Poor Households' Productive Investments of Cash Transfers: Quasi-experimental evidence from Niger[1]

Quentin Stoeffler[2], Bradford Mills[3] and Patrick Premand[4]

Abstract

Cash transfers programs have spread rapidly as an instrument to raise household consumption and reduce poverty. Questions remain about the sustainability of cash transfer impacts in low-income settings such as Sub-Saharan Africa and, in particular, on whether cash transfers can foster productive investments in addition to raising consumption among the very poor. This article investigates whether a cash transfer project in rural Niger induces sustained investments in assets and productive activities 18 months after its completion. Results show sustained increases in livestock assets and participation in saving groups (*tontines*). Cash transfers also contribute to improving agricultural productivity, though no effects in terms of diversification of other household enterprises are found. Evidence of investments in durable goods and housing is more limited. Overall, results suggest that cash transfer programs can have sustained impacts on productive investments among the very poor.

Keywords: Household investments, productive assets, cash transfers, long run impacts, Niger.

JEL codes: O1, Q1, I3, D91

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[2] Department of Agricultural and Resource Economics, University of California, Davis

[3] Department of Agricultural and Applied Economics, Virginia Tech

[4] Social Protection and Labor Global Practice, World Bank

1. Introduction

Social safety nets, and in particular cash transfer programs, are increasingly popular as an instrument to protect vulnerable households and reduce poverty (Fiszbein & Schady, 2009; Grosh, Del Ninno, Tesliuc, & Ouerghi, 2008). The roll-out of cash transfer programs has been particularly rapid in Sub-Saharan African over the last decade (Garcia & Moore, 2012; Monchuk, 2013).

Cash transfer programs often have dual objectives of reducing present and future poverty. Cash transfers directly raise current consumption, but most programs also have a longer-term goal of reducing future poverty. A number of pathways by which cash transfers can impact beneficiaries and contribute to sustained household investments and income growth have been identified at the micro-economic level (Alderman & Yemtsov, 2013; Barrientos, 2012). Cash transfers can relax liquidity constraints directly or indirectly by facilitating access to credit and savings. Similarly, transfers can help mitigate risks associated with variable income flows and promote investments in riskier, but higher-return, activities. Conditional Cash Transfers (CCT) programs have been shown to generate productive investments in Latin America (Gertler, Martinez, & Rubio-Codina, 2012). Cash transfers with productive components have also been shown to help households to diversify livelihoods, better manage risk and provide protection against shocks (Macours, Premand, & Vakis, 2012). However, long-term evidence of productive impacts is still limited.

The impacts of cash transfers in very low-income settings where the marginal propensity to consume additional income may be quite high have not been fully explored. In theory, the impact of regular transfers on investments is ambiguous in general, because poor households may consume the entire amount received (Deaton, 1990). Besides, in presence of poverty traps, small

regular cash transfers would not be expected to foster productive investments among the very poor (Barrett, Carter, & Ikegami, 2008). This paper empirically explores whether cash transfers lead to sustained productive impacts among very poor households in Niger, one of the poorest countries in the world. The impacts on productive and non-productive assets, as well as on productive activities, are analyzed. Specifically, a quasi-experimental design is employed to identify differences in participant and non-participant investments in assets and productive activities 18 months after termination of an unconditional cash transfer (UCT) program that provided small regular transfers. The results provide, to our knowledge, the first empirical evidence of sustained productive impacts of cash transfers after project termination among very low income households. Results show that cash transfer programs can have sustained impacts on productive investments, especially among the very poor.

The article is structured as follows. The next section briefly reviews the literature on cash transfers and possible pathways towards productive impacts, and presents the theoretical framework of the analysis. Section three describes the project, the data, and the empirical approach. Section four reports and discusses the results. The last section formulates policy recommendations and concludes.

2. Productive impacts of cash transfers: evidence and theoretical mechanisms

A Review of evidence

Originally implemented and rigorously studied in Latin America, cash transfer programs rapidly spread to Sub-Saharan Africa in the 2000s and are currently the focus of a number of impact evaluations (Davis, Gaarder, Handa, & Yablonski, 2012). The positive impact of cash transfers programs on consumption and human capital has been widely documented (Baird, Ferreira,

Özler, & Woolcock, 2013; Fiszbein & Schady, 2009; Garcia & Moore, 2012). Recently, the literature has also analyzed the *productive* impacts of cash transfers (Alderman & Yemtsov, 2013; Barrientos, 2012).

In Latin America, where cash transfers originated, beneficiaries from the Mexican program Progresa invest up to 26% of the cash they receive in productive assets (increasing in particular animal ownership, production and micro-enterprise activities). Productive investments in turn contribute to increasing consumption by 1.6 peso for each peso received (Gertler et al., 2012). Other studies in Mexico have found positive local economic spillovers on incomes and asset accumulation of non-beneficiaries (Barrientos & Sabatés-Wheeler, 2010; Sadoulet, Janvry, & Davis, 2001). In Nicaragua, cash transfers with productive components have also been shown to help households to diversify livelihoods, better manage risk and provide protection against shocks two years after the end of a program in Nicaragua (Macours, Premand, & Vakis, 2012).

In Sub-Saharan Africa, where extreme poverty is prevalent and much of the population lives in rural areas, impact evaluations have often tried to measure if (and how) cash transfer programs can help households develop income-generating activities, including agricultural activities and non-agricultural micro-enterprises, as well as savings. Transfers have been shown to increase beneficiary savings in Kenya, Tanzania, Democratic Republic of Congo, as well as borrowing for productive investments in Ethiopia (Aker, 2013; Evans, Hausladen, Kosec, & Reese, 2014; Gilligan, Hoddinott, Kumar, & Taffesse, 2009; Ward et al., 2010). Impacts on investments in private durable assets have been found in Malawi, Kenya and Ethiopia (Miller, Tsoka, & Reichert, 2009; Sabates-Wheeler & Devereux, 2010; Ward et al., 2010) and increases in livestock holding in Zambia, Malawi, Tanzania and Ethiopia (Evans et al., 2014; Gilligan et al., 2009; Miller et al., 2009; Seidenfeld & Handa, 2011; Tembo & Freeland, 2009). In Zambia,

Malawi, and Ethiopia, beneficiaries were found to also invest in agricultural production (input, high value crops, equipment, land or labor) (Gilligan et al., 2009; Hoddinott, Berhane, Gilligan, Kumar, & Taffesse, 2012; Miller et al., 2009; Seidenfeld & Handa, 2011). However, impacts on rural micro-enterprises have only been highlighted in Ethiopia (Gilligan et al., 2009). There is substantial variation in the nature of productive impacts identified across Sub-Saharan African, with most studies finding impacts on only some of the outcomes measured. These variations may in part stem from differences in the design of cash transfer programs, as well as differences in settings or beneficiary populations (Barca, Brook, Holland, Otulana, & Pozarny, 2015).[5] The sustainability of productive impacts of cash transfers remains unclear, particularly for very poor households in low-income settings. In addition, long-term evidence of productive impacts of cash transfer programs is still very limited, especially in Sub-Saharan Africa. To the best of our knowledge, our study is the first to consider sustained productive impacts of transfers after project termination.

A related recent literature has studied the impacts of one-time, cash grants on the creation and expansion of micro-enterprises. While these types of programs have different objectives than regular cash transfers used as social safety nets, they also have the potential to promote productive investments among the poor. Large lump-sum transfers may be more likely to increase investments than small, monthly cash transfers, which may have a greater effect on consumption (Haushofer & Shapiro, 2013). Cash grants have been shown to have large, sustained impacts on micro-enterprises in some studies in Sri Lanka and Uganda where strong credit constraints existed (Blattman, Fiala, & Martinez, 2013; De Mel, McKenzie, & Woodruff,

[5] Among other "mediating factors" found by a multi-country qualitative study, initial asset base matters, as relatively better-off households were more able to take advantage of the transfers to invest in productive activities (Barca et al, 2015).

2008, 2012b). Cash grants to poor households in Kenya have also generated large investments in assets, livestock and micro-enterprises (Haushofer & Shapiro, 2013). However, other studies in Uganda, Sri Lanka and Ghana find little lasting impact of the cash grants, especially among female entrepreneurs (De Mel, McKenzie, & Woodruff, 2012a; Fafchamps, McKenzie, Quinn, & Woodruff, 2014; Fiala, 2013).

In summation, previous research indicates that transferring cash directly to the poor can generate *some* productive investments. However, most studies of regular, small transfers in Sub-Saharan Africa have only shown *short-term* investments in productive assets and economics activities. Similarly, to the best of our knowledge, the sustained impact of transfers after program termination has not been assessed yet. This paper fills these gaps by exploring cash transfers impacts on productive investments for very poor Sub-Saharan African beneficiary households 18 months after the cessation of transfers.

B Theoretical framework

Cash transfers can potentially generate household productive investments and growth at the micro-economic level by alleviating specific constraints (such as saving and credit constraints), by protecting households against adverse shocks, and by decreasing production inefficiencies due to intra-household resource allocation.[6] In addition, transfers can indirectly trigger further productive impacts through local economic spillovers.

