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Asset Dynamics in Northern Nigeria

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ABSTRACT

This paper examines household asset dynamics and gender-differentiated asset inequality over a 20-year period (1988–2008) in northern Nigeria. We show that the initial endowments of both household capital and livestock holdings are inconsistent with the poverty trap hypothesis but that tracking rules for households in panel surveys may lead to differences in empirical results on poverty traps. We also investigate whether initial household endowments contributed to gender-differentiated future asset levels and asset inequality. Initial livestock holdings have an effect on women's future livestock holdings but not on their livestock shares within the household, as the effect of initial livestock holdings on men's future livestock levels was much greater than its effect on women's levels. The mechanism through which asset levels differed was related to the relative prices of the assets in gender-differentiated asset portfolios. Men, who primarily held larger livestock with larger unit values, benefited from large price increases in high-value livestock, while women held lower-value livestock. These price fluctuations reinforced gender asset inequality within households for both types of assets considered.

Keywords: asset dynamics, poverty traps, gender, Nigeria

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1. INTRODUCTION

Poverty dynamics reveal critical information regarding the transition paths that households experience while moving out of or slipping into poverty over time. Whether households can "grow" themselves out of poverty or are constrained by their initial conditions has led to a fundamental interest in exploring poverty dynamics with differing policy implications. In the neoclassical growth model, diminishing marginal returns on capital implies convergence of heterogeneous asset endowments over time. However, if borrowing constraints or indivisible investments constrain households, as in Galor and Zeira (1993) or Banerjee and Newman (1993), then bifurcated asset dynamics depending on the household's initial conditions result in poverty traps.

Much recent attention in the poverty dynamics literature has focused on asset dynamics (see, for example, Addison, Hulme, and Kanbur 2009; Carter and Barrett 2006; Baulch and Hoddinott 2000). We examine two questions in the poverty dynamics literature using a 20-year panel in northern Nigeria. First, we investigate the role that initial household endowments may have in future household asset growth to contribute to the debate regarding asset convergence and the existence of poverty traps. Second, we investigate the role that initial household endowments may have in men's and women's future intrahousehold inequality levels.

Numerous studies in Sub-Saharan Africa—such as Barrett, Carter, and Little (2006); Peters (2006); Adato, Carter, and May (2006); Barrett and others (2006); Whitehead (2006); Little and others (2006); and Barrett, Bezuneh, and Aboud (2001)—demonstrate that initial endowment levels influence growth patterns and are therefore essential to generating improved welfare over time. However, there is less consensus in the literature regarding the nature of growth dynamics, especially about the existence of convergence or poverty traps. A collection of studies conduct econometric tests to try to identify poverty traps using household data and find evidence in support of the presence of poverty traps (Carter et al. 2007; Adato, Carter, and May 2006; Barrett et al. 2006; Lybbert et al. 2004; Zimmerman and Carter 2003; Carter and May 2001). In contrast, a number of studies—such as Quisumbing and Baulch (2009), Antman and McKenzie (2007), Naschold (2006, 2008), Jalan and Ravallion (2004), and Lokshin and Ravallion (2004)—do not find evidence of poverty traps. In addition to variation across study sites, detection of poverty traps within the previously mentioned studies is predicated on the asset used to construct the asset measure (livestock) and whether households in the samples analyzed are drawn from primarily rural areas. We investigate household asset dynamics in northern Nigeria using a unique panel dataset to address the debate between asset convergence and poverty traps using both measures of household assets and livestock.

In this paper, we draw attention in our analysis to the concept of the household used for tracking purposes to test whether asset dynamics may differ across household units. We tracked households that were originally surveyed in 1988 (Udry 1990) and collected an additional round of data from them in 2008, as well as from individuals who had split from the original household within their village and formed new households. In our analysis, we investigate differences between the subsample of original households, split households, and the full pooled sample. One further construct of the household is the household dynasty, which we construct from the set of original households in 1988 and all branches of the household found in 2008. That is, the combination of original and split households in 2008 is considered a single unit if they were derived from the same 1988 household. This unit of analysis may more accurately capture wealth accumulation over generations.

We also investigate the role that initial household asset levels may have on men's and women's future intrahousehold inequality as measured by both levels of gender-differentiated assets and asset shares by gender. Few empirical studies present results of gender differentiated asset dynamics, with the notable exceptions of Quisumbing (2009), Deere and Doss (2006), as well as Antonopoulos and Floro (2005). Building on previous work, Quisumbing (2009) demonstrates that asset stocks are accumulated and drawn down differently in Bangladesh, depending on whether husbands or wives own them. Assets serve not only as a store of wealth and a means of production, but also serve as a buffer against

unexpected shocks as the effects of shocks are not shared equally by household members (Hoddinott 2006). Additional evidence further emphasizes the need to consider the implications of intrahousehold decisionmaking and resource allocation inequality in rural agricultural contexts on individual and household welfare (see, for example, Quisumbing and Baulch 2009, Quisumbing and de la Brière 2000, Thomas 1997, Dey Abbas 1997, Quisumbing 1996, and Hoddinott and Haddad 1995).

Building on this work, we show that the effect of initial endowments of both household capital and livestock holdings are not consistent with a poverty trap interpretation over our 20-year study period, but that tracking rules for households in panel surveys may lead to differences in empirical results on poverty traps. We also investigate whether initial household endowments contribute to gender-differentiated future asset levels and asset inequality. Initial livestock holdings appear to have some effect on levels but not on shares of livestock holdings, as the effect of initial livestock holdings on men's livestock levels is much greater than its effect on women's livestock levels. The mechanism through which differential asset stocks grew over the 20-year period is related to the relative prices of the assets in gender-differentiated portfolios. Men, who primarily held livestock, saw large price increases in the value of their assets and also held assets that biologically multiply (such as livestock), whereas women's assets were primarily held as goods, both durables and jewelry, whose value increased marginally. The price of livestock may have been driven by expansion of land cultivated in the villages and the intensification of agriculture associated with population growth, which, in turn, increased demand for bullocks to plow.

In the next section, we briefly review studies that investigate asset dynamics with emphasis on initial endowments and gender differences over longer time horizons. In the third section, we outline the econometric strategy that we employ to answer the two central questions of this paper. The fourth section describes the data collected by the authors to create a 20-year panel survey from households in northern Nigeria. We discuss the tracking process whereby we traced individuals from households surveyed in 1988 to their current households in 2008 within the original survey villages. The fifth section describes the descriptive statistics and key variables used in the analysis. The sixth section presents our empirical results, and the last section concludes.

