Poor Households' Productive Investments of Cash Transfers:

Quasi-experimental evidence from Niger[1]

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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 immediate consumption among the very poor. This article presents evidence that a cash transfer project in rural Niger induced investments in assets and productive activities that were sustained among the very poor 18 months after project completion. Results show lasting increases in livestock assets and participation in saving groups (*tontines*). Cash transfers also contributed to improved agricultural productivity, but no effects in terms of diversification of other household enterprises are found. Productive asset gains are, notably, largest among the poorest of the poor, suggesting small regular cash transfers combined with enhanced saving mechanisms can relax constraints to asset accumulation among the extreme poor.

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

JEL codes: O1, Q1, I3, D91

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 considered 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, evidence of long-term productive impacts is still limited, particularly in Sub-Saharan Africa and for unconditional transfers.

The impacts of cash transfers in very low-income settings where the marginal propensity to consume additional income may be quite high have also 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). Further, if poverty traps exist, 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 in Sub-Saharan Africa.

The article is structured as follows. The next section briefly reviews the literature on cash transfers and possible pathways for sustained productive impacts, and also presents the theoretical framework of the analysis. Section three describes the intervention, the data, and the empirical estimation strategy. Section four reports and discusses the results. The last section concludes and outlines policy implications.

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 short-term 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 were found to 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 the transfers (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 encourage 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 documented across Sub-Saharan Africa, 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).[2] Long-term evidence on the sustainability of productive impacts of cash transfers remains limited, particularly for very poor households in low-income settings of Sub-Saharan Africa. To the best of our knowledge, our study is the first to consider sustained productive impacts of transfers after project termination in this setting.

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 studies in Sri Lanka and Uganda where credit constraints are binding (Blattman, Fiala, & Martinez, 2013; De Mel, McKenzie, & Woodruff,

[2] Among other "mediating factors" found in 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 in Sub-Saharan Africa. This paper fills these gaps by exploring cash transfers impacts on productive investments for very poor Nigerien households 18 months after the cessation of transfers.

B. Theoretical framework

Cash transfers can potentially generate household productive investments at the micro-economic level by alleviating specific constraints (such as saving and credit constraints), by protecting households against risk, and by decreasing production inefficiencies due to intra-household resource allocation.[3] 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 initial levels of assets result

[3] For a review of possible mechanisms and how they translate into economic growth, see Barrientos (2012) and Alderman and Yemtsov (2013).

in a lack of productive investment. The model draws on the poverty traps literature, which aims to 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 production 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 $\bar{k}$.[4] For each technology, there is a steady-state investment level: $k_L^*(a_i)$ and $k_H^*(a_i)$. If individuals have 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:

[4] 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.[5] 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:

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

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).[6]

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

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

In the model, cash transfers can 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. It is an empirical question whether such a threshold exists, and whether cash transfers can help households cross the critical asset threshold and generate a sustained productive impact.

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 as the transfers would not be sufficient for the poorest households to reach $\hat{k}(a_i)$. Cash transfers may on the other hand enable relatively better-off poor households to cross the critical asset threshold and make sustained productive investments. As such, predictions of the critical asset threshold model can be tested empirically by measuring the heterogeneous impact of the transfers on the poorest, relatively to the less poor.[7]

Several underlying mechanisms may contribute to poor households' inability to invest 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, in this case the impact of cash transfers on productive investments will likely be greater in relatively less poor households. Liquidity constraints that

[7] 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).

also lead poorer households to keep wealth in the form of precautionary savings rather than invest it in productive assets may also be relaxed by cash transfers (Mogues, 2011; Zimmerman & Carter, 2003).

Several alternative mechanisms can generate opposite patterns with greater investments of cash transfers among the very poor. If a high-return technology is also more risky, as is often the case in drought-prone areas, ex-ante risk-management can 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*). Cash transfers can then shift investments towards a 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 diversify risk.

Lumpiness of productive investments may also 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 poorest households, they may invest more in productive assets if cash transfers facilitate savings.

These alternative mechanisms are not mutually exclusive and in some cases reinforce each other. Yet they have different implications for the heterogeneity of cash transfer impacts 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 slight less poor households. This sheds empirical light on the potential mechanisms by which cash transfers generate household investment in productive assets.

The next section presents the cash transfers intervention, the data collected and the empirical identification strategy employed in the paper.

