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Does Rwanda's flagship microcredit programme boost agriculture and incomes?

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Abstract

One of the three components of Rwanda's flagship anti-poverty programme, Vision 2020 Umurenge *(VUP), is the provision of credit to relatively poor households, nearly all of them farmers. In this paper we estimate the impact of the programme using high-quality household survey data from 2013/2014 and 2016/2017. Using the panel data, the double-difference model shows that households that borrow increase their stock of livestock. This is confirmed by the cross-section inverse probability-weighted regression adjustment models, which also find that VUP borrowing leads to more purchases of farm inputs, greater consumption (especially of home-produced food), lower poverty, and greater secondary school enrolment, but not to more hours worked. While VUP loans account for only 2% of the value of microcredit in Rwanda, they do help fill a need for production credit at a scale large enough to be able to help households appreciably increase their agricultural and other assets, and ultimately their income.*

Key words: farm expenditure, livestock accumulation, difference-in-difference, microcredit, Rwanda

1. Introduction

In 2008, Rwanda began its flagship Vision 2020 *Umurenge* Programme (VUP), which aims "to accelerate the rate of poverty reduction" (Government of Rwanda 2007: i) using three levers: direct support for the neediest, public works for poor households with able-bodied members, and rural credit "to foster entrepreneurship and off-farm employment". This was just 14 years after the genocide against the Tutsis, and Rwanda was still among the poorest countries in Africa.

In this paper, we estimate the impact of the credit component ('financial services', or VUP-FS) of the VUP programme on asset acquisition (livestock), farm expenditure (hand tools, hiring labour, fertilisers, insecticides and seeds), earnings (including farm/business profit), consumption (including

education and health), and poverty, using household survey data from 2013/2014 and 2016/2017. Although there have been descriptive reports on the components of the VUP programme (National Institute of Statistics of Rwanda [NISR] 2015), this is the first rigorous analysis of the VUP-FS programme and adds to the small, but growing, number of studies of microcredit in Africa.

Rwanda serves as a useful case study because, over the past two decades, it has gone from being at the bottom of the African income distribution to somewhere in the middle, and so its experience is likely to overlap that of many other countries in the region. Thus, the lessons we draw for policy are relevant not only to Rwanda, but also to much of Africa.

Our most robust finding is that borrowers from the VUP microcredit programme add to their stock of livestock. There is also some evidence that they increase spending on farm equipment and inputs, consumption (especially from their own farms), and that this reduces poverty, but these contemporaneous effects are small, although they may be stronger with a lag.

In what follows, we review the relevant literature, describe the VUP-FS programme, identify the impacts that we would expect it to have, discuss our data and identifying assumptions, and report and discuss the empirical findings.

2. Literature review

Theoretically, government provision of microcredit will only have an impact on income-generating activities if households are credit-constrained (Morduch 1998); otherwise, it will essentially replace existing sources of credit with no discernible effect on household production, consumption or investment. While two-thirds of Rwandan households borrowed at some point in 2016/2017 (NISR 2018a), the median loan was just USD 13, suggesting that credit constraints are likely to be real and that we may expect to see a material impact for households that are able to get VUP loans (which have a median value of about USD 120).

The initial enthusiasm for microcredit has given way to a more sober assessment of its potential. While Khandker (2005) found that microcredit programmes in Bangladesh helped the poor through consumption smoothing, and Nguyen *et al*. (2007) found that loans from the Vietnam Bank for Social Policy reduced poverty, several other studies have found no evidence of an impact of microcredit on variables such as consumption (Augsburg *et al*. 2012; Crépon *et al*. 2015; Hoffmann *et al*. 2020; Imai & Azam 2012), particularly in the long run (Buchenrieder *et al*. 2019).

Part of the challenge is that it is not always clear what effects microcredit is expected to have. Some studies have focused on the effects on income and consumption (Khandker *et al*. 1998; Banerjee 2013; Mwansakilwa *et al*. 2017), food consumption (Seng 2018), poverty reduction (Hossain 1988; Khandker 1998, 2005; Imai 2011), and welfare improvement (Bhole & Ogden 2010), while others have looked at outreach (Nguyen *et al*. 2007), changes in social indicators such as female empowerment (Hashemi *et al*. 1996; Kabeer 2001; Mahmud 2003; Zohir & Matin 2004), employment (Ahlin & Jiang 2008), educational enrolment (Kandulu *et al*. 2020), education and health expenditure (Jiang *et al*. 2020), business formation (Osa Ouma & Rambo 2013; Crépon *et al*. 2015), agricultural productivity (Loaba *et al*. 2021) and asset accumulation (Adjei *et al*. 2009; Van Rooyen *et al*. 2012).