2. ASSET DYNAMICS AND INTRAHOUSEHOLD ASSET INEQUALITY

Recent reviews of the poverty dynamics literature have assessed both theoretical and empirical findings in household poverty dynamics, including findings by Addison, Hulme, and Kanbur (2009), Carter and Barrett (2006), and Baulch and Hoddinott (2000).[1] We briefly review the papers in this literature that are of particular importance to understanding the effects of initial asset endowments on asset dynamics and intrahousehold asset inequality. Carter and Barrett (2006) provide a comprehensive theoretical framework for microeconomic poverty traps and bifurcated asset accumulation. Poverty traps may exist due to initial endowments (skills, saving propensities, discount rates, geographic locations, agroecological environment, disease burden, conflict and instability) or the presence of locally increasing returns, both of which impede asset accumulation and engender the presence of multiple equilibria. Locally increasing returns to assets may exist to differences in the type of production technology available to households or the risk aversion of households. If there exist locally increasing returns to technology or minimum size requirements for profitability in a given activity, then we expect that nonlinearities in household production could result in bifurcated asset dynamics. Alternatively, differences in risk preferences could yield differing allocations of assets with risk averse households allocating assets to low-risk, low productivity activities.

In a context where the aforementioned factors are present, households with lower initial endowment levels can be considered structurally poor because they are unable to accumulate assets at a high enough rate to rise above a critical minimum threshold point and catch up with wealthier households. As such, multiple (bifurcated) asset accumulation equilbiria can exist for poorer and wealthier households. Poverty traps can also exist, and be exacerbated, when households with lower levels of initial endowments do not have access to functioning capital and credit markets to help them reach a higher asset level equilibrium above the poverty line.

Recent studies that have focused on Sub-Saharan Africa have reached differing conclusions on the effect of initial endowments of either assets or skills on welfare trajectories. A group of studies, including Carter et al. (2007), Adato, Carter, and May (2006), Barrett, Carter, and Little (2006), Lybbert et al. (2004,) Zimmerman and Carter (2003), and Carter and May (2001), find evidence in support of the presence of poverty traps in Sub-Saharan Africa. For instance, Lybbert et al. (2004) find that multiple dynamic equilibria exist when studying wealth dynamics in pastoralist areas of southern Ethiopia. In KwaZulu-Natal, the easternmost province of South Africa, Adato et al. (2006) also find evidence of bifurcated asset dynamics when examining asset accumulation. They show that wealthier households are more effective in using social capital to take advantage of improved production technologies and higher return livelihoods; meanwhile, social capital was insufficient to overcome a lack of productive asset holdings to permit growth for poorer households. Barrett, Carter, and Little (2006) demonstrate the presence of poverty traps in remote regions when studying returns to assets and risk management behavior in the northern rangelands of Kenya and the southern highlands of Madagascar. Similar to the results from Adato, Carter, and May (2006), this study illustrates that wealthier households in Madagascar were better able to adopt enhanced production technology, considerably boosting crop yields. Disadvantaged households, on the other hand, were effectively prevented from taking up such technology due to their relative lack of credit, insurance, and labor.

In Ghana, Whitehead (2006) demonstrates that farmers with greater initial stocks of land, livestock, and male labor are able to take advantage of new higher-value crops and improved plowing technology. Those with lower endowments produced lower yields and accessed inferior terms of trade, relative to their wealthier counterparts, leading to weaker wealth accumulation. In Côte d'Ivoire, Barrett, Bezuneh, and Aboud (2001) also show that the ability of households to take advantage of nonfarm and emerging opportunities, especially those facilitated by macroeconomic policy adjustments, can be

[1] Carter and Barrett (2006) categorize poverty measures in four generations: (1) static income or expenditure poverty, (2) dynamic income or expenditure poverty, (3) static asset poverty, and (4) dynamic asset poverty. Assets are a particularly important indicator of household welfare because asset stocks fluctuate less widely than do consumption or income measures.

predicated by ex-ante conditions. In particular, they show that those with greater initial skill and land endowments benefit disproportionately relative to their poorer counterparts. Consequently, it becomes clear that initial endowment levels and returns to those stocks are strong predictors of improved welfare over time across a wide variety of circumstances.

In contrast, other studies have found no evidence of poverty traps, including Quisumbing and Baulch (2009), Antman and McKenzie (2007), Lokshin and Ravallion (2004), as well as Jalan and Ravallion (2004). In many cases, such as Lokshin and Ravallion (2004) in Hungary and Russia as well as Jalan and Ravallion (2004) in China, studies find evidence of nonlinear income dynamics, but do not demonstrate any presence of multiple dynamic equilibria and poverty traps. This is also the case with Antman and McKennzie's (2007) study in Mexico investigating the dynamics of labor earnings, income, and expenditures. In Bangladesh, Quisumbing and Baulch (2009) do not find evidence of multiple equilibria and bifurcated asset dynamics when investigating land and nonland assets. They do, however, demonstrate the presence of one low-level asset equilibrium. These results suggest that the presence of functioning land, labor, and credit markets are instrumental in coping with shocks, facilitating consumption smoothing, and accumulating assets, in order to overcome potential poverty traps.

Among the poverty dynamics studies mentioned, few investigate the determinants of intrahousehold asset inequality. Despite generally having control of a smaller asset endowment than men, intrahousehold asset inequality is an outcome of interest in and of itself (Deere and Doss 2006). Thomas (1997) illustrates this with data from Brazil, which shows that women spend considerably more on education, health, and household services, which leads to higher per capita calorie and income intake, than their male counterparts.[2] These findings, which correspond closely with those from Hoddinott and Haddad (1995) in Côte d'Ivoire and Quisumbing and de la Brière (2000) in Bangladesh, further document the prevalence of gender inequities in asset accumulation, as well as the presence of gender heterogeneity in intrahousehold resource allocation patterns.

In rural, agricultural contexts, resource allocation asymmetries, which are closely related to intrahousehold bargaining power inequities, are also evident in differential levels of input use and productivity on men's and women's plots. Dey Abbas (1997) highlights the role that gender asymmetries play in diminishing female productivity in The Gambia, particularly in limiting their ability to adopt productivity-enhancing technologies. Oladele and Monkhei (2008) demonstrate that this asymmetry is also an issue with respect to livestock in Botswana, where men are more likely to own cattle, donkeys, and horses, as opposed to women, who are considerably more likely to own goats that are less valuable for powering plows and producing manure fertilizer. Similarly, in Ethiopia, Pender and Gebremedhin (2006) show a negative association between the use of oxen and female household heads. They also illustrate that crop yields for female-headed households are 42 percent lower than for male-headed households (when holding other factors such as labor and oxen use constant).

Intrahousehold bargaining power, resource allocation asymmetries, and cultural norms invariably have an impact on household asset dynamics and individual members. This is particularly well demonstrated by Quisumbing (2009) in Bangladesh, where the manner in which asset stocks are accumulated and drawn down varies according to who in the household owns them: men, women, or jointly. Few studies on gender differentiated asset dynamics are available; as such the finding that husbands' asset stocks are primarily spent to cope with dowry and wedding expenses, while wives' endowments are chiefly drawn down to overcome illness shocks over time, is particularly instructive. In addition, Quisumbing (2009) illustrates that inheritance receipts at any time in the preceding ten years can be associated with increases in husbands' asset holdings, but only inheritances received five to ten years ago are positively associated with growth in wives' asset endowments.

[2] Interestingly, this large dichotomy in gender income effects is reduced when reducing the sample to households that include both mothers and fathers who participate in the labor market.

