are much more similar across households with very different asset holdings this period. Thus, a much stronger and speedier convergence toward the stable equilibrium asset level is suggested by this model. We can therefore conclude that the relative persistence of livestock holdings over time is greatly accounted for by the way that factors such as access to food aid, integration in village social networks and social relationships beyond the village, and experience of shocks of the household as well as of others in its community are distributed across households with different livestock asset endowments. Controlling for other variables in this way also leads to a decrease in the estimated dynamic fixed point of assets to 3.9 TLUs, i.e. a decrease by 0.3 TLUs, which is equivalent for example to three goats.

In specification B, risk with an idiosyncratic component is captured by a dummy variable whether the household suffered significant crop loss on any of its land parcels for reasons such as drought, frost, crop disease, etc. While some of these reasons given reflect a covariant exogenous shock, this variable captures the individually experienced impact. For example, within the same village at some point in time not all households report crop losses. A one-period lag of this measure is used as it is expected that the impact on livestock may not be immediate, as households may resort to other coping mechanisms before resorting to selling or otherwise drawing down on their livestock assets following crop losses. Also included is the measure of ‘bonding’ social capital described earlier. The effect on livestock assets of belonging to social and informal groups, holding prior herd size constant, is positive and very significant. Belonging to social groups increases livestock endowment by 0.22 TLUs. It is useful to keep in mind that this impact is present after controlling for last period’s livestock endowments.

This can be compared with the case in which the effect of the covariant shocks and of ‘bridging’ social capital on livestock is examined, which specifications C do. *CovShock* measures for each time period the share of households in the village who have reported suffering a crop loss, obtained after excluding household *i*. The variable measuring the (lagged) collective crop loss experience shows a strong negative effect on assets, and the additional inclusion of the individual shock in (C(ii) vis-à-vis C(i)) leaves this effect unchanged, while the idiosyncratic effect is now weak and insignificant. This points to the notion that after accounting for village shocks, the idiosyncratic component of the crop loss shock becomes much less important.

Specifications in C also include a dummy variable that indicates active linkages to other people outside the village. This includes both people living in remote areas from whom the household receives remittances, as well as people far away to whom the household makes transfers, and also cases in which one or more household members spend most of the year in further away locations outside of the village. The impact of such distant social networks is larger than the more traditional measure of social capital (through village groups), as a comparison across Table 5a shows.

To examine more explicitly the question whether social capital reduces the impact of idiosyncratic and covariant shocks, specifications D and E in Table 5b include interactions of the idiosyncratic shock variables with 'bonding' social capital, and the covariant shock variables with 'bridging' social capital. Once again, local social capital in the form of membership or participation in local groups appears to mitigate the impact that idiosyncratic income shocks have on livestock holding. Again, having geographically dispersed networks reduces to an even larger extent the degree to which collective exogenous shocks result in reduced livestock wealth [6].

c. Social capital and the evolution of livestock holdings

Having discussed the role of having different types of social networks for asset endowments, directly and indirectly through its shock-mitigating influence, we want to return to the dynamic asset path and ask how the impact of social capital on the evolution of livestock assets over time may be understood.

In the model (1) social capital affects not the impact (slope) of past on future herd endowments, but the level of this relationship. To see the extent to which belonging to village level social groups (or having active relationships with people in remote areas) changes future livestock holdings given past endowments, we use the estimates of specifications B and C(ii) to map the relationship

$$y_{it} = SH_{sk} + \sum_{k=1}^{3} \hat{\gamma}_k y_{it-1}{}^{k} \quad (8)$$

where SH_{sk} is the intercept, or shifter. Two cases are used: one in which the dummy variable for social capital is set to 0, and the other where it is set to 1, so that the two shifters are:

$$SH_0 = \hat{\phi} + \hat{\eta}\overline{\overline{L_{it}^h}} + \hat{\eta}_V \overline{\overline{L_{it}^v}} + \overline{\overline{\boldsymbol{x}_{it}}}'\hat{\boldsymbol{\beta}} \quad (9)$$

and

$$SH_1 = \hat{\phi} + \hat{\alpha} + \hat{\eta}\overline{\overline{L_{it}^h}} + \hat{\eta}_V \overline{\overline{L_{it}^v}} + \overline{\overline{\boldsymbol{x}_{it}}}'\hat{\boldsymbol{\beta}} \quad (10)$$

where $\overline{\overline{z}} = \frac{1}{nT}\sum_t \sum_i z_{it}$ i.e. the pooled mean of the variable, and α is the coefficient for the social capital dummy variable. The shift in the dynamic asset relationship resulting from an increase in the social capital variable from zero to one, again given model C(ii), implies, as described in the model specification in Section 4a, a change in the stable equilibrium.