A priori, we expect VUP-FS loans to be used for productive activities, in part because this is a condition of borrowing. This should translate into measurable effects on asset accumulation, farm expenditure, household production and consumption. We provide further details below.

3. The VUP-FS programme

While the reach of the VUP-FS programme has varied over time, by 2017/2018 it lent to 41 082 households, or 0.7% of the population, with programme expenditure equivalent to 0.6% of GDP (Local Administrative Entities Development Agency [LODA] 2015; NISR 2019). In that year, poor households made up 38% of the population and received 34% of the VUP-FS loans. Although 82% of Rwandan households are farmers, at least part time, 96% of VUP-FS loans went to farming households.

Loans advanced under the VUP-FS programme may not exceed 100 000 Rwandan franc (RWF; about USD 120[1]) for individual loans, or about twice this amount (per person) if loans are made to groups (which must have at least seven members). To be eligible to borrow, individuals are supposed to be in *Ubudehe* categories 1 or 2 (i.e. poor), or in category 3 but at risk of falling back into poverty. Loans must be used for income-generating purposes, and are extended for periods of no more than two years.

The number of VUP-FS borrowers rose quickly at first, to just over 50 000 in 2009/2010, then dipped sharply in 2014/2015, after which the number rebounded, and then settled at about 40 000, as shown in Figure 1. Loan disbursements followed a similar pattern. Prior to 2014/2015, the loans were managed by administrative sectors (i.e. subdistricts, of which there are 416 in Rwanda), charged an annual interest rate of 3%, did not require collateral, and were often spent on purposes other than 'productive' income-generating activities. From 2014/2015, the loans were managed by the *Umurenge* Saving and Credit Cooperative societies (SACCOs), which required collateral and charged an interest rate of 12% per annum. In 2017/2018, control over lending was returned to the administrative sectors, the interest rate was reduced to 2%, and loans were exempt from providing collateral (MINALOC 2019). Our data run mainly from 2013/2014 through 2016/2017.

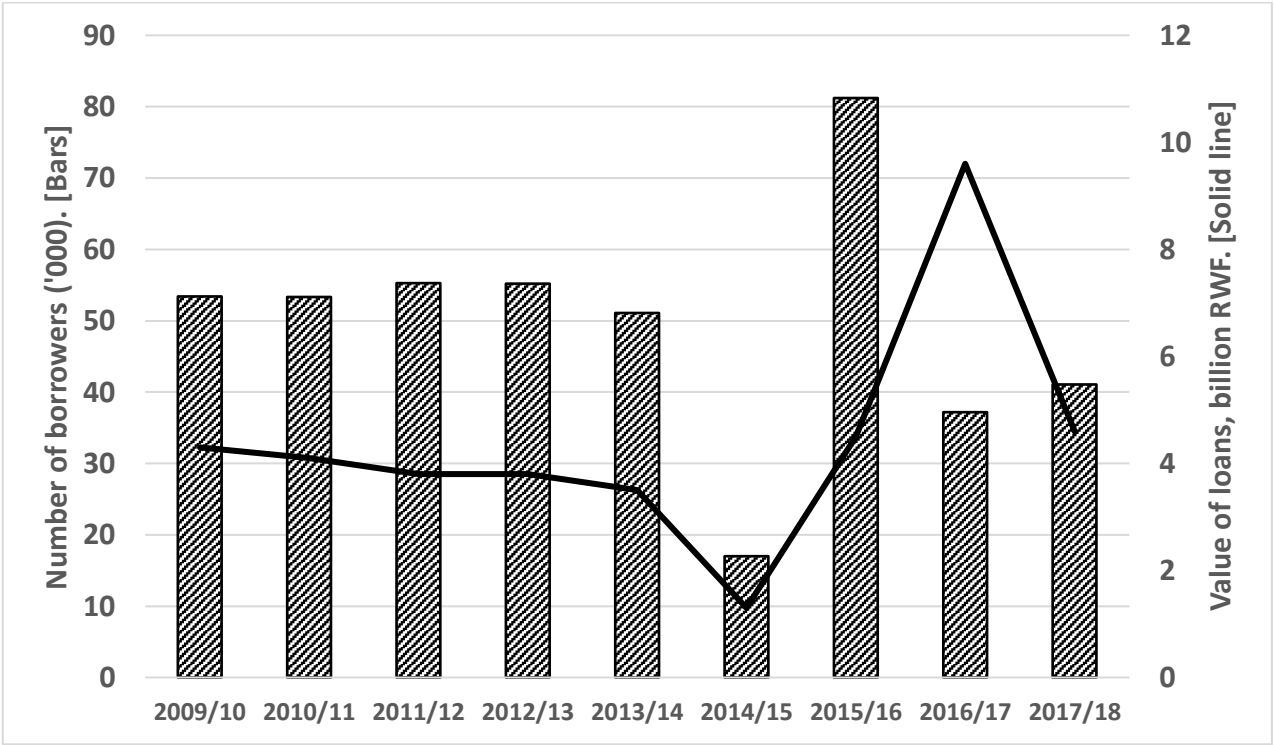

Figure 1: VUP-FS loans and number of borrowers over time
Source: Local Administrative Entities Development Agency ([LODA] 2019)

[1] As of 31 July 2017, the average exchange rate of US dollars to Rwandan francs was 832 (National Bank of Rwanda 2017).