3. ECONOMETRIC STRATEGY

The econometric strategy used to estimate the effects of initial household endowments on asset dynamics and intrahousehold inequality is motivated by the poverty dynamics literature, where lagged assets and household and village characteristics determine future asset stocks, subject to stochastic shocks over time (Carter and Barrett 2006; Barrett et al. 2006; Quisumbing and Baulch 2009). In our analysis, we consider two types of assets: the value of household capital, which includes household durable goods, and livestock holdings. In equation (1), one candidate specification would be to regress lagged per capita assets (capital or livestock) of household *h* in 1988; a set of household head and household characteristics (*X*), including the household head's age and education, household composition (number of men, women, and dependents), and per capita landholdings; and self-reported household shocks from 1989 to 2008 (deaths, illnesses, theft, and destruction of crops and livestock) on asset growth, which is defined as the difference in logarithms of the per capita asset holdings in 2008 and 1988. The equation also includes village indicators to account for village observed and unobserved heterogeneity.

$$\ln assets_{h,2008} - \ln assets_{h,1988} = \alpha \ln assets_{h,1988} + \beta \ln X_{h,1988} + \delta shocks + \varepsilon_{v,h,t}. \quad (1)$$

In equation (1), we are primarily concerned with the sign of α. If $\alpha > 0$ in equation (1), then this suggests increasing returns on assets and potential evidence of poverty traps. If $\alpha < 0$, then evidence for the neoclassical theory of asset convergence is suggested by the data. However, a potential weakness with this approach is that lagged assets are likely correlated with unobservable household characteristics, such as entrepreneurial ability, risk aversion, or political connectedness that may augment asset growth. While we cannot completely rule out the effect of unobservables on our estimates of the effect of lagged assets on asset growth, we control for serial correlation between asset stocks in lagged time periods by considering the lagged asset values 20 years previous, following Jalan and Ravallion (2004), Barrett and others (2006), and Quisumbing and Baulch (2009), who also use lagged asset or income values, assuming that the structure of serial correlation between asset stocks is less than the lagged time period.

However, the empirical evidence in equation (1) regarding potential poverty traps is not sufficient to draw conclusions about their existence. As we noted above, if $\alpha > 1$, then we have some evidence that increasing returns on assets may exist, but Carter and Barrett (2006) and Barrett et al. (2006) note that this is not sufficient evidence to confirm the existence of a poverty trap. These authors propose two parameter tests using the specification in equation (2), where lagged household assets, squared household assets, cubed household assets, and the asset stock raised to the fourth power are included in equation (1), such that

$$\ln assets_{h,g,2008} - \ln assets_{h,1988} = \alpha_1 \ln assets_{h,1988} + \alpha_2 \ln(assets_{h,1988})^2 + \alpha_3 \ln(assets_{h,1988})^3 + \alpha_4 \ln(assets_{h,1988})^4 + \beta \ln X_{h,1988} + \delta shocks + \varepsilon_{v,h,t}. \quad (2)$$

Barrett and others (2006) propose two parameter tests to identify nonlinear asset dynamics using equation (2). A null hypothesis to test for convergence can be formulated such that. $\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = 0$. Rejection of the null hypothesis in favor of $\alpha_2 = \alpha_3 = \alpha_4 = 0$ and $-2 < \alpha_1 < 0$ suggests more rapid asset growth among poorer households and slower asset growth among wealthier households, which provides some evidence in favor of a unique dynamic equilibrium. We test this null hypothesis in the following sections to provide some evidence about the existence of convergent asset dynamics or poverty traps in our sample.

In addition to our investigation of household asset dynamics, we also estimate a second set of specifications that investigates intrahousehold inequality of assets. First, we regress lagged assets on

gender-differentiated asset holdings in 2008,[3] controlling for the same set of covariates, shocks, and village indicators as in equation (1). This specification investigates whether initial asset holdings have an effect on the levels of women's future asset holdings. However, levels of assets represent only one dimension of intrahousehold inequality. Second, we also estimate equation (1) using the share of women's assets in the household using the following specifications such that

$$\ln assetshare_{h,g,2008} = \alpha \ln assets_{h,1988} + \beta \ln X_{h,1988} + \delta shocks + \varepsilon_{v,h,t}. \quad (3)$$

For equations (1), (2), and (3), the regressions are estimated using four different groups of households to verify whether the effect of different household definitions used for tracking household units implies different parameter estimates or statistically significant behavioral relationships. The first grouping of the data includes the pooled sample: all original households and their split households. We define an original household as a household that was originally interviewed in 1988 and resides in the same location as the previous household with at least one of the following members who was previously interviewed: the household head, the household head's spouse, or the oldest adult male child of the household head. We define households that split from the originally interviewed household as the household of a person who was previously included in an original household but no longer resides in the original household, having formed a new household. The second and third groupings restrict the data to subsamples of the original versus split households to estimate whether longer-established (original) households have different asset dynamics than the split households or their combination in the pooled set. The fourth grouping of the data is the set of household dynasties, which pools the assets and characteristics of all original and split households into a single unit in 2008 for purposes of comparison to the original 1988 household. Whereas original and split households are considered distinct household units and are treated as such in the analysis, a household dynasty is the agglomeration of all household units who were derivatives of the original household and this dynasty is treated as the unit of analysis. We discuss attrition and the distribution of original and split households in the next section.

[3] We estimate the sum of the relevant assets owned by all the male household members (husbands, fathers, brothers, sons, and so forth) in comparison to those held by female household members (wives, mothers, sisters, daughters, and so forth), on data which were collected using a gender-differentiated asset module posited to a male and a female respondent within each household.

4. DATA DESCRIPTION

In 1988, a small-scale household survey was undertaken with 200 households in four rural villages near the town of Zaria, Kaduna State.[4] The dataset produced a rich set of information over the survey period on informal transactions and farm production, among other topics. In May 2008, a tracking survey was undertaken by the authors to determine whether it would be possible 20 years later to follow up with some of the individuals who were originally surveyed. In combination with the qualitative interviews that we held with village leaders and residents during the tracking survey, detailed information on the individuals from households previously surveyed in 1988 was collected to identify previously surveyed households and households that had divided to establish new households over the 20-year period.

Roster data from the 1988 survey were used to confirm members of the household, ages, and relationships between household members. Many 1988 heads of households were able to be tracked within their original villages. Due to the rural setting, a majority of individuals surveyed in 1988 remained in the village after marriage and formed new households. This is especially true for sons of the household head, who divided family assets after they were married. For tracking purposes, a household was considered original if the previously surveyed head, spouse, or oldest adult male child of the household head remained in the household. A split household was classified as a household that contained a member of an originally surveyed household who now resided in a new dwelling within the village. Unfortunately, we did not have resources to track individuals outside of their villages, but we did collect location-of-residence information for all individuals previously surveyed in 1988, which is analyzed by Dillon, Mueller, and Salau (2010).