3. Intervention, Data and Empirical Identification Strategy

A. Intervention Description

Cash transfers have initially been used in Niger by humanitarian organizations as a short-term intervention delivered in the aftermath of seasonal shocks. In this context, studies have examined the relative impacts of alternative program modalities (mobile money vs. cash; food vs. cash; etc.)[8] 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). However, qualitative research has suggested that households invest transfers in livestock and agricultural activities (Olivier de Sardan, 2013).

In 2010, the government of Niger started to implement small regular cash transfers as a pilot project with technical assistance from the World Bank.[9] Specifically, the *Projet Pilote des Filets Sociaux par le Cash Transfert* (PPFS-CT) was launched to address chronic food insecurity and household vulnerability to food insecurity in the context of recurring droughts and other adverse

[8] Studies compare 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).
[9] A national safety nets project was put in place in 2011. It included a cash transfer program, which began to operate in 2012 and initiated the scale-up of the pilot. The cash transfer program is scheduled to reach 80,000 households by 2017.

economic shocks (PPFS-CT, 2011). The pilot operated in 52 villages of the Tahoua and Tillabéri regions. 2,281 beneficiary households received small regular monthly unconditional cash transfers of 10,000 FCFA (approximatively 20 USD, or about 20% of household consumption) for 18 months, between January 2011 and June 2012.

Beneficiaries were selected based on a Proxy Means Test (PMT) (Del Ninno & Mills, 2014). The PMT formula was calculated from a regression of per capita consumption on basic household demographic and economic characteristics with data from a nationally representative survey (Katayama, 2010). A village-specific PMT eligibility threshold was then chosen so that 30% of the households were designated as beneficiaries in each village. 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.[10]

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). At each meeting, one member in rotation takes all the cash from the pot 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 program.[11]

[10] In polygamous households, the recipient was typically the first wife.

[11] *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 other noteworthy features, which makes it particularly relevant to address 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 the rural Sahel, one of the poorest regions of the world where climatic shocks are recurrent.[12] Second, the program delivered small, regular, foreseeable, monthly transfers, which are distinct from the large transfers delivered as emergency response following seasonal shocks. Third, and most importantly, the transfers took place for 18-months between January 2011 and June 2012, and this limited duration was clearly communicated to beneficiaries at the beginning of the program. A follow-up survey collected 18 months after the end of the transfers (36 months after the baseline survey) provides a rare opportunity to assess long-term transfer impacts. Specifically, we can analyze the sustainability of program impacts 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: a baseline survey was collected in 2010 before the project was implemented and a follow-up survey was collected in 2013 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.[13] In November 2013, approximately 18 months after the end of the program, 2,000 households were sampled to participate in a

[12] Niger had the lowest Human Development Index (HDI) in the world in 2012 (see http://hdr.undp.org/en/statistics/).
[13] Several food security variables were collected in 2010 only for the subsample of households in Tahoua. These variables are analyzed as a robustness checks.

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 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 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 for the limited number of variables which are included in the baseline (2010) dataset: housing quality, livestock owned and some durable goods. For these variables, it is possible to use a difference-in-differences (DID) estimator to estimate differences in outcome trends between 2010 and 2013 across beneficiaries and non-beneficiaries:

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

where B_i is an indicator variable for beneficiary households (who received cash transfers), T is an indicator variable equal to 1 in 2013, and β_3 captures the impact of the cash transfers.[14] 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 band for which there exist a common support of beneficiaries and non-beneficiaries with similar PMT scores. 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. These estimates can be interpreted as Local Average Treatment Effects (LATE).

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

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 ($PMT\_threshold_{max}$,):

$$y_{i\epsilon CS} = \beta_0 + \beta_1 \mathrm{B}_i + \varepsilon_i \,, \qquad i \,\epsilon\, A \tag{8}$$

where $i\epsilon CS$ if $PMT\_threshold_{min} \leq PMT\_score_i \leq PMT\_threshold_{max}$ (common support sample), and β_1 captures the estimated 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, in particular 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).[15]

This estimation strategy relies on several key 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.[16] The next subsection presents tests of balance to explore empirically the validity of the counter-factual generated by this identification strategy. The threats to the identification strategy and the robustness of the results are further discussed further in section 4-F.

[15] The first identification strategy described in equation (7) can also be employed in the 'common support' sample (see Table 4 in section 4).

[16] 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 principle 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.