In this section, a simple model of household investment behavior is presented to illustrate how cash transfers can generate sustained productive impacts when low levels of assets result in a lack of productive investment. The model draws on the poverty traps literature, which aims to

[6] For a review of possible mechanisms, see Barrientos (2012) and Alderman and Yemtsov (2013).

explain why some households are trapped at very low asset and income levels (Barrett, Carter, & Ikegami, 2008; Buera, 2006; Carter & Barrett, 2006). Consider a production function with two technologies, a low-return technology without fixed costs and a high-return technology requiring initial fixed costs investments:

$$f(a_i, k_{it}) = \begin{cases} f_L(a_i, k_{it}) = a_i k_{it}^{\gamma_L} \\ f_H(a_i, k_{it}) = a_i (k_{it} - \bar{k})^{\gamma_H} \end{cases} \quad (1)$$

with a_i being the ability of individual i, k_{it} her assets at time t, L indicating the low-return production function and H the high-return production function with fixed costs $\bar{k}$.[7] For each technology, there is a steady-state investment level: $k_L^*(a_i)$ and $k_H^*(a_i)$. If individuals have potentially access to each technology, they choose to invest in f_L (without fixed costs) or in f_H (with fixed costs). Individuals using f_L remain trapped in the low equilibrium $k_L^*(a_i)$ and remain chronically poor. Individuals investing in f_H reach the high equilibrium level $k_H^*(a_i)$ and escape poverty. There exists a threshold $\hat{k}(a_i)$ for which $f_L(a_i, k) = f_H(a_i, k)$ above which adoption of the higher technology brings higher production. However, if initial assets k_{i0} are such that $k_L^*(a_i) < k_{i0} < \hat{k}(a_i)$, it is unclear whether an individual will deplete assets to go back to $k_L^*(a_i)$ or make additional investments to reach $\hat{k}(a_i)$ and employ to the high-return technology.

This investment problem can be analyzed as a dynamic choice where individuals make inter-temporal consumption and investment decisions to maximize lifetime utility:

[7] a_i can represent any household characteristic which increase returns, whether skills, social capital or some other factors, allowing for household heterogeneity beyond initial asset levels. The low production technology could be low-return food crops agriculture (millet and sorghum) whereas the high-return technology could be higher-return crops, livestock and micro-enterprises that require higher fixed-cost investments.

$$\max E_T \sum_{t=T}^{\infty} \beta^{t-1} u(c_{it}) \tag{2}$$

$$\text{s.t.} \quad c_{it} + i_{it} \leq f_j(a_i, k_{it}) \,, \quad j \in \{L, H\} \tag{3}$$

$$k_{it+1} = \theta_t [i_{it} + (1-\delta) k_{it}] \tag{4}$$

c_{it} is consumption at time t and i_{it} is investment, such that equation (3) is the constraint associated with the investment-consumption decision. β is the discount factor applied to future consumption, $\theta_t \in [0,1]$ is a random variable, thus introducing asset adverse shocks for $\theta_t < 1$, and δ is the depreciation parameter of old assets.[8] The investment rule is given by $i^*(k_{it}|a, \Omega)$ where $\Omega(.)$ is the cumulative density function of θ_t. i^* is the policy function associated with the Bellman equation:

$$V(k_{it}) \equiv \max_{i_{it}, j} \left\{ u\big(f_j(a, k_{it}) - i_{it}\big) + \beta E[V(k_{it+1}|k_{it}, i_{it})] \right\}, \;\; j \in \{L, H\} \tag{5}$$

where

$$E[V(k_{it+1}|k_{it}, i_{it})] = \int V\,(\theta_t [i_{it} + (1-\delta) k_{it}) d\Omega(\theta_t) \tag{6}$$

Individuals with low initial assets will invest or disinvest to converge towards $k_L^*(a_i)$, while those with initial assets superior or equal to $\hat{k}(a_i)$ will converge towards $k_H^*(a_i)$. For those with initial assets such that $k_L^*(a_i) < k_{i0} < \hat{k}(a_i)$, there is a critical asset level $\tilde{k}(a_i)$ above which individuals choose to make additional investments to reach $\hat{k}(a_i)$ and switch to the high-return technology (see for instance Buera, 2006).[9]

[8] The model assumes no borrowing, consistent with rural Niger where households have very limited access to credit.

[9] $\tilde{k}(a_i)$ has been called the "Micawber frontier", under which individuals are trapped into poverty (Barrett, Carter, & Ikegami, 2008).

In the model, cash transfers have a productive impact by increasing investments if they allow some households to cross the critical asset threshold $\hat{k}(a_i)$. This mechanism generates a sustained productive impact, according to the model, because households crossing the threshold $\hat{k}(a_i)$ will switch to the high-return technology f_H permanently. Whether cash transfers can help households cross the critical asset threshold and generate such a sustained productive impact is an empirical question.

Moreover, if there indeed exists a critical asset threshold $\hat{k}(a_i)$ which households cannot cross without significant investments, cash transfers will have a differentiated impact on households along the wealth distribution. Specifically, in presence of poverty traps, small regular cash transfers would not be expected to foster productive investments among the very poor. Small transfers would not be sufficient for the most destitute households to reach $\hat{k}(a_i)$, while poor but relatively better-off households will be able to cross the critical asset threshold and make sustained productive investments. This critical asset threshold model can be tested empirically by measuring the heterogeneous impact of the transfers on the poorest, and relatively less poor groups.[10]

Several underlying mechanisms may contribute to poor households inability to investment and accumulate assets. Credit constraints alone can explain why poor households do not invest *any* of their wealth in productive assets as long as they have urgent consumption needs (Deaton, 1990). Credit constraints can be relaxed by cash transfers if they provide sufficient resources for households to start saving. Again, the impact of cash transfers on productive investments will likely be greater in relatively well-off poor households in this case. Liquidity constraints, related

[10] Similarly, the poverty traps literature predicts a differentiated impact of shocks on asset and consumption smoothing for the lowest and highest income groups (see Janzen & Carter, 2013; Zimmerman & Carter, 2003).

to transaction costs or price risk, can also lead poorer households to keep wealth in the form of precautionary savings rather than investing it in productive assets (Mogues, 2011; Zimmerman & Carter, 2003).

If the high-return technology is also more risky, as this is often the case in drought-prone areas, ex-ante risk can also explain under-investment in productive assets such as livestock or high-return crops (Elbers, Gunning, & Kinsey, 2007; Rosenzweig & Binswanger, 1992; Rosenzweig & Wolpin, 1993; Stoeffler, *Forthcoming*). In that case, cash transfers shift investments towards the high-return technology because they provide a safety net and reduce consumption risk. Under this mechanism, the impact of transfers may actually be greater among the poorest households with fewer initial options to diversity risk.

Alternative mechanisms can generate opposite patterns with greater investments among the poor. Lumpiness of productive investments may explain low levels of asset ownership among the poorest households (Elbers, Gunning, & Vigh, 2009; Fafchamps & Pender, 1997). In that case, the provision of cash transfers that facilitate saving could positively impact household investments in productive assets. Similarly, the main barrier for household investment can be a saving constraint (Anderson & Baland, 2002; Dupas & Robinson, 2013; Platteau, 2000; Schaner, 2013). In that case, if saving constraints are more binding among the poor, the poor may save more if saving is facilitated through cash transfers.

These alternative theoretical mechanisms may overlap and in some cases reinforce each other. Yet they do have different implications for the heterogeneity of impact of the cash transfers by household wealth status. While the main objective of this article is to test for evidence of asset accumulation in a sample of very poor households, we also analyze heterogeneity in program

impacts between extremely poor and relatively better-off households. This sheds light on the theoretical mechanisms by which cash transfers generate household investment in productive assets.

The next section presents the cash transfers project, data collected and empirical approach used in the paper.

3. Project, Data and Empirical Approach

A. Project Description

Cash transfers have originally been used in Niger by humanitarian organizations as a short-term seasonal intervention. Studies have examined the relative impacts of alternative program modalities (mobile money vs. cash; food vs. cash; etc.) on household well-being, but have not documented the direct impact of transfers on productive activities (Aker, Boumnijel, McClelland, & Tierney, 2011; Hoddinott, Sandstrom, & Upton, 2013; Tumusiime, 2013).[11] However, qualitative research has suggested that households invest transfers in livestock and agricultural activities (Olivier de Sardan, 2013).

The government of Niger has recently started to implement cash transfers as a pilot project with technical assistance from the World Bank.[12] Specifically, the *Projet Pilote des Filets Sociaux par le Cash Transfert* (PPFS-CT) was launched in 2010 to address chronic food insecurity and household vulnerability to food insecurity in the context of recurring droughts and other adverse economic shocks (PPFS-CT, 2011). In 52 villages of the Tahoua and Tillabéri regions 2,281

[11] These studies consist in comparing emergency transfers delivered by mobile phone or cash (Aker et al., 2011), or in form or food or cash (Hoddinott et al, 2013), or focus on food consumption and resilience (Tumusiime, 2013).
[12] The pilot project was scaled-up to a national safety nets project in 2013 to eventually reach 140,000 poor households throughout the country.

beneficiary households received small regular monthly cash transfers of 10,000 FCFA (approximatively 20 USD, or about 20% of household consumption) for 18 month, between January 2011 and June 2012.

Pilot beneficiaries were chosen based on a Proxy Means Test (PMT), which is an increasingly common targeting method in Sub-Saharan Africa (Del Ninno & Mills, 2014). The PMT formula was calculated based on the regression of per capita consumption on basic household demographic and economic characteristics with data from a nationally representative survey (Katayama, 2010). In each village, a village-specific PMT eligibility threshold was then chosen so that 30% of the households were designated as beneficiaries. Ex-post assessments of the targeting method show that the PPFS-CT targeting procedure is relatively efficient in reaching poor households (McBride, 2014). The transfers were delivered to a woman within selected households.[13]

A distinct feature of the cash transfer pilot project is that it also promoted women's participation in local saving groups known as *tontines*. *Tontine* members bring cash to a common pot each time they meet (daily, weekly or monthly). One member in rotation takes all the cash from the pot at each meeting and invests it. *Tontines* are an important vector for investments in rural Niger, and in Sub-Saharan Africa in general (Van den Brink & Chavas, 1997). The PPFS-CT encouraged beneficiaries receiving cash transfers to set-up *tontines*, so that households could save and invest in productive assets. According to project managers, almost 90% of the beneficiaries took part to these *tontines* during the pilot phase.[14]

[13] In polygamous households, the recipient was typically the first wife.
[14] *Tontines* are often referred to as a rotating savings and credit association (ROSCA). Project monitoring data suggests that *tontine* funds were mostly used by beneficiaries to purchase livestock.