After the tracking exercise was completed, the survey design was undertaken and fieldwork was scheduled to commence in November 2008, which corresponded closely to the date of interview from the original fieldwork in 1988. In addition to closely following the ordering, sequencing, and phrasing of questions from the original survey, the fieldwork was organized to carefully replicate the meticulous strategy described by Udry (1990), whereby male enumerators interviewed the head male, and female enumerators interviewed the head female in the household. An intensive field testing and enumerator training was also conducted to assure uniform implementation of the questionnaire in the field. Households were reinterviewed if there was at least one individual from the original survey in a household. In total, 169 of the 200 original households were tracked from the dataset in 1988 and 407 households that split from these original households were tracked within the survey villages. Therefore, there is a total of 576 households in the 2008 resurvey.

Table 1 presents evidence regarding the factors of attrition in the dataset. Of the original households, 84.5 percent were found and resurveyed in the follow-up 2008 survey. The attrition rate in the sample is within the bounds of attrition found in other panel surveys reviewed by Alderman and others (2001). In analyzing the factors from the household's 1988 characteristics that could predict attrition, we find few significant variables that predict attrition. Common sources of selection bias in other studies include wealth and household demographics,[5] which may bias estimates downward. We include in the attrition regression explanatory variables, including the age of the household head, the household head's occupation, household composition, land size by type (*gona* or *fadama* land),[6] number of livestock, value of livestock, and household assets. Among these variables, there is a negative correlation between the number of men or women in the household and attrition, while there is a positive correlation between the amount of *fadama* land owned in 1988 and attrition. While the positive correlation between

[4] This work was led by Christopher Udry, who was hosted by Ahmadu Bello University in Zaria.

[5] Education levels are very low in this sample, so concerns about higher attrition rates among the educated are not relevant in this data. We do include a variable that measures whether any household member has special skills that may be rewarded differentially in the labor market. In the estimates in Table 1, we find no effect of special skills on attrition.

[6] *Gona* land is highland and is generally considered less valuable than *fadama* land, which is defined as a lowland area that retains water throughout a longer period of the planting and growing seasons.

fadama land and attrition may mean that wealthier households were more likely to experience attrition, none of the other asset variables (livestock, assets, *gona* land) confirm this hypothesis.

Table 1. Determinants of household attrition

Total value of assets (in NGN1,000)	-0.002
	(0.002)
Total value of livestock (in NGN1,000)	0.010*
	(0.004)
Total number of livestock in tropical livestock units	0.000
	(0.011)
Age of household head	-0.001
	(0.002)
Number of men	-0.042
	(0.037)
Number of women	-0.054***
	(0.006)
Number of household head dependents	0.004
	(0.008)
Gona land size in hectares	-0.006
	(0.005)
Fadama land size in hectares	0.055*
	(0.019)
Number of observations	196
Adjusted R2	0.068

Source: Authors' calculations from 1988 northern Nigeria survey (Udry 1990) and the 2008 tracking survey conducted by the authors.
Notes: All household variables are from the 1988 data. ***p < 0.01, **p < 0.05, *p < 0.10.

The tracking study provided not only useful information on attrition in the sample but also the opportunity to undertake qualitative work in the villages and develop the household questionnaires. From these field visits, a detailed set of survey instruments was designed to replicate the interview structure used in 1988, in which a male and a female respondent were asked to report on gender-specific agriculture, asset, labor, and credit activities, among other topics. The primary design difference between the 2008 and 1988 questionnaires was the inclusion in 2008 of retrospective questions about shocks and the collection of gender-disaggregated information on a set of assets similar to those used in 1988 (household capital, livestock, and agricultural equipment).[7] Differences in household assets do not vary due to the inclusion of additional categories in the 2008 questionnaire, since the list used in the 1988 questionnaire was relied on to ensure comparability. The field research included a set of qualitative interviews both before and during the tracking exercise, which informed the design of the household questionnaire. In addition to the qualitative interviews on village and household characteristics, a community questionnaire was administered to a group of village leaders to collect information on village infrastructure.

Udry (1990) provided detailed observations on the survey villages in comparison to other anthropological work that had been conducted in the area by Norman (1972) and Norman and others (1976). The predominant crops (maize, guinea corn, and rice) cultivated by these rural agricultural

[7] The household list of durables did differ by a few items that did not exist as household durables in 1988, such as DVDs and videos, but that are a distinguishing feature of increased household wealth in 2008, as identified by our discussions with villagers during the tracking and design phases of the research.

households remained similar to those cultivated in 1988, with the exception of tobacco, sorghum, and cotton, which are now rarely grown in the villages. The timing of planting and harvest seasons in the villages has also remained invariant over time. Dry-season farming is still prevalent in the survey villages and irrigation on household plots greatly expanded. Electricity, through the use of motorized generators and electric lines, is now found in three of the four villages, but wells are still the primary source of drinking water in three of the villages, with the fourth having access to a borewell. Households reported, as in 1988, that assets in the form of livestock, agricultural equipment, and grains were their primary means of storing wealth, although village leaders also reported a higher prevalence of mutual savings, or *adashi,* groups in three of the four survey villages, as well as increased use of savings accounts in commercial banks.

5. DESCRIPTIVE STATISTICS

Following much of the literature on poverty dynamics, we take a multidimensional approach to measuring asset dynamics, because different assets have different liquidity and productive use. In Table 2, we present descriptive statistics on the differences in household asset holdings and demographic characteristics, presented in per capita terms when relevant, between the 1988 and 2008 samples. In panel A, we restrict the sample to the set of households originally surveyed in 1988 compared to the set of pooled households, which includes the original households resurveyed in 2008 as well as their splits. Both livestock and household capital values are presented in real terms.[8] Livestock value increased by 6,345 naira (NGN) in the 20-year period, which is a statistically significant difference at the 1 percent level. Household capital holdings also increased over this period by NGN350, not as large an increase as that of the households' livestock holdings. Landholdings among households did not vary significantly between the two survey rounds. Household *fadama* landholdings did show a modest increase by 0.31 hectares, while *gona* landholdings decreased by 0.8 hectares. Household demographic characteristics, including the age of the household head and the number of wives in the household, did not differ substantially among the two survey rounds, assuaging concerns that the sample may be biased by the aging of the full sample. The number of men included in the household decreased between 1988 and 2008 by 0.09 persons per capita, while the number of dependents increased by 0.16 per capita.

In panel B, we compare the households surveyed in 1988 with their dynastic equivalents in 2008. We define a household dynasty as the set of households that originated from the original household surveyed in 1988, including all split households who reside in the village. An interesting set of trends occurs when we compare livestock, capital, and landholdings from 1988 to 2008. The livestock and capital increases are consistent between the two different samples in panels A and B of Table 2, but household landholding increases are larger and statistically significant at the 1 percent level in the dynastic comparison. We would expect that the other demographic household characteristics would be larger in 2008 if population growth occurred in the villages, as our qualitative interviews suggested. However, the growth in landholdings shown in panel B suggests an extensification of agriculture rather than an intensification. *Gona*, or upland landholdings, increased twofold, while more valuable *fadama*, or lowland landholdings, increased fivefold.