D. Tests of Balance and Attrition

Table 1 presents formal tests for the difference between beneficiaries and non-beneficiaries characteristics at baseline. Panel A displays results for the common support sample, and panel B for the full sample. Significant differences across groups are expected since all the variables considered are included in the PMT formula. 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.[17] These tests indicate that the SD design does not produce a perfectly balanced sample, but differences between the treatment and control groups for most assets are not significant. Moreover, non-beneficiary households appear better off (higher levels of assets), which would make positive effects of the treatment harder to find.[18]

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. Attrition is 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 the 1,592 completed 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,

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

[18] 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 in the Simple Difference strategy.

they are limited and as such appear unlikely to strongly affect results of the main identification strategy.[19]

Table 3 presents descriptive statistics for all variables in the follow-up survey and the full sample, 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 at follow-up.

4. Results

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. Consistent with equation (7) above, the coefficient of the interaction between post-program and beneficiary dummies captures the cash transfer impacts. 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. SD results are presented for a range of outcomes: housing, durable goods, livestock, household enterprises (HE) and agricultural activities.

A. 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

[19] There are additional significant differences between attrition and non-attrition households in the full sample compared to the common support sample.

(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).[20] The SD estimates of impacts on livestock are also highly consistent with the DID estimates, 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 further show that consumption from own livestock increases 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.

B. Impacts on Durables and Housing

[20] Panel B provides more conservative estimates, using the preferred (common support) sample in the SD strategy. 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.

SD estimates provide some indications of increased investments in durable goods among beneficiary households (Table 5, Panel B). Beneficiaries have more 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). In addition, SD estimates reveal no robust significant impacts on housing quality (Table 5, Panel C).

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 in SD estimates (Table 5, Panel D). Thus, despite impacts on productive assets, participation in the cash transfer program does not appear to lead to livelihood 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 enterprises are very diverse in terms of activities and scale.[21] There is indication of an increase in the number of household enterprises among beneficiaries, but this effect is not robust to the

[21] The point estimates are large and positive for revenues and profits from HEs, but the standard errors are large due to the heterogeneity of household enterprises.

inclusion of village fixed-effects. 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 in particular agricultural productivity. Beneficiaries use more agricultural inputs, particularly by spending more on fertilizers. Strong impacts on quantities produced and yields are also found 18 months after the end of the transfers. Some impacts are observed on land area cultivated, although they are not robust and only significant in the specification including village fixed-effects.

D. 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 *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 SD approach because the relevant variables are only included in the follow-up survey (Table 6). Results show large and significant increases in the participation in *tontines*, in the 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). Conditional on tontine participation, 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 investments in productive activities and durable goods. As such, *tontines* is one of the mechanisms that can explain the observed impacts of transfers on productive assets.

Overall, the results suggest that beneficiary households continue to participate in the *tontines* that were set-up during the project, even 18 months after the project terminated. Still, 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).[22] This is consistent with what is expected after beneficiaries stop receiving regular transfers and encouragement to participate in savings groups.

E. 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 the slightly less poor segments of the sample can shed light on the mechanisms through which cash transfers promote productive investments. If poverty traps exist, small regular cash transfers would not be expected to foster productive investments among the very poor. In contrast, small, regular transfers would be more likely to help slightly less poor households to cross a potential poverty trap threshold and make productive investments. This question also addresses the important policy issue of whether small, regular cash transfers can have durable impacts on the poorest households, or just meet their 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

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

lowest initial PMT scores) or the slightly less poor households. To explore impact heterogeneity across consumption levels, DID estimates are computed separately for the sub-samples below and above the median PMT score (Table 7).[23] 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. However, while the observed investment impacts are driven by the poorest households, the coefficients for the two sub-samples are only significantly different (based on a Wald test) for number of different assets owned.

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 curve for the poorest beneficiaries with lower initial assets.

Lastly, since *tontines* appear to be a key mechanism behind observed impacts on productive investment, we also test the impact heterogeneity across consumption levels for the *tontine* variables based on initial PMT score. Results show a much larger impact on *tontines* usage, number, amount invested and amount received for households with lower initial PMT scores (Table 8). These results are in line with the larger livestock increase observed among the poorest households. For instance, with village fixed-effects, poorer beneficiaries increase the number of

[23] 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).

tontines by 26.7 percentage points among the poorest, whereas the increase is only 2.6 percentage points for less poor beneficiaries.