The pilot program has several noteworthy features, which allows us to address current knowledge gaps on the sustainability of transfer impacts on productive investments in low-income settings. First, the program targeted very poor, food insecure households in rural Niger, one of the poorest regions of the world where climatic shocks are recurrent.[15] Second, the program delivered small, regular, foreseeable, monthly transfers rather than large transfers following a crisis. Third, and most importantly, the transfers took place for 18-months between January 2011 and June 2012, and this duration was communicated to beneficiaries at the beginning of the program. Through a follow-up survey taking place 18 months after the end of the transfers (36 months after the baseline survey), we can analyze the sustainability of program impacts on investments in the medium-term after households have made investments, realized some returns, and possibly also disinvested in response to adverse shocks and other factors.

B. Data

The study uses two rounds of household data collected in 2010 and 2013, i.e. a baseline collected before the project was implemented and a follow-up survey collected 18 months after households received the last transfers. In September 2010, a PMT (baseline) questionnaire was administered to all households in the pilot villages. The information collected is limited to the variables necessary to calculate the PMT formula. In November 2013, approximately 18 months after the end of the program, 2,000 households were sampled to participate in a comprehensive follow-up survey. In each project village, 20 beneficiaries and 20 non-beneficiaries were randomly sampled based on the baseline PMT data. The follow-up survey includes all the variables in the 2010

[15] Niger has the lowest Human Development Index (HDI) in 2012 (see http://hdr.undp.org/en/statistics/).

baseline questionnaire, and additional modules on investments (durables, local credit, household enterprises, and agriculture), education, health and consumption.

As further discussed below, the quasi-experimental empirical strategy employed to evaluate the impact of the cash transfer program on productive investments is largely driven by the structure of the data. Notably, most investment variables were collected only in the follow-up survey.

C. Empirical and identification strategy

We estimate the effect of cash transfers on household i's investments and other outcomes of interest y_i. Specifically, we consider a range of outcomes including livestock (stock at the follow-up survey in 2013, stock 12 months before, consumption and sales); housing quality (house material, access to water, toilets, etc.); durable goods (number and value of durable goods); engagement in household enterprises (HEs) (number of HEs, revenues, charges and profits, value of equipment); and agricultural investments (surface cultivated, quantity produced and yields, input spending, type of crops). These outcomes cover a wide range of potential investments. We also consider the participation in *tontines* (number of *tontines*, amount received, and usage).

The first identification strategy is suitable to the limited number of variables which are included in the baseline (2010) dataset: housing quality, livestock own and some durable goods. For these variables, it is possible to use a difference-in-differences (DID) estimator to measure differences in beneficiary and non-beneficiary between 2010 and 2013:

$$y_{i\epsilon A,t} = \beta_0 + \beta_1 \mathrm{B}_i + \beta_2 T_t + \beta_3 \mathrm{B}_i * T_t + \varepsilon_{i,t} \quad (7)$$

where B_i is an indicator variable for beneficiary households (received cash transfers), T is an indicator variable equal to 1 in 2013, and β_3 captures the impact of the cash transfers.[16] Standard errors are clustered at the village level. By definition, the difference-in-differences strategy controls for group fixed effects, as well as common trends between beneficiaries and non-beneficiaries.

A second identification strategy is employed for outcomes only observed in the follow-up survey. This strategy exploits a discontinuity in project beneficiary selection, in particular the variation in eligibility thresholds across villages. The PMT cut-off was set on a village-specific basis so that the project would cover 30% of the population of each village. Because the eligibility threshold varies by village, some households with similar PMT scores have different eligibility status. On that basis, we restrict the analysis to a 'common support sample' within a range of PMT scores that include both beneficiaries and non-beneficiaries. Figure 1 shows the spread of PMT scores across villages, and the rather wide PMT score band for which there exist a common support of beneficiaries and non-beneficiaries. While the difference in eligibility status is not random, non-beneficiary households within that band can be used to estimate counterfactual outcomes for beneficiary households with similar PMT scores.[17] These estimates can be interpreted as Local Average Treatment Effects (LATE).

[16] With only two time periods, this specification (DID) is econometrically equivalent to using household fixed-effects.

[17] This estimation strategy relies on a range of assumptions: i) the PMT difference between beneficiaries and non-beneficiaries, in the subsample, is small; ii) differences do not arise from the fact that some villages have more beneficiaries and other more non-beneficiaries. Village fixed-effects are added in some specifications to control for the latter possibility.

The second identification strategy is implemented by estimating a Simple Difference (SD) OLS regression on a subsample of households whose PMT scores range from the lowest village PMT threshold ($PMT\_threshold_{min}$) to the highest village PMT threshold ($PMT\_threshold_{max}$,):

$$y_i = \beta_0 + \beta_1 \mathrm{B}_i + \varepsilon_i \,, \qquad i \in A \tag{8}$$

where $i \epsilon A$ if $PMT\_threshold_{min} \leq PMT\_score_i \leq PMT\_threshold_{max}$, and β_1 measures the impact of the cash transfer. Standard errors are clustered at the village level. An alternative specification includes village fixed effects to take into account non-random differences across villages– since a mechanical implication of the identification strategy is that villages with lower PMT scores tend to have fewer beneficiaries in the common support sample (see Figure 1).[18]

Tests of Balance and Attrition

In Table 1, the difference between beneficiaries and non-beneficiaries characteristics at baseline 2010 is formally tested. Panel A presents results for the common support sample, and panel B for the full sample. All the variables tested are included in the PMT formula, so significant differences across groups are expected. In the common support sample, besides the difference in PMT scores (beneficiaries have lower scores), the main significant differences are household size and the number of goats and chicken.[19] These tests indicate that the SD design does not produce a perfectly balanced sample, but differences between the treatment and control groups

[18] This identification strategy is similar to a Regression Discontinuity Design (RDD) in some respects. RDD with PMT score as forcing variable was not used for several econometric reasons: i) The PMT threshold varies across villages, requiring the construction of an artificial threshold ("normalized PMT score") around which households have very different *actual* PMT scores and baseline characteristics, contrary to the principal of RDD itself; ii) Some variables of interest (e.g. livestock) enter positively in the construction of the forcing variable (PMT score); iii) At certain bandwidths, continuity of the forcing variable (an important assumption to obtain valid RD estimates) is violated (Lee & Lemieux, 2009); iv) With standard bandwidths, the number of observations around the threshold is low; and with large bandwidths results become identical to those obtained with the SD identification strategy.

[19] The difference in motorcycle is also significant, however very few households owns this item.

for most assets are not significant. Moreover, non-beneficiary households appear to be better off (higher levels of assets), which makes positive effects of the treatment harder to find.[20]

The level of attrition in our sample is relatively high. 2,000 households were included in the sample, but complete interviews are only available for 1,592 households due to difficulties in finding households in the field three years after administration of the baseline (186 questionnaires), to the loss of survey questionnaires in three villages (108 questionnaires), and to the inability to match identifiers in some cases. Among these 1,592 questionnaires, 1,138 are in the common support sample. A formal test of baseline differences between attritors and non-attritors is presented in Table 2. In the common support sample (panel A), among all the variables collected in 2010, only ownership of cart (lower), sheep ownership (higher) and PMT score (higher) are significantly different at 5% for attritors. While some differences are observed, they are limited and as such are unlikely to strongly affect results of the main identification strategy.[21]

Table 3 presents descriptive statistics for all variables in the follow-up (2013) sample for all households, as well as separately for beneficiaries and non-beneficiaries. As expected based on the PMT formula, non-beneficiary households are smaller, have more physical assets, and have higher PMT scores on average. However, beneficiary households have a higher level of livestock, household enterprise activities, and *tontine* usage.

4. Results

[20] There are some additional significant differences between beneficiaries and non-beneficiaries in the full sample, which is one of the reasons why the common support sample is preferred for the Simple Difference estimation.
[21] There are additional significant differences between attrition and non-attrition households in the full sample compared to the common support sample.

Table 4 contains Difference-in-Differences (DID) estimates of the impact of the cash transfers on beneficiaries 18 months after project termination for the limited number of outcome variables included in both the baseline and the follow-up surveys. In Table 5, Simple Difference (SD) estimates are computed for a larger set of investment outcomes available in the follow-up survey. Column 1 presents the results for households in the common support sample without village fixed effects, and column 2 with village fixed effects. Consistent with equation (7) above, the coefficient of the interaction between post-program and beneficiary dummies captures the cash transfer impacts. SD results are presented for a range of outcomes: housing, durable goods, livestock, household enterprises (HE) and agricultural activities.

Impacts on Livestock

DID estimates show a large significant program impact on livestock ownership, which differentially increased by 0.418 Tropical Livestock Units (TLU) for beneficiary households (more than half a cow, or four goats, or forty chickens) (Table 4, Panel A). The magnitude of the impact is equivalent to more than half of the sample average baseline TLU. 18 months after the termination of the cash transfer, the increase in livestock amounts to an increase of 87,812 FCFA in livestock value, which represents almost half of the transfers received over the 18 month program (180,000 FCFA). The significance and magnitude of the results are robust when restricting the sample to households within the PMT range with common support (Table 4, Panel B).[22] The SD estimates are also highly consistent with the DID estimates. The SD estimates of

[22] Panel B provides more conservative estimates, using the preferred (common support) sample in the SD approach. Note that the impact on investments found 18 months after program termination includes return on investments: for livestock it includes birth and death of the animals acquired. This may partly explain the high impact on livestock value.

impacts on livestock are significant and of large magnitude (Table 5, Panel A). With village fixed-effects (FE), an impact of 0.435 TLU or 86,095 FCFA is found.

The additional variables available in the follow-up survey also show that increased livestock assets are partly used for consumption, but not much for sales. Consumption from own livestock does increase significantly among beneficiaries. However, increases in livestock sales for beneficiaries are found to be rather small and are only significant in the village fixed-effect specification.