Specifically, the stable equilibrium for a household with relationships to distant people is 4.2 TLUs, versus the equilibrium if it does not have such relationships (3.8 TLUs). The difference in equilibria here, 0.4, is larger than the shift itself, which amounts to the size of the marginal effect $\hat{\alpha}$, (0.3 TLUs) given that relationship between y_{it-1} and y_{it} is positive and has little curvature in the neighborhood of the equilibria. Hence, whether one measures the social networks effect in the standard way, i.e. the coefficient, or by quantifying how it affects the equilibrium level of assets in a dynamic asset path, this impact appears to be large relative to average livestock wealth in the study area.

6. Concluding remarks

Over the period of the latter half of the 1990s until the early 2000s, rural households in the north-east of Ethiopia have experienced dramatic changes in their livestock holdings. This period was also marked by severe as well as repeated events of poor or untimely rains, including three successive failed short-rain (*belg*) seasons in 1998-2000. Given the importance of livestock in households' capital endowment set, we set out to investigate the nature of livestock asset dynamics in the presence of weather shocks.

Of interest was to test the hypothesis, as found in part of the literature on assets and shocks, that missing financial and other key input markets in developing countries lead to a process of divergence of wealth and increasing asset inequality. In the context of South Wollo, we find instead that livestock assets exhibit convergent tendencies. This finding may be driven in large part by more well endowed households engaging in consumption smoothing by drawing down on their herd in times of food shortages while asset poorer households may choose not to divest themselves of their already small livestock holdings if they have reason to fear that reacquisition of even these low levels of animal capital will be slow and/or very costly. Such asset smoothing behavior would then come at the expense of high consumption fluctuation unless other smoothing strategies are available to them. Unfortunately, for the period that is most responsible for the convergent process, 1996-2000, there is only animal stock data available, but not the source of animal additions and deductions (purchases, deaths, etc.), which would have permitted a more in depth examination of the causes of the strongly wealth differentiated accumulation behavior observed.

In contrast to these results, work by Chris Barrett and co-authors on livestock dynamics among pastoralists in Ethiopia (see for example Lybbert et al. 2004) finds evidence of nonlinear asset equilibria resulting in divergence of assets. One of the factors behind this contrast in findings may be how the different production technologies interact with covariant shocks. In Lybbert et al., mobile herding requires a large enough herd size as nomadic pastoralists must rely predominantly on milk and other livestock products for consumption. Pastoralists falling below the threshold herd size and thus taking up sedentary production are more subject to drought shocks, which erode their livestock assets even further. Here, sedentary farmers with livestock assets much smaller on average than pastoralists, do not enjoy this type of gain from having more livestock on the margin. In this sense, it may well be that the households in this study are all in the bottom range of the stylized asset path in Figure 4. This hypothesis can naturally not be tested with the data at hand, but an interesting area for future research would be to explore more deeply the possible drivers behind different dynamic wealth paths.

This paper also finds that the evolution of assets over time is influenced importantly by the extent to which households are embedded in institutional as well as more informal social relationships. A differentiation is made in this analysis between local forms of social capital, that is, social ties that are mostly limited to others within the village, and ‘bridging’ social capital that reflects how far-flung these social connections are. Holding past assets constant, bridging social capital has a positive effect on current asset levels by mitigating the impact of income shocks on livestock capital.

These findings contradict standard assumptions about social capital, namely that it has no role to play in mitigating the consequences of covariant risk. To begin with, unfortunately, this issue is hardly seriously explored in the social capital or the risk literature. Underlying this assumption is likely a conception of social networks as necessarily always village or other highly localized institutions. This may well be the more common form in which social networks manifest themselves. Nevertheless, where people consciously forge ties across geographic space, or may be connected to others far away through the bonds of ethnicity or other strong social affiliations, the assumption would no longer hold. In such cases, a distinction of local from bridging forms of capital — as is done in this paper — is called for to seriously address the empirical question of the usefulness of social mechanisms for coping with covariant shocks.