Overall, the observed heterogeneity in program impacts is not consistent with theoretical predictions of the basic critical asset threshold model outlined in section 2. First, as results for the entire sample show, modest, regular transfers delivered to the poor were invested in productive activities and assets. Second, the impact of transfers in terms of investment is greater for the very poorest beneficiaries compared to less poor households in the sample. However, the asset threshold model suggests that better-off poor households would invest a larger share of the transfers received, because the poorest cannot 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 contributed to help very poor households to overcome these constraints directly, or through the facilitation of savings groups.

F. Robustness

There are several limitations to the empirical identification strategy that may affect the validity of the results. First, there may be some concerns with internal validity in the SD identification strategy: control households belong to poorer villages on average, since they are not among the poorest 30% in their village, but would be in the poorest 30% in other villages. This could generate an upward bias in the estimated impacts if control households are hurt by the relatively weak economic standing of their villages. Alternatively, it could generate a downward bias if they gain from their relatively strong economic standing within the village. Adding village-

effects partly addresses this potential issue, but given the few number of observations per village, it does so with a loss of degrees of freedom.

Conversely, control households have higher PMT scores than treatment households, in each village and overall – which may induce a downward bias in impact estimates. Also, there may also be some local spillover effects from beneficiaries to non-beneficiaries within villages, affecting SD and DID estimates.[24] Both higher PMT scores and local spillover effects would create a downward bias in the impact estimates; consequently it does not cast doubt on the significance of a positive impact.

Another concern would be the existence of an "Ashenfelter's dip", where beneficiaries become eligible due to a consumption dip immediate prior to program selection (Ashenfelter, 1978; Heckman & Smith, 1999). Given the design of the pilot cash transfer project in Niger, such an "Ashenfelter's dip" effect is unlikely for a number of reasons. First, beneficiaries are not self-targeted into the program, which rules out self-selection bias. Second, targeting is conducted based on long-term assets and household characteristics which usually do not fluctuate rapidly in response to shocks. In fact, the PMT approach has been questioned precisely because it does not allow identifying households hit by temporary shocks (Del Ninno & Mills, 2014). Third, 30% of the villages population is targeted, which means that idiosyncratic short-term shocks would have to be particularly widespread and large– especially given the magnitude of the impact found– to generate a broad "Ashenfelter's dip" effect. Fourth, beneficiaries are not only found to catch-up with non-beneficiaries, but to pass them in many cases. Fifth, in the "common support" sample, baseline characteristics between beneficiary and non-beneficiary are relatively similar. In fact we

[24] For evidence of such a spillover effects in other cash transfers programs, see Angelucci & De Giorgi (2009).

test the possibility of shocks affecting beneficiary households (and not non-beneficiaries) using a range of food security outcomes that are more correlated with exposure to a short-term shocks than PMT scores (Schnitzer, 2016). In the common support sample, there are no significant differences between beneficiary and non-beneficiary households, suggesting that none of these groups have been particularly affected by shocks.[25]

With these potential limitations in mind, we offer some additional robustness tests using Propensity Score Matching (PSM).

Similar to the SD identification strategy, the matching strategy 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 (beneficiary households) and $Y(0)$ for untreated observations (non-beneficiary households).[26]

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

[25] Results available upon request. The food security variables include the Household Hunger Scale; three Coping strategy indices; the Food Consumption Score; and the Household Dietary Diversity Score (see McBride (2015) for an analysis and discussion of these indicators). Unfortunately, the baseline survey only includes food security variables for the Tahoua region which includes 591 households in our common support sample.
[26] The PSM estimator is implemented using Stata (Leuven & Sianesi, 2014).

'common support' sample.[27] A test of balance between treated and control units is performed for unmatched (before PSM is used) and matched observations (after PSM weighting) and illustrates 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 slightly reduces this bias.[28] Common support is found for all but for 89 beneficiary households, which means that most observations are used.

PSM estimates are very close to those obtained from the SD identification strategy (Table 9), with two main exceptions. First, PSM estimates also suggest a significant, negative effect in terms of housing quality, which confirms that most households have not invested in their dwelling. Second, the magnitude of the estimated effects tends to be slightly larger in PSM estimates than in DID and SD estimates. Overall, PSM results support the findings obtained from 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 in this paper show that even very poor households in one of the poorest settings in the world, for whom marginal propensity to consume additional income is expected to be very high, invest part of small regular transfers in productive assets to raise future

[27] Several other PSM specifications are tested, including: a specification for households in the common support sample; 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 common support sample are much closer to results from the main identification strategy.
[28] Indeed selection into beneficiary status is based on PMT scores. Besides, PMT targeting is known to select larger households in general (Stoeffler, Mills & del Ninno, 2015).