Yet in panel A, which considers the original households and their splits, each household has maintained relatively constant landholdings, which suggests an egalitarian land distribution pattern within the village. This distribution pattern, coupled with population growth, as evidenced by the number of split households remaining in the village and reports of population increase, indicates that the total amount of land cultivated has increased since 1988, rather than an intensification of highly productive lands. Although the change in average household land size varies across the four villages, the increase in total land cultivated is consistent across villages in 2008 at a level of two to four times the 1988 values. It should also be pointed out that while essentially 100 percent of households reported landownership in 1988, this percentage is closer to 60 in 2008. The increase in reported landlessness in 2008, which is distributed across all four villages, likely reflects not only land constraints related to population growth, but also a shift from agricultural to nonfarm activities for some households.[9]

[8] Nominal 2008 values are deflated to generate real 2008 values based on the changes in exchange rates (US$1 = NGN4 in 1988 to NGN118 in 2008). All monetary values in the paper are converted into real values.

[9] Appendix Table A.1 makes a final comparison of asset and demographic characteristics between the original and split households. Originally surveyed households are older than the split households, as expected, but are not necessarily more asset-rich than split households. There are no statistically significant differences between original and split households in livestock or capital holdings. Original households do have 1.4 more hectares of *gona* land and 0.37 more hectares of *fadama* land than split households, although this difference is statistically significant only regarding *gona* land.

Table 2. Differences in household assets and demographics from 1988 to 2008

Panel A

Sample restriction: All households surveyed in 1988 compared with households found in 2008 including all original households and their splits

	1988		2008		Difference in means
Variable	Mean	Std. dev.	Mean	Std. dev.	
Livestock value per capita	364.51	1,132.73	6,709.86	14,983.73	6,345.35***
Household capital value per capita	209.33	342.34	559.19	702.31	349.86***
Land size *gona*	3.17	4.67	2.37	5.49	-0.80*
Land size *gona* per capita	0.49	1.03	0.35	0.83	-0.14*
Land size *fadama*	0.43	1.03	0.74	2.64	0.31
Land size *fadama* per capita	0.07	0.24	0.11	0.36	0.04
Household head age	39.83	13.38	40.50	15.07	0.67
Household head primary school attendance	0.14	0.34	0.44	0.50	0.30***
Number of household wives per capita	0.24	0.23	0.21	0.13	-0.03**
Number of household men per capita	0.36	0.31	0.27	0.17	-0.09***
Number of household dependents per capita	0.45	0.33	0.61	0.21	0.16***
Observations	200		574		

Panel B

Sample restriction: All households surveyed in 1988 compared with their dynastic equivalent (pooled original and split households) in 2008

	1988		2008		Difference in means
Variable	Mean	Std. dev.	Mean	Std. dev.	
Livestock value per capita	364.51	1,132.73	5,432.21	7,201.48	5,067.70***
Household capital value per capita	218.05	25.02	1,755.59	2,016.75	1,537.54***
Land size *gona*	3.17	4.67	7.63	10.23	4.46***
Land size *gona* per capita	0.49	1.03	0.34	0.59	-0.15
Land size *fadama*	0.43	1.03	2.37	4.89	1.94***
Land size *fadama* per capita	0.07	0.24	0.10	0.22	0.03
Household head age	39.83	13.38	55.37	15.65	15.54***
Household head primary school attendance	0.14	0.34	0.63	0.48	0.49***
Number of household wives per capita	0.24	0.23	0.19	0.08	-0.05***
Number of household men per capita	0.36	0.31	0.27	0.13	-0.09***
Number of household dependents per capita	0.45	0.33	0.66	0.13	0.21***
Observations	200		178		

Source: Authors' calculations from 1988 northern Nigeria survey (Udry 1990) and the 2008 tracking survey conducted by the authors.

Note: Nominal 2008 values are deflated to generate real 2008 values based on the changes in exchange rates (US$1 = NGN4 in 1988 to NGN118 in 2008). ***p < 0.01, **p < 0.05, *p < 0.10.

In Table 3, we present the value of household livestock and capital holdings in 2008, disaggregated by gender. Differences in the value of livestock and capital holdings disproportionately favor men in both the sample that includes original and split households (panel A) and the one that looks at dynasties (panel B). In both samples we also see that livestock value shares for males are consistently greater than those for females. Meanwhile, we do not find this to be the case with capital value shares, which are greater for females when considering original and split households (panel A) as well as for household dynasties (panel B).

Table 3. Gender-differentiated assets per capita in 2008

Panel A Sample restriction: Households found in 2008 including all original households and their splits						
		Male		Female		Difference in means
		(3.96 males per household)		(4.05 females per household)		
Per capita variable	Obs.	Mean	Std. dev.	Mean	Std. dev.	
Livestock value	504	11,994	36,543	4,645	8,778	7,348***
Livestock asset share		0.209		0.177		0.032
Household capital value	574	627	1,144	542	648	85.60**
Household capital asset share		0.181		0.196		-0.015
Panel B **Sample restriction: All dynastic households (pooled original and split households) in 2008**						
		Male		Female		Difference in means
		(12.68 males per household)		(12.94 males per household)		
Per capita variable	Obs.	Mean	Std. dev.	Mean	Std. dev.	
Livestock value	170	35,498	78,994	13,234	18,841	22,263***
Livestock asset share		0.071		0.066		0.005
Household capital value	178	1,950	2,607	1,648	1,855	301.91**
Household capital asset share		0.069		0.082		-0.013

Source: Authors' calculations from 1988 northern Nigeria survey (Udry 1990) and the 2008 tracking survey conducted by the authors.
Note: Nominal 2008 values are deflated to generate real 2008 values based on the changes in exchange rates (US$1 = NGN4 in 1988 to NGN118 in 2008). ***p < 0.01, **p < 0.05, *p < 0.10.

Distinctions between nominal and real values in 2008[10] suggest that for some types of livestock, such as fowl, goats, sheep, and donkeys, the real change has not been nearly as large as the change for cows and bulls. Given that cows and bulls are predominantly owned by males for use in field plowing (or as a means of saving), these descriptive statistics suggest that the overall increase in median livestock values over the 20-year period has been inequitably in favor of the asset portfolio choices of men. The increase in cow and bull prices is not surprising, given the mounting population pressure and resulting demand for land, which likely drove up sharply the demand for bullocks to plow.

To provide some descriptive information on the transitions that households and dynasties have made over time, transition matrices are presented in Table 4. These matrices include household per capita asset levels (panel A) and women's asset shares (panel B) in 2008 disaggregated by asset value groups above and below the mean per capita holdings in 1988, for both pooled and dynastic household samples. The mean real value of household capital holdings in 2008 is similar whether the household began above or below the mean 1988 value. These descriptive transition patterns do not hold in the case of the household livestock holdings. Sixty-one percent of households who initially had a below-mean value of livestock holdings in 1988 still had low livestock holdings in 2008. However, 57 percent of households who began 1988 with an above-mean value of livestock holdings maintained their high livestock holdings in 2008. This suggests that although there was substantial movement in household asset holdings, there was less movement among households' livestock holdings. Whether this increased mobility suggests convergence in asset holdings or a poverty trap with respect to livestock holdings must be estimated empirically in order to understand the determinants of asset growth, in addition to movements within the distribution of a household's asset or livestock holdings.