With risk (of which weather risk is but one form) being an integral part of rural life in Ethiopia and indeed many rural areas of poor countries, and with very limited ways to insure against risk, it is important to gain a better grasp of how social connectedness contributes to protecting assets from becoming eroded by shocks. Our results were not necessarily expected, since in earlier qualitative work in the study area (Castro et al. 1999) informants suggested that severe food shortages borne of droughts have themselves led to an erosion of social institutions as participation declined when households were searching for ways to economize. There well may be a threshold degree of exposure up to which being able to draw on others' help can be mutually beneficial, but beyond which social mechanisms break down. Explicit attention to these issues in empirical projects is warranted to get a richer understanding of the role of social capital as a risk-coping mechanism.

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Tables

Table 1: Agroclimatic characteristics of study villages

Kebele (peasant association)	Wereda (district)	Main growing season	Primary agro-ecological zone	% of households that experienced crop losses			
				Dec00	Jun 01	Dec01	Mar02
Chachato	Bati	Meher (long rain season) only	Kolla (lowlands)	81.8	83.6	5.5	94.6
Kamme	Bati	Meher only	Kolla	88.9	88.9	48.2	94.4
Tulu Mojo	Jemma	Meher only	Dega (highlands)	98.1	98.1	1.9	88.5
Yedo	Jemma	Meher only	Dega	96.0	96.0	6.0	74.0
Tebasit	Dessie Zuria	Belg (short rain season) only	Dega	80.9	80.9	85.1	89.4
Gerado	Dessie Zuria	Both seasons	Woine dega (midlands)	96.2	96.2	88.5	94.2
Tach Akesta	Legambo	Both seasons	Dega	85.2	85.2	61.1	72.2
Temu	Legambo	Belg only	Wurch (afroalpine areas)	84.6	84.6	69.2	80.8
Total				89.0	89.2	45.7	86.0

Table 2: Number of household memberships / participation in community groups and institutions

Community organizations	
Iddir/Kire (burial society)	327
Mehaber (religious association)	17
Senbete (religious association)	8
Debo (labor party)	108
Wonfel (labor exchange group)	293
Formal institutions	
NGO	125
Service cooperative	57
Governmental group	4
Rural credit association	3
Milisha	1

Table 3: Agents to whom survey households provided or from whom they received loans

(% of all credit transactions)

Transaction partner	Dec 00	Jun 01
Family	23.6%	19.4%
Other kin	19.0%	29.6%
Iddir/Iqqub	0.5%	0.0%
Neighbors	1.0%	14.3%
Money lender	19.0%	16.3%
Trader	0.5%	4.1%
NGO	21.5%	8.2%
Bank	6.2%	0.0%
Others	5.6%	1.0%
Min. of Agr./Development Agent	3.1%	7.1%

Table 4: Agents to whom any household member sent remittances or from whom they received remittances (% of all remittances)

Relationship to the household head	Dec 00	Jun 01
Spouse	4.3%	
Child		17.2%
Grandchild	52.2%	5.2%
Nephew/niece	4.3%	12.1%
Neighbor		1.7%
Other	34.8%	19.0%
Aunt/Uncle		1.7%
Parent		25.9%
Sibling	4.3%	17.2%
Residence of sender / receiver		
Outside Ethiopia	50.0%	35.9%
Addis Abeba	12.5%	2.6%
Other locations in Ethiopia	37.5%	61.5%

Table 5a: Arellano-Bond estimation of livestock asset holdings, including direct effect of social assets on livestock assets

	A	B	C(i)	C(ii)
y_{t-1}	0.6761**[1]	0.2176**	0.1964**	0.1986**
	.000[2]	.000	.000	.000
y_{t-1}^2	-0.0100**	0.0070**	0.0064**	0.0063**
	.000	.002	.007	.009
y_{t-1}^3	0.0002**	-0.0003**	-0.0003**	-0.0003**
	.000	.000	.000	.000
CovShock $_{t-1}$			-0.4388**	-0.4326**
			.000	.000
IndShock $_{t-1}$		-0.2581**		-0.0028
		.000		.967
Distance SK $_t$			0.3089**	0.3061**
			.000	.000
Local SK $_t$		0.2234**		
		.000		
Aid $_{t-1}$ (kg)		-0.0025**	-0.0031**	-0.0031**
		.000	.000	.000
Land $_t$ (timad = ¼ ha)		0.0009	-0.0005	-0.0006
		.382	.627	.616
HH Size $_t$		-0.1818**	-0.1621**	-0.1722**
		.000	.000	.000
constant	1.5023	4.0898	4.3208	4.3684

Arellano-Bond test that autocovariance in residuals of order j is 0:				
j=1:		-8.16**	-4.01**	-4.04**
		.000	.000	.000
j=2:		-1.00	-1.08	-1.09
		.316	.279	.277

[1] ** Significant at 5% level; [2] p-values.