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 represents more than half of households' baseline livestock. These gains are durable, as they are obtained 18 months 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 for 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 suggest objectives of raising long-term income and agricultural productivity and retaining accumulated assets. Importantly, the sustained positive effect of the program was not concentrated among the slightly less poor 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 cash transfers lasting for one and a half year combined with enhanced saving mechanisms can be effective to help very poor households build an asset base in the medium-term, and thus tackle some of the "deep roots" of poverty. The results also shed light on binding constraints to asset accumulation 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 critical asset threshold existed, small regular cash transfers would be more likely to help less poor 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 of strong productive asset gains among the poorest beneficiaries.

The results stand in sharp contrast to some arguments made by the critics of social assistance, in particular that cash transfers improve immediate consumption, but create dependency and leave little lasting impacts upon program termination. A growing body of evidence supports the hypothesis that beneficiary households make long-term productive investments. This paper shows that even some of the very poorest households in the world – living in Sahelian rural areas lacking infrastructures and prone to adverse shocks – are able to productively invest cash transfers.

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 interesting result that the very poorest households may have the greatest propensity to allocate transfer income to productive investments would benefit from being examined in a wider variety of contexts. This finding has important implications for addressing extreme poverty, as it suggests that safety nets programs can be particularly effective in generating sustainable income gains among the poorest of the poor.

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Tables

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: $\text{TLU} = \#camels * 1 + \#cows * 0.7 + (\#sheeps + \#goats) * 0.1 + (\#chicken + \#other\ poultry) * 0.01 + (\#donkeys + \#horses) * 0.5$

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: $\text{TLU} = \#camels * 1 + \#cows * 0.7 + (\#sheeps + \#goats) * 0.1 + (\#chicken + \#other\ poultry) * 0.01 + (\#donkeys + \#horses) * 0.5$

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*** (3.52)**	**87,811.8*** (3.94)**	**0.352*** (3.21)**	**0.0470** (2.03)**	**0.0157 (0.63)**	**0.0744** (2.51)**	**0.0460** (2.46)**	**0.377*** (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*** (3.25)**	**81,386.1*** (3.60)**	**0.157 (1.31)**	**-0.00168 (-0.06)**	**-0.0180 (-0.51)**	**0.0484 (1.54)**	**0.0605** (2.27)**	**0.123 (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: 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.
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Figures