[10] See Appendix Table A.2.

Panel B of Table 4 considers women's asset and livestock shares. Women whose households had initially higher asset holdings maintain this advantage when compared to those women whose households had initially lower asset holdings in 1988. However, livestock shares in 2008 are lower for women whose households had initially higher livestock holdings in 1988. Differences in women's asset and livestock shares in 2008 are small when compared to those who had initially high or low household asset or livestock levels in 1988.

Table 4. Transition matrices

		Panel A							
		Variable:	2008 household asset holdings		2008 household asset holdings		2008 household livestock holdings		2008 household livestock holdings	
		Sample restriction:	Pooled		Dynasty		Pooled		Dynasty	
			Below mean holdings	Above mean holdings	Below mean holdings	Above mean holdings	Below mean holdings	Above mean holdings	Below mean holdings	Above mean holdings
1988 asset holdings	Below mean holdings	N	119	136	47	38	153	98	50	32
		% within category	*47%*	*53%*	*55%*	*45%*	*61%*	*39%*	*62%*	*38%*
		Value in 2008 real NGN	267	832	700	2,877	921	9,991	3,422	28,747
	Above mean holdings	N	145	131	41	43	122	165	36	50
		% within category	*53%*	*47%*	*47%*	*53%*	*43%*	*57%*	*42%*	*58%*
		Value in real NGN	265	799	462	2,753	1,165	13,730	5,458	44,144

		Panel B				
		Variable:	2008 women's asset share	2008 women's asset share	2008 women's livestock share	2008 women's livestock share
		Sample restriction:	Pooled	Dynasty	Pooled	Dynasty
1988 asset holdings	Below mean holdings	N	255	85	251	82
		% within category	*48%*	*50%*	*47%*	*49%*
		Asset share	50	48	44	51
	Above mean holdings	N	276	84	287	86
		% within category	*52%*	*50%*	*53%*	*51%*
		Asset share	54	52	41	38

Source: Authors' calculations from 1988 northern Nigeria survey (Udry 1990) and the 2008 tracking survey conducted by the authors.
Notes: Transition matrices are conditional on capital and livestock ownership in 1988. Nominal 2008 values are deflated to generate real 2008 values based on the changes in exchange rates (US$1 = NGN4 in 1988 to NGN118 in 2008).

6. EMPIRICAL RESULTS

Table 5 shows results of estimating equation (1), the asset growth regression for capital holdings and livestock holdings, restricting the sample to the set of pooled households (all original and split households), original households, split households, and dynasties. These results provide interesting insights into differential asset growth of households over the period of 1988 to 2008. Both capital and livestock growth regressions yield negative lagged asset coefficients across all sample restrictions. These negative coefficients of the lagged asset variables are consistent with convergence of asset stocks predicted by the neoclassical growth model. However, the rates of convergence between capital and livestock growth regressions differ substantially across the definitions of household units. The lagged capital coefficient in the pooled, original, and split household regressions (columns 1, 3, and 5 in Table 5) are quite similar (-1.164, -1.109, and -1.196, respectively), but they differ considerably from the lagged capital coefficient among household dynasties (-3.282 in column 7). The lagged capital coefficient among the pooled, original, and split households is statistically significant at the 1 percent level, while the coefficient for the dynastic households is statistically significant at the 5 percent level. Differences in lagged capital coefficients between the pooled, original, and split households and the dynastic households suggest that intergenerational convergence of assets is stronger among the dynastic sample than among other household definitions.

The lagged livestock coefficient among the pooled sample of households (column 2) and the split households (column 6) are also similar (-1.081 and -1.157), followed by the original sample (-0.876 in column 4). On the other hand, we find a much smaller negative effect of lagged livestock on the sample of household dynasties (-0.108 in column 8). The coefficient results are statistically significant at the 1 percent level for the pooled and split households and at the 10 percent level for original households, but not statistically significant for household dynasties. These results suggest that increases in livestock holdings are concentrated in the split households, which would be consistent with extensification of land use associated with the expansion of households in these four villages. Further, dynastic livestock holdings are relatively constant over time. This may be due to the intergenerational transfer of livestock between older and younger households over time. It may also explain the differences in coefficient estimates of lagged livestock holdings on livestock growth between originally surveyed households and split households, as older households transfer control of their livestock positions over time to younger generations.

As described in the econometric strategy, estimates of the coefficient of lagged assets provide only suggestive evidence about convergence or increasing returns on assets. Carter and Barrett (2006) proposed two parameter tests that we implemented after estimating equation (2). These results are summarized in Table 6. We find evidence to reject the hypothesis of poverty traps in most of our specifications where the parameter tests $\alpha_2 = \alpha_3 = \alpha_4 = 0$ and $-2 < \alpha_1 < 0$ are rejected, with the exception of the livestock growth specifications for the original household subsample. This suggests that the decision regarding which households to track over time (which may have different asset accumulation strategies) has implications for the empirical results of poverty trap tests. Few robustness tests of this type have been carried out in the literature to assess the sensitivity of empirical tests of poverty traps.

In addition to establishing the existence of convergence or poverty traps among our household sample, a neglected component of analysis within the poverty dynamics literature has been that of gender-differentiated asset inequality. We begin our empirical investigation by regressing lagged initial household asset holdings in 1988 on male and female asset levels in 2008, controlling for the same set of covariates, shocks, and village indicators as above. These results are presented in Table 7. Comparisons between the coefficient estimates of the male and female regressions suggest the differential effects of the household's initial asset holdings on men's and women's future asset holdings. We also test whether the coefficient estimate is significantly different from zero and present the p-value in Table 7. Initial household livestock holdings have a much larger effect on men's future livestock holdings than on women's future livestock holdings in all the subsamples of tracked households. The descriptive statistics

suggest a mechanism that may explain why women's livestock shares do not increase along with higher livestock holdings. Women's asset portfolios are primarily concentrated in smaller, lower valued animals (such as poultry) than are those of men, who tend to hold larger, higher valued livestock (such as cows). As the median price of higher valued livestock increased more rapidly than that of lower-valued livestock over the 20-year survey period, the livestock portfolios of men increased more rapidly than those of women.

We also find evidence to reject the hypothesis that the male capital holdings coefficient is statistically different than zero (p-value = 0.038), but we do not find evidence for this hypothesis in the female regression (p-value = 0.124). However, the effect of initial capital holdings on men's and women's future capital holdings is not found to be statistically significant, with the exception of the dynastic households. Among the dynastic households, the effect of the dynasty's initial capital holdings is statistically significant and negative, more so with respect to men's capital holdings than to women's capital holdings. Overall, these results suggest that men capture more of the gains in livestock holdings over time than do women, given initial holdings. However, initial household capital holdings do not appear to have a statistically significant effect on gender-differentiated levels of capital across household types.