The follow-up survey also asks retrospectively about livestock ownership in 2012 (6 months after the end of the program, and 12 months prior the follow-up survey). Impacts on the difference between livestock assets in 2013 and 2012 is not significantly different between beneficiary and non-beneficiaries, suggesting that beneficiary households are not depleting livestock assets at a greater rate than non-beneficiaries since the end of the project.

Impacts on Durables and Housing

SD estimates provide some indications of increased investments in durable goods (Panel B) among beneficiary households (Table 5, Panel B). Beneficiaries have a higher number of some durable goods than non-beneficiaries in 2013, and both the total value of durables and the value of durables purchased in the last 3 years are greater (by 59,432 FCFA and 22,693 FCFA respectively). These results stem from increased investments in durable goods such as plows, carts, motorcycles and pirogues, whose ownership significantly increased.

Results are more mixed on housing quality. DID estimates suggest improvements for several housing quality indicators, including better cooking fuel (instead of wood), improved source of lighting, access to toilets, and number of assets owned (Table 4, Panel A). However, these results

are not robust when focusing on the common support sample, where only the impact on access to toilets remains significant (Table 4, Panel B).[23] In addition, SD estimates reveal no robust significant impacts on housing quality (Table 5, Panel C).

Impacts on Household Enterprises and Agriculture

Beneficiaries are not found to be more likely to participate in non-agricultural household enterprises (HEs) activities or to have higher HE profits (Table 5, Panel D). Thus, despite impacts on productive assets, participation in the cash transfer program does not appear to lead to livelihood enterprise diversification outside of agriculture. This is, perhaps, not surprising given that less than 15% of households in the sample have a household enterprise, and household enterprise are very diverse in terms of activities and scale.[24] There is indication of an increase in the number of household enterprises among beneficiaries, but this effect does not remain significant when village fixed-effects are added. Equipment purchased in the last 3 years increases significantly for beneficiaries, but the magnitude is small.

There is, however, evidence of impact on agricultural activities (Table 5, Panel E) and agricultural productivity in particular. Beneficiaries have higher use of agricultural inputs, particularly spending on fertilizers. Strong impacts on quantities produced and yields are also found 18 months after project completion. Some impacts are observed on land area cultivated, although they are not robust and only significant in the village fixed-effects specification.

[23] Note that 2010 and 2013 values for housing characteristics such as roof and walls quality may differ because the questions may not have been asked the same way in the two surveys. While questionnaires are identical, the surveying firms have changed. For these variables, SD estimates focusing on 2013 data may be more reliable.
[24] The point estimates are large and positive for revenues and profits from HEs, but the standard errors are large due to the diversity of these household enterprises.

Mechanisms: Savings and Tontines

Tontines are an important vector for investment in rural Niger. As mentioned above, one of the particular features of the cash transfer pilot is that it encouraged beneficiaries to set-up of *tontines*. *Tontines* represent a possible mechanism used by households to invest in productive activities. We therefore also analyze the impact of the project on participation in *tontines* 18 months after the end of the program.

Project impacts on participation in *tontines* is estimated by the Single Difference approach as the variable is only included in the follow-up survey (Table 6). Results show large and significant increases in the participation in *tontines*, number of *tontines* to which individuals contribute, and in the amount invested in and received from *tontines*. The percentage of beneficiaries participating in tontines in 2013 is twice the percentage of non-beneficiaries (20.7% vs. 10.2%). The average effect of being a former beneficiary on the amount invested monthly in tontines is 385 FCFA (and the average effect on the amount received when one's turn comes is 3,566 FCFA). Among those participating in tontines, the average effect is greater: 1,271 FCFA (13,528 FCFA for amount received). Increased participation in *tontine* translates into a more prevalent use of tontines to support consumption, but also into investment in productive activities and durable goods. As such, *tontines* is one of the mechanisms that can explain the observed impacts on productive assets.

Overall, the results suggest that beneficiary households continue to participate in the *tontines* that were set-up during the project. Thus, poor households remained credible participant to these financial arrangements even after project termination. Nevertheless, both the share of beneficiaries participating in the tontines and the amounts invested in 2013 are below levels

observed during the project (PPFS-CT, 2011).[25] This is consistent with what is expected after beneficiaries stop receiving regular transfers and encouragement to participate in savings groups.

Mechanisms: Heterogeneity between the very poor and slightly less poor

As discussed in the theoretical framework, analyzing whether program impacts are larger for the poorest or relatively well-off segments of the sample can also help shed light on the mechanisms through which cash transfers promote productive investments. In presence of poverty traps, small regular cash transfers would not be expected to foster productive investments among the very poor. In contrast, small, regular transfers could help slightly less poor households to cross a potential poverty trap threshold and make productive investments. This question also links to the important policy issues of whether small, regular cash transfers can have durable impacts on the poorest households, or just meet immediate consumption needs.

The pre-intervention baseline PMT score– a proxy for consumption level– is used to analyze whether transfers had a greater productive impact on the poorest beneficiaries (those with the lowest initial PMT scores). To explore potential impact heterogeneity, DID estimates for variables available both at baseline and follow-up are computed separately for the sub-sample below and above the median PMT score (Table 7).[26] For almost all outcomes considered, the impact of the transfers tends to be larger for households below the median PMT score. In particular, previously documented impacts on livestock are larger among the poorest households.

[25] Project managers recorded a 90% participation rate in *tontines* among beneficiaries.

[26] The heterogeneity of impact can be explored in many ways. For simplicity, and because of the relatively small sample size, only the DID estimator is presented and the sample is split at the median. Other specifications, such as splitting the sample by quintile, confirm a greater impact on households with lower PMT scores, but effects are not significant because of the low number of observations by quintile (results available upon request).

However, the coefficients above and below median PMT score are only significantly different (Wald test) for the number of different assets owned variable.

The heterogeneity of the impact on livestock– the asset on which transfers had the highest average impact– is further explored though a non-parametric approach. Figure 3 displays a non-parametric lowess regression of follow-up TLU over baseline TLU for beneficiaries and non-beneficiaries (Figure 3). Results show a much steeper TLU accumulation for beneficiaries with lower initial PMT scores.

Since *tontines* appear a key mechanism for the impacts on productive investment, we also test the impact heterogeneity for the *tontine* variables similarly to what was done for livestock. Results show a much larger impact of the project on *tontines* usage, number, amount invested and amount received for households with lower PMT scores (Table 8). These results are in line with the larger livestock increases among the very poor. For instance, with village fixed-effects, poorer beneficiaries increase the number of tontines by 26.7 percentage points among the poorest, whereas the increase is only 2.6 percentage points for slightly better-off beneficiaries.[27]

Overall, these results on impact heterogeneity do not support the theoretical predictions of the basic poverty trap model in section 2. First, modest, regular transfers delivered to the very poor (our entire sample) were invested in productive activities and assets. Second, the impact in terms of investment is even greater for the very poorest beneficiaries than those better-off within the sample of relatively poor households. However, the poverty trap model suggests that better-off households would invest a larger share of the transfers received, because the poorest cannot

[27] In the full sample specification, coefficients above and below the PMT median are significantly different from each other (at 1%, 5% or 10% confidence level). In the (smaller) "common support" sample specification, the difference is statistically significant at 5% for the number of tontines.

reach the critical asset threshold needed to make durable investments. Overall, the observed empirical patterns are more consistent with binding saving constraints for the poor in presence of lumpy investments, or constraints to risky investment in presence of imperfect insurance mechanisms. The cash transfer program may have very poor households to overcome these constraints directly or along with its facilitation of savings groups.

Robustness

There are several limitations to the empirical identification strategy that may affect the internal validity of the results. First, there may be some concerns with internal validity due to the composition of the counterfactual in the SD identification strategy: control households belong to poorer villages, since they are not among the poorest 30% while having similar PMT scores to beneficiary households.[28] Conversely, control households have higher PMT scores than treatment households, in each village and overall – which may induce a downward bias in impact estimates.[29] Also, there may be some local spillover effects from beneficiaries to non-beneficiaries within villages, affecting both SD and DID estimates.[30] With these limitations in mind, we further offer some additional robustness tests to complement the two specifications presented above with Propensity Score Matching (PSM) models.

[28] This could create a positive bias for impact estimates if beneficiary households gain from the better overall economic position of their village (for instance by receiving higher agricultural wages). Conversely, the bias could be negative if they suffer from their lower position in a richer village (for instance if their relative poverty prevents access to institutions in the village). Adding village-effects partly resolves this potential bias, but given the few number of observations per village, this is at a large loss of degrees of freedom.

[29] This potential downward bias does not cast doubt on the significance of a positive impact, but generates a higher probability to find insignificant results.

[30] There are evidence of such a spillover effect in other cash transfers programs (Angelucci & De Giorgi, 2009). Contamination would create a negative bias on the impact estimate; consequently it does not cast doubt on the significance of a positive impact.

Similar to the SD identification strategy, matching compares beneficiaries to non-beneficiaries with similar pre-program characteristics (Caliendo & Kopeinig, 2008; Rosenbaum & Rubin, 1983). The propensity to participate to the program $P(X)$ is estimated via a probit regression including pre-program baseline characteristics as covariates X. Then, impacts are estimated via PSM:

$$\tau^{PSM} = E_{P(X)|D=1}(E[Y(1)|D = 1, P(X)] - E[Y(0)|D = 0, P(X)]) \quad (9)$$

where $D = 1$ indicates treatment, $Y(1)$ is the outcome of interests for treated observations and $Y(0)$ for untreated observations.[31]

The propensity score (propensity to be treated, i.e. beneficiary of the project) is computed from the PMT score, since it is known that project eligibility is determined by this PMT score. One-on-one matching without replacement is performed for all households, not only those in the PMT 'common support' sample.[32] A test of balance between treated and control observations is performed for unmatched (before PSM is employed) and matched observations (after PSM weighting) and shows the reduction in the standardized percentage bias obtained by the matching procedure (Figure 2). The test shows that standardized percentage bias is relatively small, except for household size and the PMT score itself (which is expected) and that the PSM weighting

[31] The PSM estimator is estimated with Stata (Leuven & Sianesi, 2014).