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

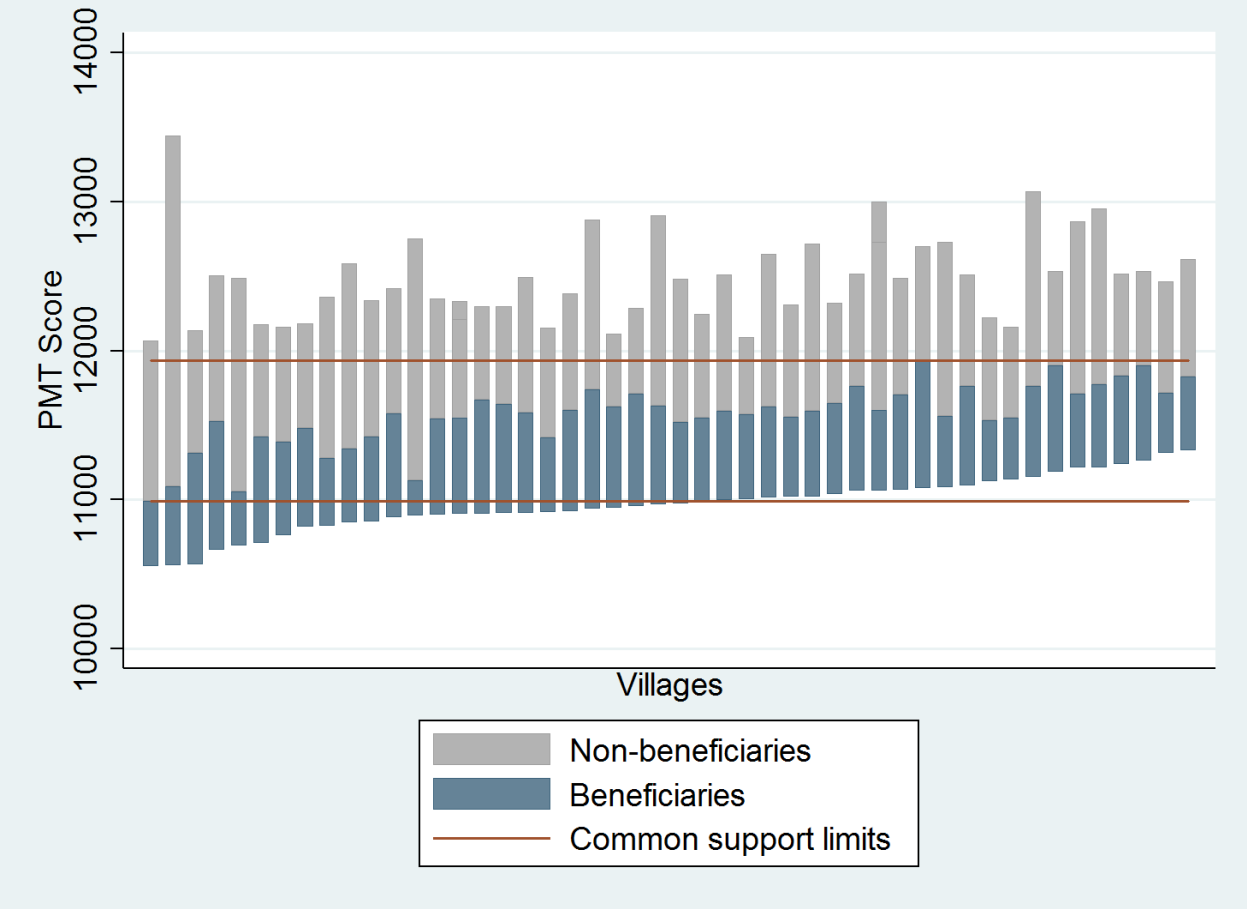
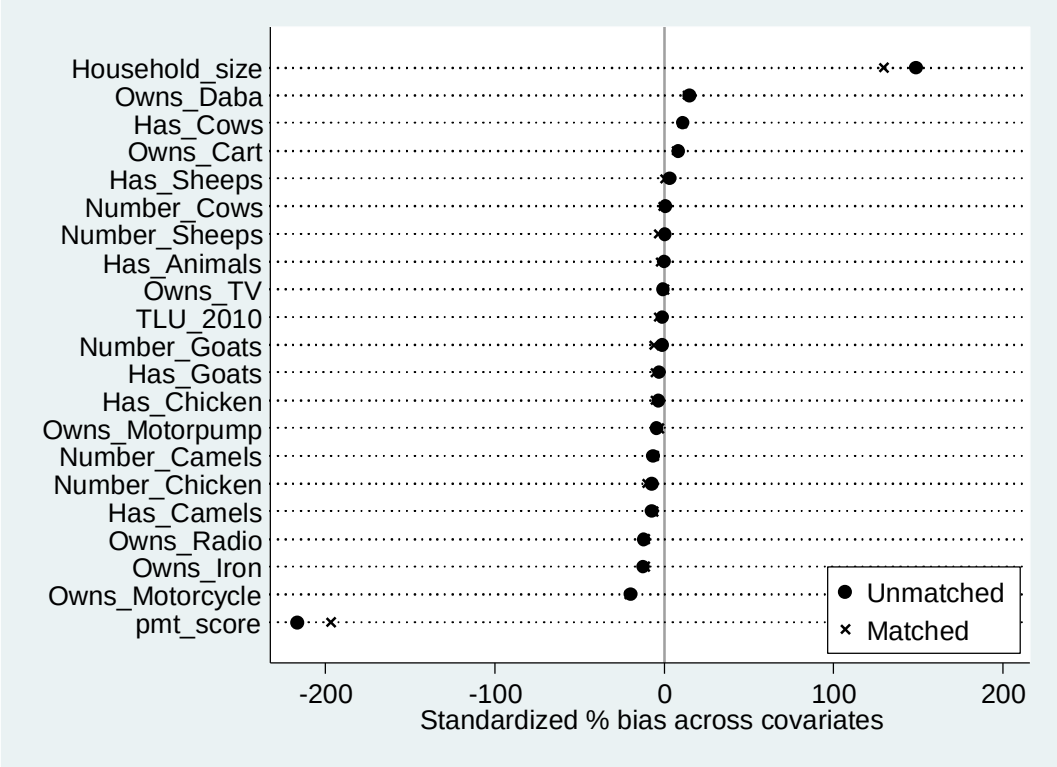


Figure 2: Test of balance for the propensity score matching (PSM) estimator



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