In Table 8, we estimate one measure of asset inequality among households, the gender-differentiated asset share, as specified in equation (3). As in our other specifications, we restrict the sample to pooled, original, split, and dynastic households. Women's capital share and women's livestock holdings are generally not affected by the initial capital or livestock holdings of the household. None of the lagged capital coefficients estimated from equation (3) are statistically significant at the 10 percent level, with the exception of women's livestock share among dynastic households. Further, tests of the null hypothesis that the lagged capital and livestock coefficient is equal to zero show that it cannot be rejected. However, all coefficients of the effect of households' initial assets on women's future asset shares are negative. With respect to women's livestock shares in dynastic households, we do find evidence that as household livestock holdings increase, women's livestock shares decrease. However, these effects may be more closely related, as described above, to differences in the relative prices of the livestock holdings in men's and women's livestock portfolios than other factors.

Table 5. Asset growth regression results

Dependent variable:	Capital growth	Livestock growth	Capital growth	Livestock growth	Capital growth	Livestock growth	Capital growth	Livestock growth
Sample restriction:	*Pooled*	*Pooled*	*Original household*	*Original HH*	*Split household*	*Split household*	*Dynasties*	*Dynasties*
Ln capital/livestock per capita in 1988	-1.164***	-1.081***	-1.109***	-0.876*	-1.196***	-1.157***	-3.282**	-0.108
	(0.042)	(0.128)	(0.046)	(0.287)	(0.048)	(0.118)	(0.945)	(1.010)
Number of observations	562	562	163	163	399	399	164	163
Adjusted R2	0.816	0.236	0.764	0.178	0.835	0.251	0.267	0.222

Source: Authors' calculations from 1988 northern Nigeria survey (Udry 1990) and the 2008 tracking survey conducted by the authors.
Notes: Village fixed effects included. Household characteristics included are the log of household head age, a household head schooling dummy, land holdings, and household composition variables, including the number of wives of the head, and the number of men, women, and dependents in the household. Robust standard errors in parentheses. Wald statistics for the test of the null hypothesis and their significance level using the wild bootstrap are indicated in brackets. ***p < 0.01, **p < 0.05, *p < 0.10.

Table 6. Asset growth regressions results with quadratic lagged assets

Dependent variable:	Capital growth	Livestock growth	Capital growth	Livestock growth	Capital growth	Livestock growth	Capital growth	Livestock growth
Sample restriction:	*Pooled*	*Pooled*	*Original Household*	*Original household*	*Split household*	*Split household*	*Dynasties*	*Dynasties*
Ln capital/livestock per capita in 1988	-1.133***	-4.034	-0.513	-2.917	-1.719***	-4.865**	-15.945	2.794
	(0.103)	(2.313)	(0.532)	(5.126)	(0.113)	(1.483)	(8.218)	(6.047)
Ln capital/livestock per capita in 1988 squared	-0.349*	0.924	-0.680**	0.565	0.009	1.289	2.509	0.983
	(0.117)	(1.166)	(0.174)	(2.136)	(0.080)	(0.948)	(6.077)	(3.302)
Ln capital/livestock per capita in 1988 cubed	0.098*	-0.101	0.166**	-0.047	0.023	-0.162	-0.069	-0.475
	(0.032)	(0.197)	(0.032)	(0.324)	(0.022)	(0.174)	(1.311)	(0.624)
(Ln capital/livestock per capita in 1988)^4	-0.007*	0.004	-0.012**	0.001	-0.002	0.007	-0.010	0.040
	(0.002)	(0.011)	(0.002)	(0.016)	(0.002)	(0.010)	(0.086)	(0.038)
$\alpha_2 = \alpha_3 = \alpha_4 = 0$	0.124	0.031	0.032	0.353	0.003	0.002	0.004	0.083
$-2 < \alpha_1 < 0$	0.003	0.136	0.000	0.129	0.047	0.058	0.020	0.095
Number of observations	562	562	163	163	399	399	164	163
Adjusted R2	0.832	0.275	0.780	0.187	0.851	0.298	0.267	0.238

Source: Authors' calculations from 1988 northern Nigeria survey (Udry 1990) and the 2008 tracking survey conducted by the authors.

Notes: Village fixed effects included. Household characteristics included are the log of household head age, a household head schooling dummy, land holdings, and household composition variables, including the number of wives of the head, and the number of men, women, and dependents in the household. Robust standard errors in parentheses. Wald statistics for the test of the null hypothesis and their significance level using the wild bootstrap are indicated in brackets. ***p < 0.01, **p < 0.05, *p < 0.10.

Table 7. Women's and men's asset regression results

Dependent variable:	Women's capital holdings in 2008	Women's livestock holdings in 2008	Women's capital holdings in 2008	Women's livestock holdings in 2008	Women's capital holdings in 2008	Women's livestock holdings in 2008	Women's capital holdings in 2008	Women's livestock holdings in 2008
Sample restriction:	*Pooled*	*Pooled*	*Original household*	*Original household*	*Split household*	*Split household*	*Dynasties*	*Dynasties*
Capital/livestock per capita in 1988	0.035	1.534***	0.051	0.485***	0.046	2.286***	-0.735**	3.199**
	(0.114)	(0.158)	(0.397)	(0.163)	(0.050)	(0.488)	(0.347)	(1.619)
$\alpha = 0$	0.778	0.002	0.907	0.059	0.432	0.018	0.124	0.143
Dependent variable:	Men's capital holdings in 2008	Men's livestock holdings in 2008	Men's capital holdings in 2008	Men's livestock holdings in 2008	Men's capital holdings in 2008	Men's livestock holdings in 2008	Men's capital holdings in 2008	Men's livestock holdings in 2008
Sample restriction:	*Pooled*	*Pooled*	*Original household*	*Original household*	*Split household*	*Split household*	*Dynasties*	*Dynasties*
Capital/livestock per capita in 1988	0.721	7.439*	-0.363	8.671*	1.018**	6.906***	-1.110***	9.547*
	(0.556)	(3.799)	(0.231)	(4.480)	(0.396)	(2.359)	(0.311)	(5.097)
$\alpha = 0$	0.285	0.145	0.214	0.148	0.083	0.061	0.038	0.158
Number of observations	556	556	161	161	395	395	170	170

Source: Authors' calculations from 1988 northern Nigeria survey (Udry 1990) and the 2008 tracking survey conducted by the authors.
Notes: Village fixed effects included. Household characteristics included are the log of household head age, a household head schooling dummy, land holdings, and household composition variables, including the number of wives of the head, and the number of men, women, and dependents in the household. Robust standard errors in parentheses. Wald statistics for the test of the null hypothesis and their significance level using the wild bootstrap are indicated in brackets. ***p < 0.01, **p < 0.05, *p < 0.10.