[32] Several other PSM specifications are tested, including: a specification for households in the PMT range only; a specification using all baseline (2010) variables instead of the PMT score only; and a specification using a different matching algorithm, i.e. radius matching. Results are relatively similar across specifications, but results from the PMT range specification are much closer to results from the main identification strategy. The magnitude of the effects also tends to be larger in PSM specifications.

slightly reduces this bias.[33] Common support is found for all but for 89 beneficiary households, which means that most observations are used.

Results from PSM are very close to those obtained from the SD identification strategy, with two main exceptions (Table 9). First, PSM estimates also finds a significant, negative effect in terms of housing quality, which confirms that most households have not invested in their dwelling and not caught up with non-beneficiaries (house quality variables are included in the PMT score). Second, the magnitude of the effects obtained tends to be slightly larger in PSM specifications than in DID and SD estimates. Overall, PSM results supports the results obtained in the DID and SD specifications. While the PSM specification does not address all the limitations in terms of village differences and spillover effects, it provides additional confidence in the consistency of our results.

5 Discussion and Conclusion

Taken as a whole, the results show that even very poor households in one of the poorest settings in the world, for whom marginal propensity to consume additional income may be very high, invest part of small regular transfers in productive assets to raise future revenues. The effect is particularly large for investments in livestock and agriculture, which are the primary sources of income in rural Niger. Beyond statistical significance, the magnitude of investments is noteworthy. Livestock value increased by approximately 80,000 FCFA 18 months after project termination, which constitutes a large share of the 180,000 FCFA that beneficiary households received over the whole duration of the project. The associated increase of 0.4 TLU also

[33] Indeed selection into beneficiary status is based on PMT scores. Besides, PMT targeting is known to select larger households in general (Stoeffler & Mills, 2015).

represents more than half of households' baseline livestock. Non-beneficiaries are not rapidly de-capitalizing after program termination.

Results also show that cash transfers were not invested in housing quality, from which households could have derived an immediate consumption flow. The impact on (private) durable investments is also small. Instead, households focused on *productive* investments to raise their long-term revenues. The priority of longer-term inter-temporal consumption improvements is consistent with observations made during qualitative fieldwork, where many households emphasized the need to "keep something when the project will end in two years". However, choosing to invest in productive activities (including agricultural inputs) means going beyond the idea of "keeping something": households' investment choices illustrate their objective of raising long-term income and agricultural productivity and to retain accumulated assets. Importantly, the sustained positive effect of the program was not concentrated among the relatively better-off households of our sample of poor households: impacts on productive investments were greater for the very poorest households.

In addition, results suggest that savings groups (*tontines)*, which were promoted by the project, may have played a key role in facilitating asset accumulation. Indeed, monthly cash transfers are relatively small compared to the size of investments required in livestock and agriculture: the average value of a sheep is 37,500 FCFA, whereas monthly transfers were 10,000 FCFA. In addition, large impacts on tontine participation are found, and these impacts remain 18 months after the cessation of the transfers.

Combined, the findings suggest that medium durage transfers combined with enhanced saving mechanisms can be effective tools to help very poor households build a lasting asset base in the

medium-term, and thus tackle some of the "deep roots" of poverty. The results also shed light on binding constraints and patterns wealth dynamics in one of the poorest settings in the world. Specifically, observed empirical patterns are not consistent with the empirical implications of a poverty trap framework. If a poverty trap existed, even small regular cash transfers would have been sufficient to help households overcome it. Alternative mechanisms, in particular saving constraints in presence of lumpy investments, or constraints to risky investment under imperfect insurance mechanisms, are more consistent with the observed empirical patterns.

The results stand in contrast to the critic of social assistance that cash transfers improve immediate consumption, but create dependency and leave little lasting impact upon program termination. If this were the case then beneficiaries would passively raise consumption only during the time of the transfer and by the amount of the transfers. A growing body of evidence supports the hypothesis that beneficiary households make long-term productive investments. This paper shows that even very poor households – living in Sahelian rural areas lacking infrastructures and prone to adverse shocks – are able to actively take advantage of cash transfers in this fashion.

Finally, the large increase in the use of *tontines* and their survival after project termination have important implications for the design of social protection programs for the poor. These findings suggest that there may exist complementarities between cash transfers and support of financial instruments (credit, insurance or saving) to foster investments in productive activities.

The results, while promising, raise many questions regarding the precise mechanisms by which transfers foster asset accumulation. Further research is needed to identify the role played by cash transfers in alleviating separately two major barriers to productive investments, risk and

saving/credit constraints. Finally, the interesting finding that the very poorest households may have the greatest propensity to allocate transfer income to productive investments needs to be examined in a wider variety of contexts, as it contains the important implication that medium term transfers may be particularly effective in generating sustainable income gains among the poorest of the poor.

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Tables and Figures

Figure 1: PMT score range by village for beneficiaries and non-beneficiaries, and PMT bandwidth with common support

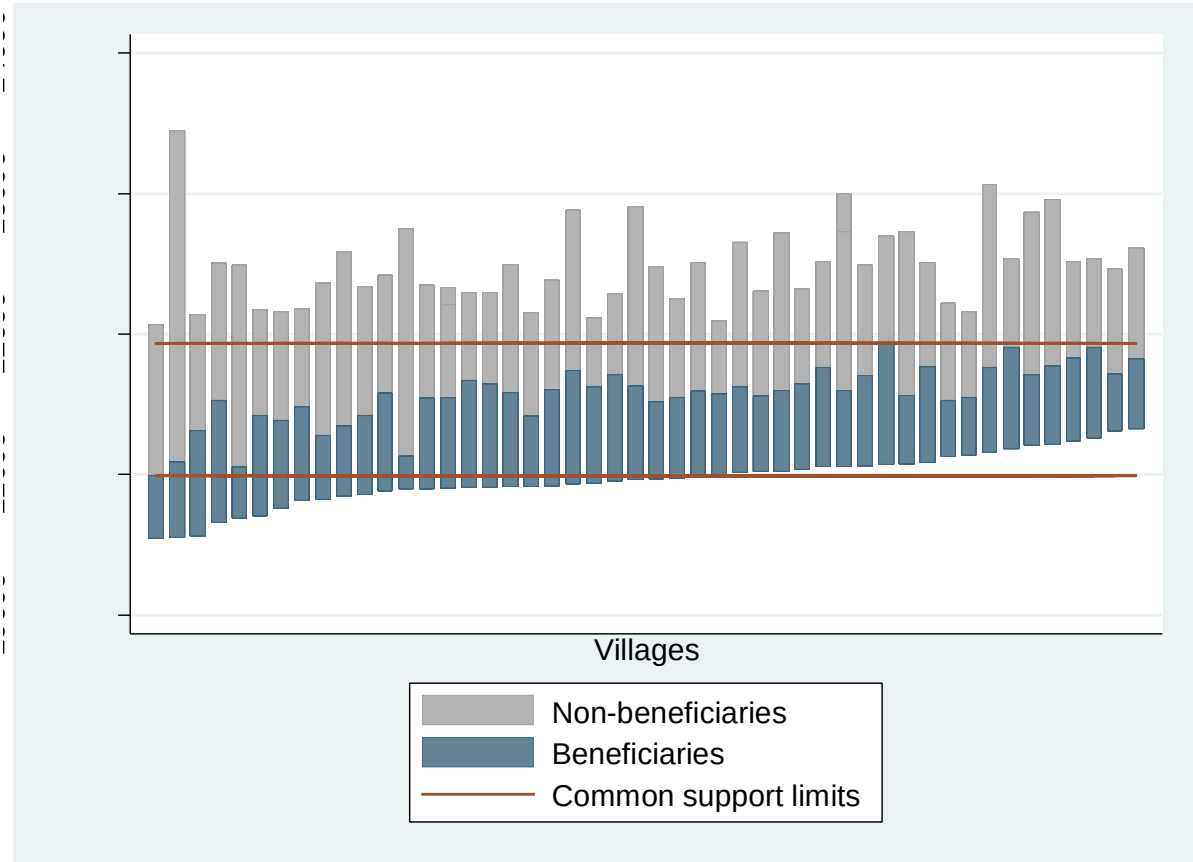
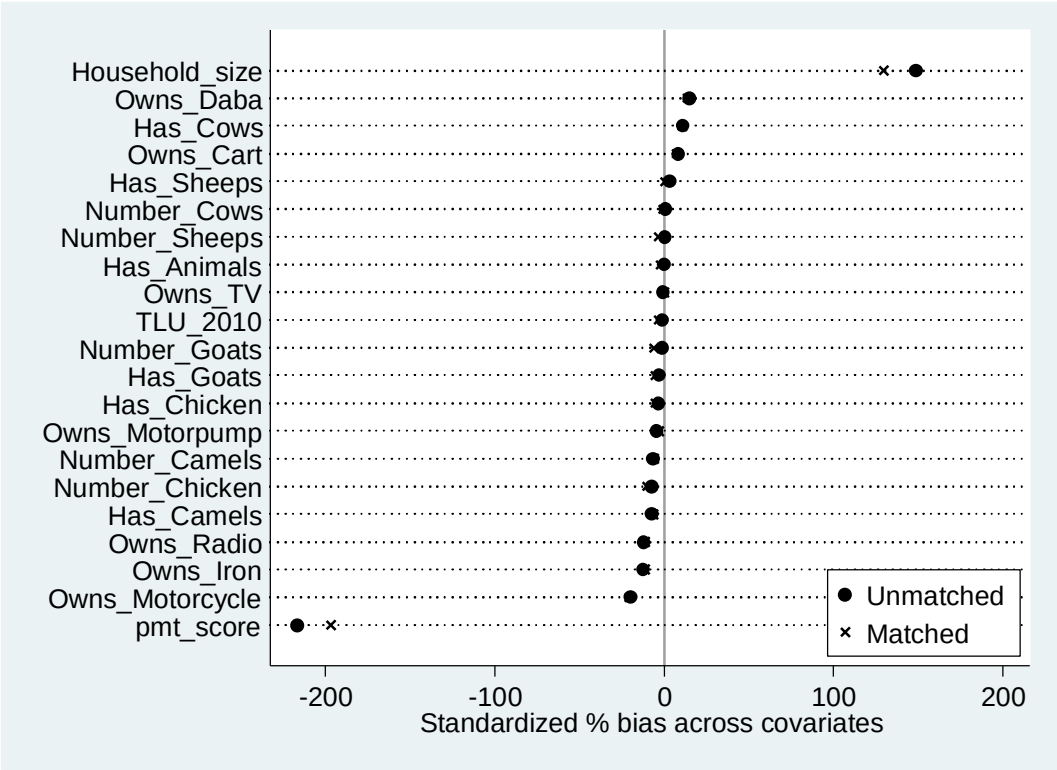


Figure 2: Test of balance for the propensity score matching (PSM) estimator



Note: Test of balance for the propensity score matching (PSM) estimator for baseline (2010) variables.