In 2016/2017, according to the fifth integrated household living conditions survey (EICV5), 66.7% of households had borrowed at some point during the previous year, and 53.4% had an outstanding loan at the time of the survey. Most household borrowing is on a very small scale, with 45% of loans coming from relatives and 32% percent from tontines (i.e. rotating credit associations), for which the median loans were about USD 9 and USD 18 respectively, as shown in Table 1.

Table 1: Sources of credit for households, 2016/2017

	Loans worth less than 1 000 000 RWF						**All loans**	
	% of all loans		**% of loans**		**Per loan**		**Per loan**	**% of all loans**
Loan source	**Number**	**Value**	**Without collateral**	**For production**	**Median**	**Mean**	**Mean**	**Value**
Commercial bank	1.9	12.9	21	49	380 000	389 350	3 986 607	56.9
Relative	44.6	23.4	98	15	7 000	26 743	43 181	7.3
Tontine (community)	32.2	21.2	84	30	15 000	31 920	36 143	4.6
Informal lenders	9.9	5.8	94	16	10 000	33 588	65 292	2.2
VUP-FS	**1.0**	**2.0**	**20**	**77**	**100 000**	**96 073**	**96 073**	**0.4**
SACCO	3.2	18.6	13	53	200 000	274 660	614 756	10.2
Other	7.2	15.3	68	37	30 000	109 163	457 999	13.2
All loans	**100.0**	**100.0**	**86**	**24**	**11 000**	**50 622**	**254 011**	**100.0**

Source: NISR (2018a). In 2016/2017, RWF 100 000 was worth about USD 120 at market exchange rates

In 2016/2017, VUP-FS loans constituted just 0.4% of loans by value if all loans were counted, or 2.0% of the value of loans of less than 1 000 000 RWF (about USD 1 202 in 2016/2017), which may be considered to represent microcredit. These loans represented 4.5% of the value of microcredit going to poor households.

One feature of VUP-FS credit is that borrowers are supposed to use the proceeds for 'productive' activities. Table 2 shows the stated purposes of borrowing, based on borrowing households surveyed in the EICV5 in 2016/2017. Of the VUP-FS loans, 77% were earmarked for 'productive' activities, compared with 24% for all other loans. Almost half (46%) were targeted for agricultural expansion, which is more than twice as much as for loans from any other source. This suggests that VUP-FS loans are qualitatively different from most other loans contracted by households, and are more clearly oriented toward agriculture.

Table 2: Stated purpose of borrowing, 2016/2017

	VUP-FS	**Other loans**
	% of all loans	
'Productive' purposes		
Agricultural equipment	15.8	6.6
Agricultural inputs	1.5	2.2
Livestock purchases	28.8	2.5
Business expansion	31.3	12.9
'Consumption' purposes		
Home improvement	3.7	5.7
Education	3.1	4.9
Medical treatment	1.2	7.5
Ceremonies	1.3	2.6
Household items	4.4	18.1
Other	8.9	37.1
Total	100.0	100.0
Sample size	163	15 636

Source: NISR (2018a)

If credit is constrained, as seems likely, then access to credit for productive purposes may open up new possibilities. We should then expect to see, for VUP-FS borrowers:

1. Some accumulation of productive assets, especially of livestock and farm equipment;
2. More household output, especially farm output (reflected in higher household business 'profit') and household consumption from its own farm. However, this effect may occur with a lag and so may be difficult to discern in the year of the loan. There may also be an effect on hours worked, which would rise if capital and labour are complementary, but not if they are substitutes; and
3. Higher spending on consumption, including health and educational expenditure. Even when this is not the stated purpose, loan proceeds are fungible, and may free up funds for consumption that would otherwise have been invested. A result would be lower levels of poverty.

These are the propositions that we now test.