Table 5b: Arellano-Bond estimation of livestock asset holdings, including indirect effect of social assets on livestock assets

	D	E(i)	E(ii)
y_{t-1}	0.2208**	0.2109**	0.2145**
	.000	.000	.000
y_{t-1}^{2}	0.0059**	0.0060 **	0.0058**
	.013	.008	.010
y_{t-1}^{3}	-0.0003**	-0.0003*	-0.0003**
	.000	.000	.000
CovShock $_{t-1}$		-0.4736**	-0.4892**
		.000	.000
IndShock $_{t-1}$	-0.3995**		-0.0193
	.000		.777
$DistSK_t$ * CovShock $_{t-1}$		0.3062**	0.3026**
		.000	.000
$LocSK_t$ * IndShock $_{t-1}$	0.2398**		
	.000		
Aid $_{t-1}$ (kg)	-0.0027**	-0.0030**	-0.0031**
	.000	.000	.000
Land $_t$ (timad = ¼ ha)	0.0016	-0.0003	-0.0003
	.121	.793	.763
HH Size $_t$	-0.1906**	-0.1803**	-0.1907**
	.000	.000	.000
constant	4.2924	4.3991	4.4450

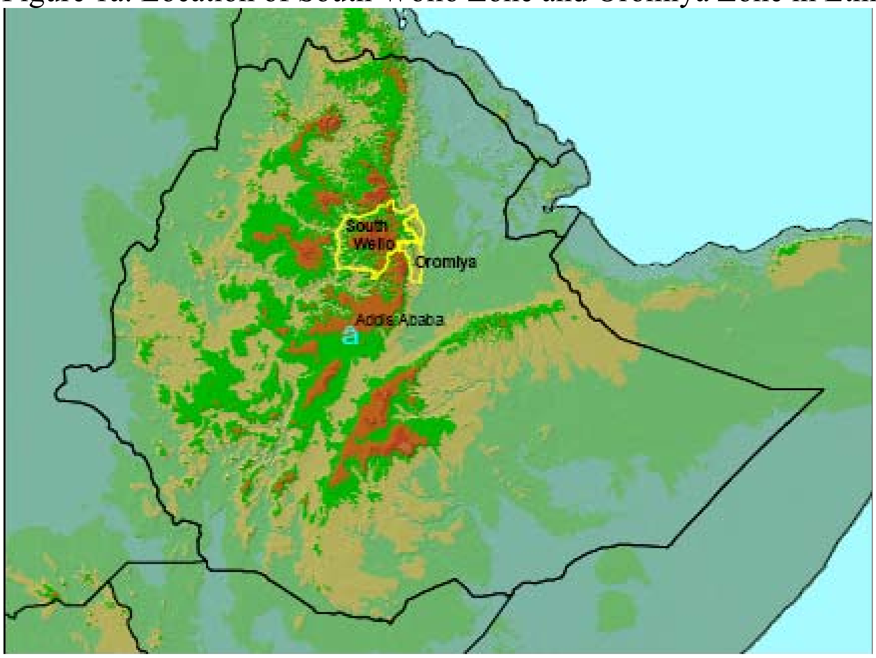
Arellano-Bond test that autocovariance in residuals of order j is 0:

j=1:	-4.15**	-4.18**	-4.21**
	.000	.000	.000
j=2:	-1.05	-1.05	-1.05
	.293	.296	.295