Figure 3: LOWESS regression of TLU in 2013 over TLU in 2010

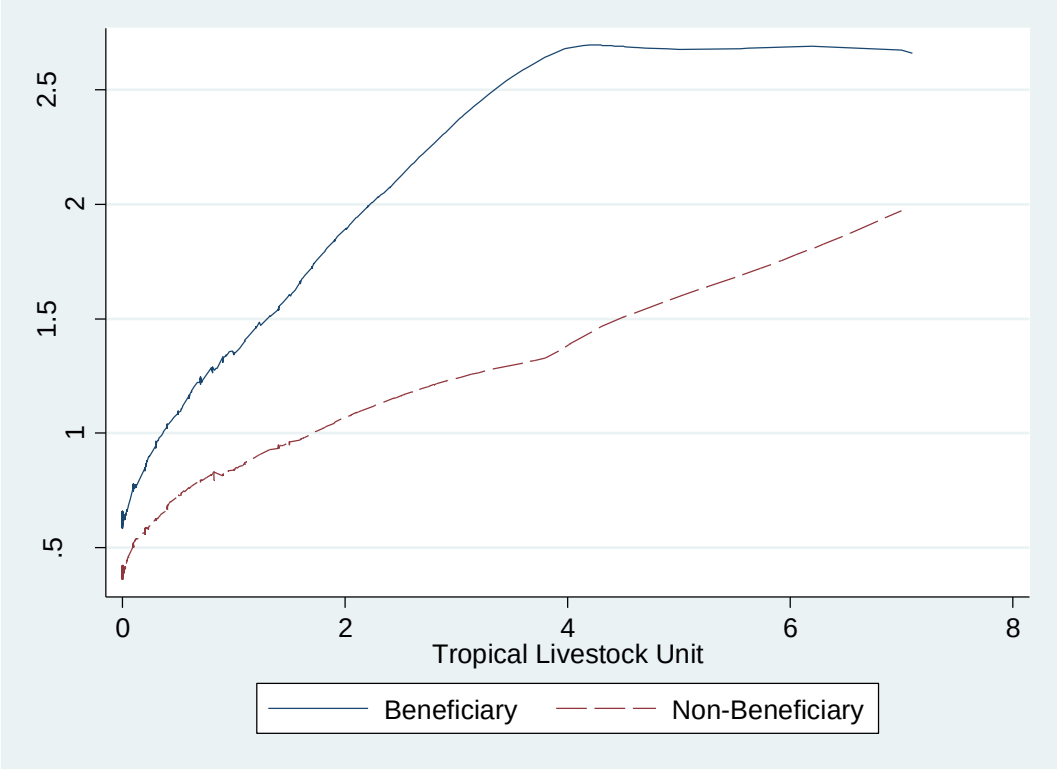


Table 1: Test of Balance in PMT Range at Baseline (2010)

Panel A: Common support sample				
	All	Non-Beneficiary	Beneficiary	Difference p-value
Household size	9.24	7.08	10.4	**(0.00)**
Owns Iron	0.011	0.015	0.0081	(0.26)
Owns Radio	0.046	0.051	0.043	(0.54)
Owns TV	0.0053	0.0076	0.0040	(0.42)
Owns Motorcycle	0.011	0.025	0.0040	**(0.00)**
Owns Daba (hoe)	0.96	0.95	0.96	(0.26)
Owns Motor-pump	0.015	0.010	0.017	(0.34)
Owns Fridge	0.00088	0	0.0013	(0.47)
Owns Cart	0.13	0.12	0.13	(0.56)
Has Cows	0.24	0.21	0.26	(0.09)
Has Sheeps	0.38	0.39	0.37	(0.62)
Has Goats	0.30	0.33	0.28	(0.13)
Has Camels	0.026	0.031	0.024	(0.52)
Has Chicken	0.29	0.31	0.27	(0.14)
# Cows	0.64	0.64	0.63	(0.95)
# Sheeps	1.10	1.15	1.08	(0.56)
# Goats	1.00	1.19	0.90	**(0.03)**
# Camels	0.044	0.061	0.035	(0.27)
# Chicken	1.03	1.28	0.89	**(0.01)**
Tropical Livestock Unit (TLU)	0.71	0.76	0.69	(0.47)
PMT score	11500.5	11717.5	11386.0	**(0.00)**
Adjusted PMT score	-58.3	219.5	-204.9	**(0.00)**
Observations	1137	393	744	

Panel B: Full sample				
Household size	8.54	5.91	10.9	**(0.00)**
Owns Iron	0.015	0.023	0.0083	**(0.02)**
Owns Radio	0.058	0.072	0.046	**(0.03)**
Owns TV	0.0038	0.0040	0.0036	(0.89)
Owns Motorcycle	0.015	0.028	0.0036	**(0.00)**
Owns Daba (hoe)	0.95	0.93	0.96	**(0.00)**
Owns Motor-pump	0.018	0.021	0.015	(0.39)
Owns Fridge	0.00063	0	0.0012	(0.34)
Owns Cart	0.12	0.11	0.14	(0.08)
Has Cows	0.24	0.22	0.26	**(0.02)**
Has Sheeps	0.38	0.37	0.39	(0.43)
Has Goats	0.30	0.31	0.29	(0.56)
Has Camels	0.028	0.035	0.023	(0.15)
Has Chicken	0.29	0.29	0.28	(0.67)
# Cows	0.68	0.67	0.68	(0.86)
# Sheeps	1.13	1.12	1.15	(0.83)
# Goats	1.03	1.05	1.02	(0.81)

# Camels	0.041	0.053	0.031	(0.20)
# Chicken	1.03	1.12	0.94	(0.14)
Tropical Livestock Unit	0.74	0.75	0.74	(0.88)
PMT score	11615.6	11923.4	11341.1	**(0.00)**
Adjusted PMT score	51.7	361.6	-224.5	**(0.00)**
Observations	1592	753	839	

Mean coefficients; *p*-values in parentheses. Bold indicates significance at 5% confidence level.
Adjusted PMT score is the distance to the PMT threshold (= PMT score - PMT threshold in the village).
The Tropical Livestock Unit formula used is: $\mathrm{TLU} = \#camels * 1 + \#cows * 0.7 + (\#sheeps + \#goats) * 0.1 + (\#chicken + \#other\ poultry) * 0.01 + (\#donkeys + \#horses) * 0.5$

Table 2: Test of Attrition in PMT Range at Baseline (2010)

Panel A: common support sample

	All	Non-Attrition Households	Attrition Households	Difference p-value
Household size	9.18	9.24	8.83	(0.15)
Owns Iron	0.011	0.011	0.011	(0.97)
Owns Radio	0.047	0.046	0.054	(0.62)
Owns TV	0.0045	0.0053	0	(0.32)
Owns Motorcycle	0.011	0.011	0.0054	(0.46)
Owns Daba (hoe)	0.96	0.96	0.95	(0.77)
Owns Motor-pump	0.017	0.015	0.027	(0.23)
Owns Fridge	0.00076	0.00088	0	(0.69)
Owns Cart	0.12	0.13	0.043	**(0.00)**
Has Cows	0.24	0.24	0.21	(0.29)
Has Sheeps	0.37	0.38	0.29	**(0.01)**
Has Goats	0.30	0.30	0.28	(0.61)
Has Camels	0.025	0.026	0.016	(0.41)
Has Chicken	0.28	0.29	0.22	(0.05)
# Cows	0.64	0.64	0.65	(0.91)
# Sheeps	1.06	1.10	0.83	(0.09)
# Goats	1.01	1.00	1.02	(0.95)
# Camels	0.039	0.044	0.0054	(0.17)
# Chicken	1.00	1.03	0.81	(0.25)
Tropical Livestock Unit (TLU)	0.69	0.71	0.57	(0.24)
PMT score	11512.2	11500.5	11575.4	**(0.00)**
Adjusted PMT score	-55.1	-58.3	-38.2	(0.29)
Observations	1350	1138	212	