Table 8. Women's asset shares regression results

Dependent variable:	Women's capital share in 2008	Women's livestock share in 2008	Women's capital share in 2008	Women's livestock share in 2008	Women's capital share in 2008	Women's livestock share in 2008	Women's capital share in 2008	Women's livestock share in 2008
Sample restriction:	*Pooled*	*Pooled*	*Original household*	*Original household*	*Split household*	*Split household*	*Dynasties*	*Dynasties*
Capital/livestock per capita in 1988 (NGN1,000 units)	-0.051	-0.032	-0.077	-0.026	-0.012	-0.057	-0.016	-0.028**
	(0.035)	(0.034)	(0.137)	(0.021)	(0.029)	(0.062)	(0.092)	(0.011)
$\alpha = 0$	0.234	0.425	0.611	0.307	0.709	0.421	0.875	0.084
Number of observations	558	558	162	162	396	396	170	170

Source: Authors' calculations from 1988 northern Nigeria survey (Udry 1990) and the 2008 tracking survey conducted by the authors.
Notes: Village fixed effects included. Household characteristics included are the log of household head age, a household head schooling dummy, land holdings, and household composition variables, including the number of wives of the head, and the number of men, women, and dependents in the household. Robust standard errors in parentheses. Wald statistics for the test of the null hypothesis and their significance level using the wild bootstrap are indicated in brackets. ***p < 0.01, **p < 0.05, *p < 0.10.

7. CONCLUSION

After reviewing the literature on poverty dynamics, we provide new evidence about household asset dynamics and asset gender inequality in Northern Nigeria. Over a 20-year period, we show that the initial household endowments of both capital and livestock holdings are not consistent with the existence of poverty traps in our sample, but that tracking rules for households in panel surveys may lead to differences in empirical results concerning poverty traps. This evidence in favor of asset convergence is similar to that found in Quisumbing and Baulch (2009), Antman and McKenzie (2007), Lokshin and Ravallion (2004), and Jalan and Ravallion (2004). In our sample we find that we can consistently reject the hypothesis of poverty traps (in seven out of eight specifications)—with the exception of livestock growth for original households. We also demonstrate that convergence is strongest among the dynastic sample of households, indicating the presence of intergenerational convergence dynamics. Further, we show that the increase in livestock holdings are concentrated in split households, which is consistent with land extensification in the survey area. This paper differs from previous contributions on poverty dynamics by also demonstrating that these convergence rates are consistent over a 20-year time horizon across distinctive subsamples of households, based on differing tracking rules for the panel. In panel data surveys, decisions about tracking original households surveyed, splits or household dynasties are necessary in assessing welfare dynamics over time. We show that the description of poverty dynamics depends on these decisions.

Our results also suggest that households are able to grow out of poverty over long time horizons rather than remain trapped in poverty. However, effective policy to reduce poverty may still require increasing households' access to productive capital for enterprises and livestock for agricultural production to increase the rate at which poverty reduction occurs within the economy, particularly in poor, remote agrarian contexts. If rates of asset growth among the poor are too slow to reduce the severe consequences of poverty, then policies to increase asset growth are necessary. Further, social protection programs that protect the poor's assets are necessary whether or not poverty traps exist if poor households are more vulnerable to shocks.

We also investigate whether initial household endowments contribute to gender-differentiated future asset levels and asset inequality. We find a positive effect of initial endowments on women's livestock holdings, but a much larger effect on men's livestock holdings. Although our coefficient estimates are negative, we find no statistically significant effects of initial capital or livestock holdings on women's asset shares. Hence, initial livestock holdings seem to have some effect on levels, but not on shares of livestock holdings, since the effect of initial livestock holdings on men's livestock levels is much greater than its effect on women's livestock levels. The lack of change in shares also suggests the need to re-evaluate the adequacy of such measures of intrahousehold inequality, which may hold relatively constant over time, despite changes in the levels of assets.

The mechanisms through which this type of gender asset inequality is reinforced over generations may differ, depending on the economic environment, in particular, agricultural production, labor, and asset markets. Our combination of both qualitative and quantitative analysis indicates that population growth among the survey villages has increased the value of land and extensified cultivation within the villages. This increased demand for land has caused some households to move out of agriculture, as evidenced by the larger share of households reporting no landholdings in the 2008 survey, but it has also increased demand for draft animals as an input into the agricultural production process. These factors favor the accumulation of men's livestock holdings, which are primarily higher-valued animals, over the growth of women's livestock holdings.

As the survey villages remain primarily rural agricultural villages, even after 20 years, changes in the labor market have been moderate, especially as men continue to work in some secondary agricultural jobs during planting or harvest season; these jobs are largely inaccessible for women in northern Nigeria. Therefore, the mechanism through which gender asset inequality has been reinforced intragenerationally is through the mechanism of changes in the relative prices of men's and women's assets. From a policy

perspective, increasing access for women to a diversified asset portfolio is a critical component of a rural poverty alleviation strategy, so that women may share in the returns on livestock along with men. If women are able to capture the gains of asset price increases over time, their ability to liquidate assets in response to shocks could greatly improve welfare for women and children within the household as well as for households as a whole.

APPENDIX: SUPPLEMENTARY TABLES

Table A.1. Differences in assets between split and original households in 2008

	Original		*Split*		*Difference in means*
Variable	Mean	Std. dev.	Mean	Std. dev.	
Livestock value per capita	6,726.80	1,9891.36	6,702.84	1,2429.47	23.96
Household capital value per capita	491.47	706.04	587.21	699.72	-95.74
Land size *gona*	3.36	6.76	1.96	4.81	1.40***
Land size *gona* per capita	0.47	0.98	0.30	0.75	0.17**
Land size *fadama*	1.00	3.14	0.63	2.41	0.37
Land size *fadama* per capita	0.14	0.50	0.09	0.29	0.05
Household head age	53.65	16.17	35.06	10.58	18.59***
Household head primary school attendance	0.21	0.41	0.54	0.50	-0.33***
Number of household wives per capita	0.21	0.13	0.21	0.13	0.00
Number of household men per capita	0.32	0.19	0.25	0.16	0.07***
Number of household dependents per capita	0.64	0.21	0.60	0.21	0.04**
Observations	168		406		

Source: Authors' calculations from 1988 northern Nigeria survey (Udry 1990) and the 2008 tracking survey conducted by the authors.
Note: Nominal 2008 values are deflated to generate real 2008 values based on the changes in exchange rates (US$1 = NGN4 in 1988 to NGN118 in 2008). ***p < 0.01, **p < 0.05, *p < 0.10.

Table A.2. Median value of livestock, by animal type in NGN

Animal type	Median nominal value in 1988	Median nominal value in 2008	Median real value in 2008	Nominal percentage change	Real percentage change
Fowl	9	367	12	358	4
Goats	65	4,183	142	4,118	77
Sheep	100	6,000	203	5,900	103
Cows and bulls	100	50,000	1,695	49,900	1,595
Donkeys	300	10,000	339	9,700	39

Source: Authors' calculations from 1988 northern Nigeria survey (Udry 1990) and the 2008 tracking survey conducted by the authors.
Note: Nominal 2008 values are deflated to generate real 2008 values based on the changes in exchange rates (US$1 = NGN4 in 1988 to NGN118 in 2008) for all households (original and split households).

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