Figures

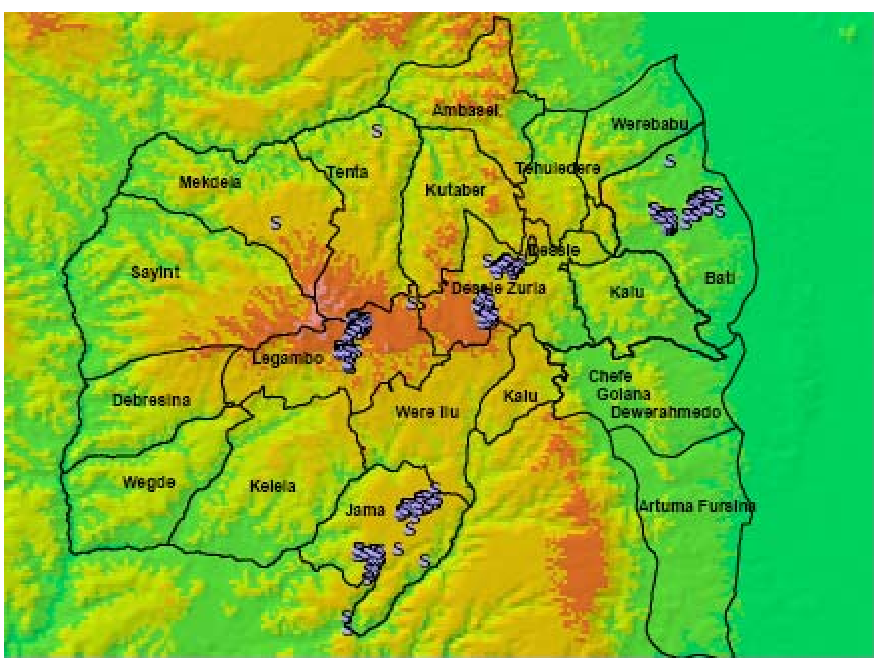
Figure 1: Maps of study area

Figure 1a: Location of South Wollo Zone and Oromiya Zone in Ethiopia



Source: Shin 2002.

Figure 1b: Location of sample households in the four *weredas* Legambo, Dessie Zuria, Jemma, and Bati



Source: Shin 2002.

Legend for Figures 2 and 3:

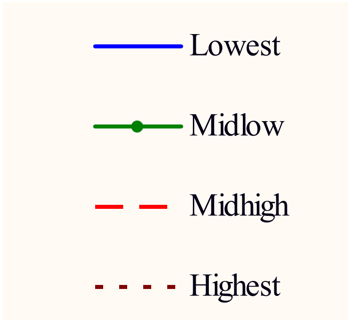


Figure 2a: Oxen holdings by initial livestock quartiles

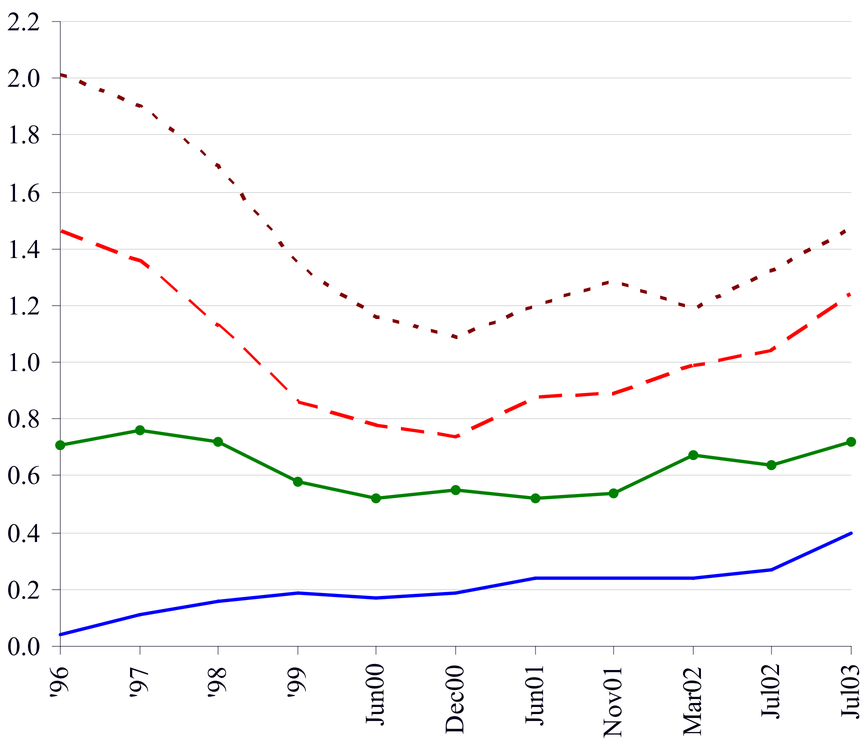


Figure 2b: Total livestock ownership by initial livestock quartiles

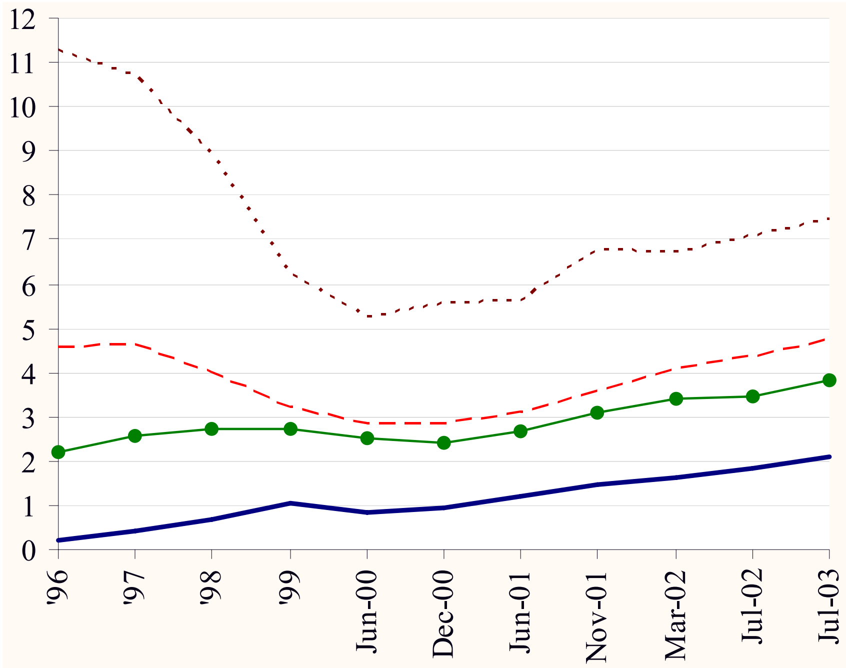


Figure 3a: Livestock accumulation: Net births by wealth quartiles

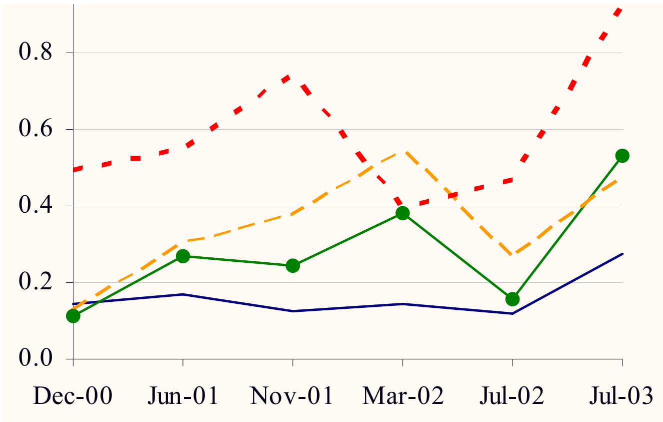