Panel B: Full sample

Household size	8.31	8.54	7.13	**(0.00)**
Owns Iron	0.016	0.015	0.023	(0.33)
Owns Radio	0.059	0.058	0.065	(0.66)
Owns TV	0.0037	0.0038	0.0032	(0.89)
Owns Motorcycle	0.014	0.015	0.0097	(0.47)
Owns Daba (hoe)	0.94	0.95	0.93	(0.11)
Owns Motor-pump	0.021	0.018	0.032	(0.11)
Owns Fridge	0.00053	0.00063	0	(0.66)
Owns Cart	0.11	0.12	0.065	**(0.00)**
Has Cows	0.23	0.24	0.20	(0.17)
Has Sheeps	0.37	0.38	0.30	**(0.01)**
Has Goats	0.30	0.30	0.28	(0.47)
Has Camels	0.027	0.028	0.019	(0.38)
Has Chicken	0.28	0.29	0.24	(0.07)
# Cows	0.67	0.68	0.63	(0.72)
# Sheeps	1.10	1.13	0.93	(0.13)

# Goats	1.02	1.03	0.96	(0.63)
# Camels	0.037	0.041	0.016	(0.21)
# Chicken	1.03	1.03	1.06	(0.83)
Tropical Livestock Unit	0.71	0.74	0.58	(0.08)
PMT_score	11649.9	11615.6	11806.3	**(0.00)**
Adjusted PMT score	72.9	51.7	169.2	**(0.00)**
Observations	1945	1592	353	

Mean coefficients; p-values in parentheses. Bold indicates significance at 5% confidence level.
Adjusted PMT score is the distance to the PMT threshold (= PMT score - PMT threshold in the village).
The Tropical Livestock Unit formula used is: $\mathrm{TLU} = \#camels * 1 + \#cows * 0.7 + (\#sheeps + \#goats) * 0.1 + (\#chicken + \#other\ poultry) * 0.01 + (\#donkeys + \#horses) * 0.5$

Table 3: Descriptive Statistics, 2013 sample

	All	Non-Beneficiary	Beneficiary
Household size	8.15	6.50	9.63
Widow household head	0.028	0.028	0.027
Female household head	0.036	0.037	0.035
Handicapped household head	0.95	0.97	0.92
Household Dietary Diversity Score	5.25	5.11	5.37
2010 PMT score	11,615.6	11,923.4	11,341.1
Livestock (TLU)	1.16	0.91	1.38
Livestock in 2012 (TLU)	1.14	0.87	1.39
Livestock sales (FCFA)	20,764.1	14,128.0	26,720.0
Livestock consumption (FCFA)	9,961.0	7,691.9	11,997.5
Index of housing quality	2.13	2.24	2.03
Solid Walls	0.0082	0.0066	0.0095
Solid Roof	0.0082	0.015	0.0024
Access to clean water	0.30	0.29	0.31
Access to toilets	0.068	0.080	0.058
Home lighting	0.33	0.36	0.30
Cooking fuel	0.097	0.12	0.077
Different assets own (#)	6.52	6.30	6.72
Total value of assets (FCFA)	166,133.4	133,015.4	195,817.3
HE owning	0.13	0.12	0.14
Number of types of HEs	0.14	0.12	0.16
HEs revenues (monthly, FCFA)	5,293.2	3,379.2	7,011.0
HEs charges (monthly, FCFA)	3,015.4	2,651.9	3,341.7
HEs equipment total value	5.20	7.19	3.41
Total land	5.09	4.58	5.54
Total land owned	4.75	4.36	5.10
Total land borrowed	0.27	0.22	0.32
Uses fertilized	0.70	0.69	0.70
Total fertilizer spending	2,050.4	1,412.6	2,622.9
Total field spending	4,327.7	3,521.9	5,050.9
Number of crops	2.16	2.11	2.21
Quantity produced per hectare (kg)	164.3	154.6	172.9
Total quantity produced (kg)	614.9	533.1	688.3
Tontine participation	0.16	0.094	0.23
Number of tontines	0.20	0.11	0.28
Tontine amount (monthly, FCFA)	362.2	121.0	578.8
Shock: any	0.64	0.63	0.65
Shock: loss of private transfers	0.023	0.015	0.030
Shock: theft	0.027	0.033	0.021
Shock: agriculture	0.58	0.58	0.58
Coping mechanism: any	0.25	0.25	0.24
Observations	1,592	753	839

Mean coefficients. Household Dietary Diversity Score computed following Swindale and Bilinsky (2005). The Tropical Livestock Unit formula used is: TLU = #camels * 1 + #cows * 0.7 + (#sheeps + #goats) * 0.1 + (#chicken

+ #other poultry) * 0.01 + (#donkeys+#horses) * 0.5. The index of housing quality aggregates wall and roof material, cooking fuel, lighting source and access to clean water and toilets.

Table 4: DID model

Panel A: Full sample

Dependent variable	(1) Livestock (TLU)	(2) Livestock Value (FCFA)	(3) Index of housing quality	(4) Cooking fuel	(5) Access to clean water	(6) Home lighting	(7) Access to toilets	(8) Different assets own (#)
Mean baseline value	*0.74*	*153,689*	*2.13*	*0.10*	*0.30*	*0.33*	*0.07*	*4.43*
2013	-0.0567	-102.6	-0.333*	-0.0744***	0.114*	-0.307***	0.0279	0.378***
	(-0.58)	(-0.01)	(-1.73)	(-2.85)	(1.89)	(-7.34)	(1.02)	(4.18)
Beneficiary	-0.0130	-1661.6	-0.212**	-0.0407**	0.0152	-0.0618**	-0.0213	-0.135**
	(-0.14)	(-0.10)	(-2.35)	(-2.22)	(0.67)	(-2.27)	(-1.59)	(-2.06)
2013 * Beneficiary	**0.418*** **	**87,811.8*** **	**0.352*** **	**0.0470** **	**0.0157**	**0.0744** **	**0.0460** **	**0.377*** **
	(3.52)	**(3.94)**	**(3.21)**	**(2.03)**	**(0.63)**	**(2.51)**	**(2.46)**	**(3.72)**
Constant	0.748***	154565.1***	2.239***	0.118***	0.293***	0.359***	0.0797***	4.499***
	(7.34)	(7.90)	(17.15)	(4.94)	(5.94)	(9.33)	(4.39)	(58.28)
Observations	3184	3184	3184	3184	3184	3184	3184	3184

Panel B: Common support sample

Dependent variable	(1) Livestock (TLU)	(2) Livestock Value (FCFA)	(3) Index of housing quality	(4) Cooking fuel	(5) Access to clean water	(6) Home lighting	(7) Access to toilets	(8) Different assets own (#)
Mean baseline value	*0.71*	*147,665*	*2.01*	*0.08*	*0.28*	*0.3*	*0.07*	*4.39*
2013	-0.0101	7619.0	-0.127	-0.0305	0.160**	-0.267***	0.00254	0.598***
	(-0.09)	(0.36)	(-0.62)	(-1.25)	(2.19)	(-5.07)	(0.10)	(6.61)
Beneficiary	-0.0709	-14917.9	-0.0549	0.0106	0.0579*	-0.0358	-0.0224	0.0272
	(-0.64)	(-0.69)	(-0.59)	(0.38)	(1.89)	(-1.21)	(-1.33)	(0.33)
2013 * Beneficiary	**0.382*** **	**81,386.1*** **	**0.157**	**-0.00168**	**-0.0180**	**0.0484**	**0.0605** **	**0.123**
	(3.25)	**(3.60)**	**(1.31)**	**(-0.06)**	**(-0.51)**	**(1.54)**	**(2.27)**	**(1.08)**
Constant	0.757***	157431.3***	2.051***	0.0712***	0.247***	0.326***	0.0814***	4.372***
	(5.63)	(5.91)	(15.05)	(3.19)	(5.03)	(6.76)	(3.75)	(53.57)
Observations	2276	2276	2276	2276	2276	2276	2276	2276

t statistics in parentheses
Standard Errors are clustered at the village level. The Tropical Livestock Unit formula used is: TLU = #camels * 1 + #cows * 0.7 + (#sheeps + #goats) * 0.1 + (#chicken + #other poultry) * 0.01 + (#donkeys + #horses) * 0.5.
The index of housing quality aggregates wall and roof material, cooking fuel, lighting source and access to clean water and toilets.
Bold indicates the DID estimator.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5: Simple Difference Results: Investments				
	(1) Simple Difference		(2) Simple Difference, Village Fixed-Effects	
	"Beneficiary" Coefficient	Standard Errors	"Beneficiary" Coefficient	Standard Errors
Panel A: Livestock				
Livestock (TLU)	0.329***	(0.097)	0.435***	(0.098)
Livestock in 2012 (in TLU)	0.362***	(0.100)	0.468***	(0.110)
Value of livestock (FCFA)	66,468***	(20,806)	86,095***	(18,818)
Log of value of livestock (FCFA)	0.925***	(0.331)	1.275***	(0.315)
Value of livestock sales (FCFA)	5,106	(3,581)	8,229**	(3,607)
Log of livestock sales (FCFA)	-0.048	(0.327)	0.406	(0.337)
Value of livestock consumption (FCFA)	2,938*	(1,620)	3,373**	(1,464)
Log of livestock consumption (FCFA)	0.743**	(0.291)	0.797***	(0.277)
Livestock difference: 2013 - 2012 (TLU)	-0.020	(0.042)	-0.020	(0.050)
Panel B: Physical Assets				
# of different assets own	0.327**	(0.148)	0.426***	(0.147)
Total value of assets (FCFA)	59,432.010***	(12,068.897)	61,389.730***	(11,159.782)
Log of total value of assets (FCFA)	0.344***	(0.080)	0.344***	(0.070)
# of different assets purchased, last 3 years	0.069	(0.118)	0.140	(0.121)
Assets purchased, last 3 years (FCFA)	22,618.821***	(6,971.937)	25,765.161***	(7,734.534)
Log of assets purchased, last 3 years (FCFA)	0.215*	(0.115)	0.278**	(0.111)
Panel C: Housing				
Index of housing quality	0.015	(0.050)	-0.053	(0.042)
Solid Walls	0.004*	(0.002)	0.000	(0.004)
Solid Roof	0.000	(0.003)	0.000	(0.004)
Access to clean water	0.058*	(0.031)	0.012	(0.026)
Access to toilets	-0.022	(0.017)	-0.029	(0.018)
Home lighting	-0.036	(0.030)	-0.034	(0.024)
Cooking fuel	0.011	(0.028)	-0.002	(0.024)
Panel D: Household Enterprises (HE)				
HE owning	0.034	(0.025)	0.021	(0.027)
Types of HE (#)	0.047*	(0.026)	0.031	(0.026)
HE equipment total value (FCFA)	3,074	(2,100)	3,500	(2,553)
HE created, last 3 years	0.016	(0.010)	0.008	(0.011)
HE equipment purchased last 3 years	0.024**	(0.010)	0.019*	(0.010)
HE(s) revenues (monthly, FCFA)	4,685	(3,001)	912	(1,735)
HE(s) charges (monthly, FCFA)	2,090	(1,717)	-181	(512)
HE(s) profits (monthly, FCFA)	2,592	(1,563)	1,090	(1,493)
Panel E: Agriculture				
Total land (ha)	0.159	(0.311)	0.788**	(0.298)

Total land owned (ha)	-0.130	(0.312)	0.557*	(0.283)
Total land borrowed (ha)	0.162**	(0.072)	0.098	(0.062)
Uses fertilized	-0.032	(0.030)	0.003	(0.024)
Total fertilizer spending (FCFA)	1,679*	(945)	785*	(408)
Total field spending (FCFA)	1,717	(1,166)	1,326*	(748)
Number of crops	0.045	(0.040)	0.113***	(0.039)
Quantity produced per hectare (kg)	36.640***	(8.626)	27.465***	(8.442)
Total quantity produced (kg)	125.704***	(36.288)	180.943***	(41.469)

Notes: Observations: 1,138 households. Standard errors are clustered at the village level. The Tropical Livestock Unit formula used is: $\text{TLU} = \#camels * 1 + \#cows * 0.7 + (\#sheeps + \#goats) * 0.1 + (\#chicken + \#other\ poultry) * 0.01 + (\#donkeys + \#horses) * 0.5$

The index of housing quality aggregates wall and roof material, cooking fuel, lighting source and access to clean water and toilets.

*** p<0.01, ** p<0.05, * p<0.1

Table 6: Simple Difference Results: Tontines				
	(1) Simple Difference		(2) Simple Difference, Village Fixed-Effects	
	"Beneficiary" Coefficient	Standard Errors	"Beneficiary" Coefficient	Standard Errors
Tontine participation	0.105***	(0.028)	0.117***	(0.029)
Number of tontines	0.123***	(0.035)	0.142***	(0.037)
Tontine amount invested (monthly, FCFA)	385.049***	(131.240)	435.074***	(152.579)
Tontine amount received (when received, FCFA)	3,565.562***	(937.250)	4,292.315***	(1,143.331)
Log of tontine amount invested (monthly, FCFA)	0.760***	(0.201)	0.829***	(0.212)
Log of tontine amount received (when received, FCFA)	0.977***	(0.254)	1.087***	(0.268)
Tontine usage: consumption	0.088***	(0.021)	0.101***	(0.024)
Tontine usage: productive investment	0.062***	(0.018)	0.072***	(0.022)
Tontine usage: private investment	0.019***	(0.006)	0.023***	(0.008)
Tontine usage: other	0.056***	(0.016)	0.071***	(0.018)

Notes: Observations: 1,138 households. Standard errors are clustered at the village level.

Table 7: DID model by PMT score

Panel A: Full sample

Dependent variable	(1) Livestock (TLU)	(2) Livestock Value (FCFA)	(3) Index of housing quality	(4) Cooking fuel	(5) Access to clean water	(6) Home lighting	(7) Access to toilets	(8) Different assets own (#)
				Below median PMT score:				
2013 * Beneficiary	0.367**	94,282.8***	0.660***	-0.00852	0.0830	0.106	0.102**	0.333
	(2.34)	(2.78)	(2.83)	(-0.36)	(1.13)	(1.20)	(2.46)	(1.45)
				Above median PMT score:				
2013 * Beneficiary	0.274*	48,407.9	0.369	-0.0594	-0.0219	0.205***	0.0325	-0.173
	(1.86)	(1.68)	(1.19)	(-0.98)	(-0.25)	(3.61)	(0.70)	(-1.40)
Observations by PMT score quantile	1,554	1,554	1,554	1,554	1,554	1,554	1,554	1,554

Panel B: Common Support Sample

Dependent variable	(1) Livestock (TLU)	(2) Livestock Value (FCFA)	(3) Index of housing quality	(4) Cooking fuel	(5) Access to clean water	(6) Home lighting	(7) Access to toilets	(8) Different assets own (#)
				Below median PMT score:				
2013 * Beneficiary	0.577***	133,919.6***	0.549*	-0.0114	0.111	0.0352	0.0902*	0.524**
	(3.27)	(3.46)	(1.74)	(-0.79)	(1.12)	(0.32)	(1.75)	(2.32)
				Above median PMT score:				
2013 * Beneficiary	0.310**	58,623.9**	0.230	-0.0484	-0.0161	0.123**	0.0493	-0.240*
	(2.25)	(2.14)	(0.94)	(-1.05)	(-0.21)	(2.54)	(1.17)	(-1.98)
Observations by PMT score quantile	1,138	1,138	1,138	1,138	1,138	1,138	1,138	1,138

Rows indicate DID estimator, *t* statistics in parentheses.
Standard Errors are clustered at the village level. The Tropical Livestock Unit formula used is: TLU = #camels * 1 + #cows * 0.7 + (#sheeps + #goats) * 0.1 + (#chicken + #other poultry) * 0.01 + (#donkeys + #horses) * 0.5.
The index of housing quality aggregates wall and roof material, cooking fuel, lighting source and access to clean water and toilets.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8: SD model by PMT score for *tontines*

Panel A: Full sample

Dependent variable	(1) Has tontine(s)	(2) Number of tontines	(3) Tontine investment amount (monthly, FCFA)	(4) Last tontine amount received (FCFA)
		Below median PMT score:		
Beneficiary	0.213***	0.286***	636.1**	8440.2**
	(4.06)	(4.97)	(2.26)	(2.52)
		Above median PMT score:		
Beneficiary	0.0829**	0.0667*	146.8	1635.3
	(2.25)	(1.72)	(1.53)	(1.43)
Observations by PMT score quantile	776	776	776	776

Panel B: Common Support Sample

Dependent variable	(1) Has tontine(s)	(2) Number of tontines	(3) Tontine investment amount (monthly, FCFA)	(4) Last tontine amount received (FCFA)
		Below median PMT score:		
Beneficiary	0.174***	0.269***	502.1**	6015.7***
	(3.22)	(2.81)	(2.21)	(2.74)
		Above median PMT score:		
Beneficiary	0.0620	0.0260	170.3	2255.9
	(1.14)	(0.38)	(1.38)	(1.21)
Observations by PMT score quantile	702	702	702	702

Rows indicate SD estimator, *t* statistics in parentheses.
Standard Errors are clustered at the village level.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 9: Propensity Score Matching estimates

	"Beneficiary" Coefficient	Standard Errors
Livestock (TLU)	0.475***	(0.081)
Livestock in 2012 (TLU)	0.514***	(0.092)
Value of livestock (FCFA)	86,387.832***	(14,785.767)
Value of livestock sales (FCFA)	12,772.135***	(3,701.501)
Value of livestock consumption (FCFA)	4,403.817***	(1,392.289)
Livestock Difference: 2013-2012 (TLU)	-0.037	(0.038)
Number of different assets own	0.410***	(0.111)
Number of different assets purchased in the last 3 years	0.244**	(0.102)
Total value of assets (FCFA)	64,758***	(11,117)
Total value of assets purchased in the last 3 years (FCFA)	25,354***	(6,088)
Aggregate index of housing quality	-0.126***	(0.041)
Solid wall	0.003	(0.005)
Solid roof	-0.013***	(0.005)
Access to clean water	0.013	(0.023)
Access to toilets	-0.019	(0.013)
Home lighting	-0.071***	(0.024)
Cooking fuel	-0.039***	(0.015)
HE owning	0.022	(0.017)
Number of types of HE	0.034*	(0.019)
HE created (the last 3 years)	0.007	(0.011)
HE(s) revenues (monthly, FCFA)	3,688.613	(2,930.713)
HE(s) charges (monthly, FCFA)	657.609	(2,003.616)
HE(s) profits (monthly, FCFA)	3,041.531	(2,867.565)
HE equipment total value	-3.906	(4.528)
HE equipment purchased (last 3 years)	0.013	(0.009)
Total land	0.962***	(0.244)
Total land owned	0.749***	(0.244)
Total land borrowed	0.099	(0.062)
Uses fertilized	0.005	(0.023)
Total fertilizer spending (FCFA)	1,358.365**	(619.772)
Total field spending (FCFA)	1,669.798	(1,062.384)
Number of crops	0.092**	(0.037)
Quantity produced per hectare (kg)	19.364**	(7.910)
Total quantity produced (kg)	160.160***	(32.260)
Tontine participation	0.135***	(0.018)
Number of tontines	0.164***	(0.027)
Tontine amount (monthly, FCFA)	466.974***	(125.789)
Tontine amount received (when received, FCFA)	4,678.011***	(922.978)
Tontine usage: consumption	0.105***	(0.015)
Tontine usage: productive investment	0.077***	(0.012)

Tontine usage: private investment	0.019***	(0.006)
Tontine usage: other	0.071***	(0.011)

Standard Errors in parentheses. Bold indicates statistical significance.
Observations: 1,553 households. The Tropical Livestock formula used is: TLU = #camels * 1 + #cows * 0.7 + (#sheeps + #goats) * 0.1 + (#chicken + #other poultry) * 0.01 + (#donkeys + #horses) * 0.5. Bold indicates the DID estimator.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$