Figure 3b: Livestock decumulation: Net sales by wealth quartiles

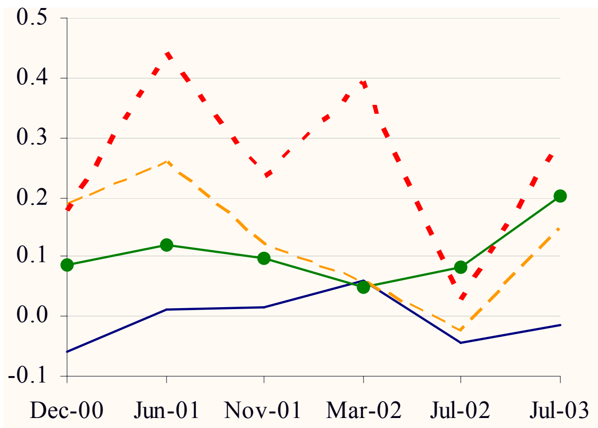


Figure 3c: Livestock accumulation: Net borrowing by wealth quartiles

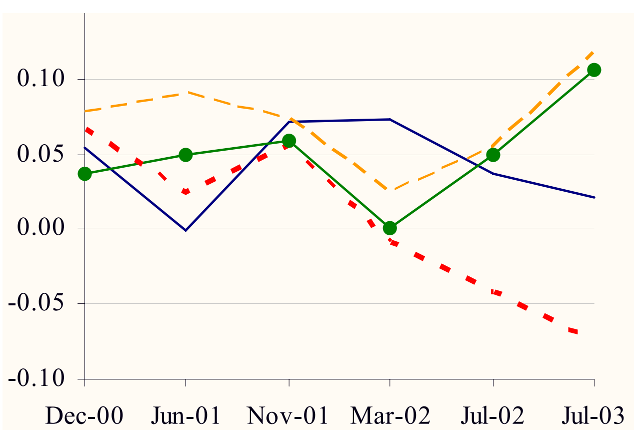


Figure 4: Asset dynamics reflecting multiple dynamic equilibria

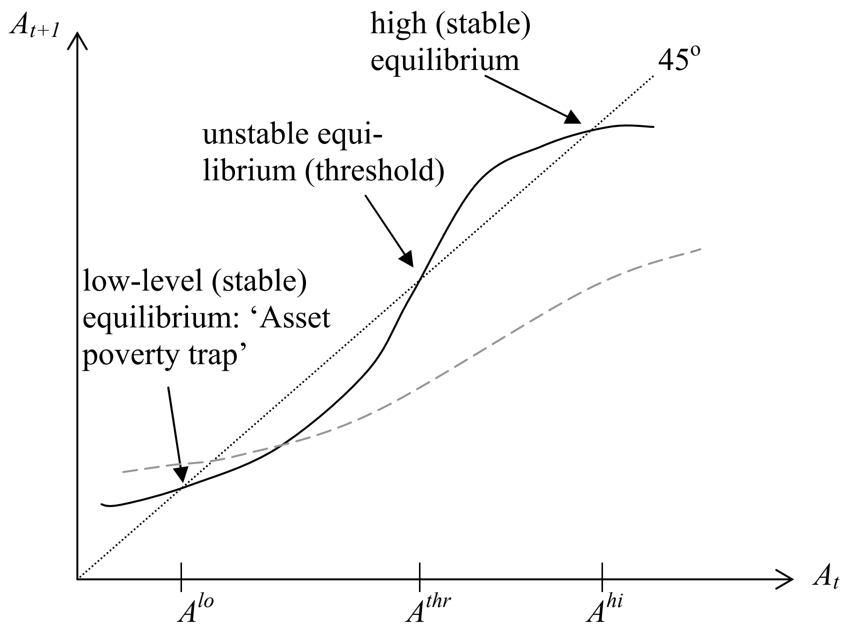
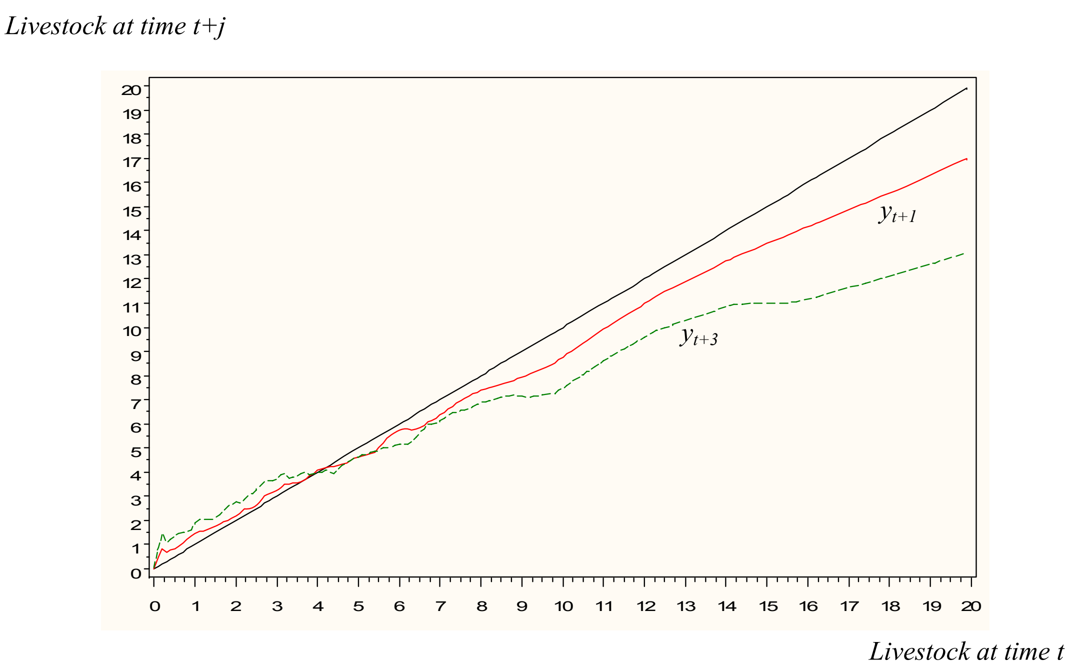
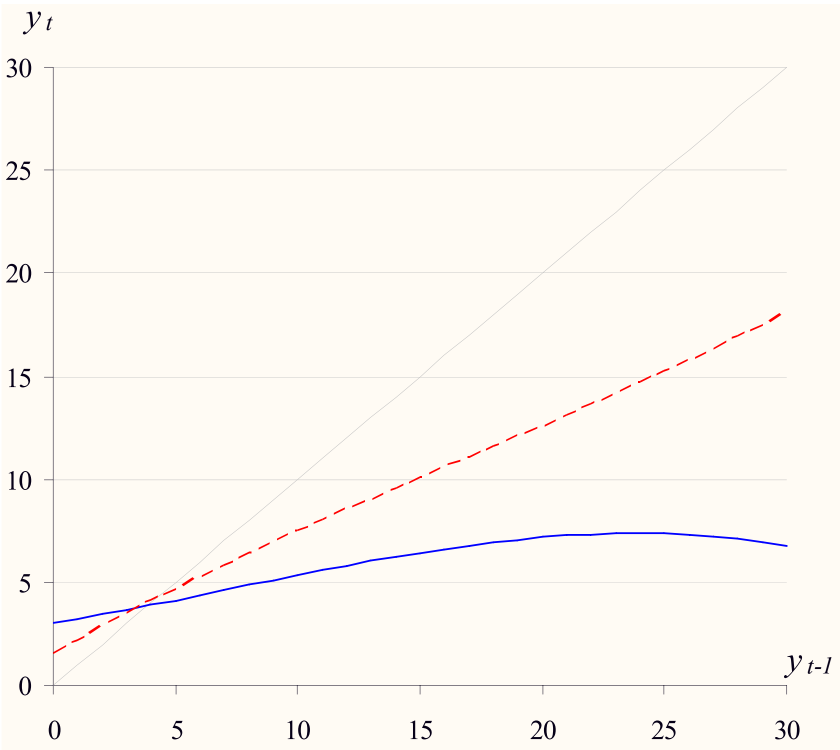


Figure 5: Nonparametric estimation of dynamic asset path



(Smoothing parameter: 0.07)

Figure 6: Parametric estimation of dynamic asset path



Endnotes

[1] *Kebeles*, also referred to as peasant associations, are administrative units comprising of approximately 4 small villages on average. As however often *kebeles* are referred to as villages, we will use these terms interchangeably.

[2] The conversion factors used generating TLUs are: Camel = 1.43; Oxen, cow, heifer, bull and calf = 1; Horse, mule, donkey = 0.5; Goat, sheep = 0.1; Chicken = 0.05.

[3] Lybbert et al. (2004) use this representation of livestock asset dynamics in pastoral Southern Ethiopia.

[4] We will from here forward ignore the village subscript for household-specific variables or parameters for notational simplicity.

[5] The neighborhood of y^0_{it-j} can be determined by choosing a smoothing parameter, whereby this parameter constitutes the percentage of data points that are to be included in the neighborhood. If the parameter is chosen to be large, the relationship between y^0_{it-j} and y_{it} will appear very smooth, whereas a very small smoothing parameter results in "overfitting", which can make it difficult to discern a general relationship.

[6] Among the control variables, a noticeable and perhaps surprising phenomenon is that the negative coefficient on food aid appears robustly in all specifications. This is the case despite the fact that both aid and lagged aid are treated as sequentially exogenous in the estimation and are thus instrumented for in the GMM framework. Furthermore, it is interestingly the lagged variable for which the negative effect is consistently significant. Similar results with respect to food aid were found in another study using the same data set (Carter et al. 2005). A further paper examining the impact on food aid on welfare in three regions in Ethiopia including South Wollo (Mathys, 1999) also points in a similar direction (though less pointedly), finding that while in the short term asset sales are somewhat reduced with food aid, months later households tend to resort back to elevated sales. While the impact of food aid on assets is not central to our paper, the somewhat disheartening results from this and other studies on the same region suggest a more in depth look at this question in a way that specific policy insights for the design of food aid programs can be gained.