4. Data

To estimate the influence of the VUP-FS programme, we used four distinct, but related, datasets. All are surveys of households, conducted by the National Institute of Statistics of Rwanda (NISR), and all use essentially the same questionnaires. They are:

1. EICV4, a survey of 14 419 households conducted in 2013/2014;
2. EICV5, a survey of 14 580 households conducted in 2016/2017;
3. The EICV4/5 panel, which surveyed 1 492 households in 2013/2014 and again in 2016/2017; and
4. The VUP panel, covering 1 315 households that were identified as benefitting from a VUP programme (direct support, public works or loans) in 2013/2014, and re-surveyed in 2016/2017.

The surveys used cluster sampling, and the sampling weights are known and were deemed appropriate for use in the data summarised in this paper. This data has been used for a series of reports on poverty (NISR 2018a, 2018b), in which details of the survey methodology may be found.

Table 3 presents summary statistics on the outcome variables of interest, based on all the available observations for 2013/2014 and for 2016/2017, broken down by those who do, and do not, benefit from borrowing under the VUP-FS scheme. In 2013/2014, VUP-FS borrowers were slightly less likely to be poor than non-borrowers, but the pattern was reversed in 2016/2017. In both periods, borrowers had lower levels of consumption per adult equivalent, but relied more heavily on home-produced food. Borrowers had somewhat more livestock and their children were more likely to attend secondary school. Both groups worked a comparable number of hours per year.

In Table 4, we present some information about the main control variables that we believe may influence the values of the outcome variables. VUP-FS borrowers are drawn disproportionately from *Ubudehe* category 3, and generally are those with consumption levels somewhat above the national poverty line. The *Ubudehe* categories are not stable over time, so cannot be compared between 2013/2014 and 2016/2017.

We see from Table 4 that VUP-FS borrowers tend to come from relatively larger households, and are more literate than non-beneficiaries. Borrowers have housing that is of slightly poorer quality – as measured by the materials used for roofing, walls and floors, and are more likely to cook with firewood. However, about 75% of VUP-FS beneficiaries live in planned *Umudugudu* settlements, compared to 69% of non-beneficiaries in 2017.

Table 3: Descriptive statistics of outcome variables for the VUP-FS loans programme

	EICV 2013/14		EICV 2016/17	
	Beneficiaries	**Non-beneficiaries**	**Beneficiaries**	**Non-beneficiaries**
Farm and household business	*Number per household*			
Tropical livestock (TL) units owned	1.0	0.7***	0.8	0.5***
	'000 RWF per household			
Farm expenses	65.9	36.6***	42.3	46.7
Business profit for self-employed	205.5	1 400.1	147.5	51.6
Employment	*Number*			
Hours worked in a year	1 913	1 955	1 954	1 926
Consumption and profit	*'000 RWF per adult equivalent p.a. in January 2014 prices*			
Household consumption	244.2	307.4*	215.6	323.3***
of which:				
Household food consumption	135.4	143.6	137.1	166.9***
of which:				
Household own food consumption	66.0	50.3***	49.9	38.1***
Educational enrolment	*Percentage of households*			
Secondary net enrolment rate	32.4	26.3**	35.2	25.7**
Poverty measure	*Percentages*			
Headcount poverty rate	34.6	38.8*	36.9	32.4
Memo: Annual VUP-FS loans ('000 RWF)	76.7		84.3	
Sample size	632	16 258	275	15 961

Notes: Statistical significance of raw difference between beneficiaries and non-beneficiaries is shown by *** (1%), ** (5%) and * (10%). Values are in thousands of Rwandan franc (RWF) in January 2014 prices. According to the National Bank of Rwanda, the exchange rate in January 2014 was RWF 631 per USD, and the poverty line was RWF 159 375 per adult equivalent per year. VUP-FS refers to the microcredit programme that provides small loans under the VUP programme. Access to education is measured by the net enrolment rate (NER), defined as the number of children or individuals of official secondary school age (13 to 18 years) in secondary education in a given school year expressed as a percentage of the corresponding population. 'TL unit' is the tropical livestock unit, commonly used to convert the number of livestock animals into a unit corresponding to an animal having a live weight of 250 kg. In this measure, the number of livestock animals is multiplied by a factor depending on the type of animal (e.g. 0.7 for cattle, 0.1 for goats or sheep, 0.2 for pigs and 0.01 for chickens), as defined by FAO (FAO 2018) .
Sources: NISR (2015, 2018a)

Table 4: Descriptive statistics of the key independent variables in the VUP-FS programme participation model

	EICV 2013/2014		EICV 2016/2017	
	Beneficiaries	**Non-beneficiaries**	**Beneficiaries**	**Non-beneficiaries**
Ubudehe category	*Percentage of households*			
1 (Poorest)	1.6	2.1	7.4	16.3***
2	17.1	20.5*	39.6	33.6*
3	71.3	58.0***	50.4	40.1***
4 (Rich)	10.0	19.4***	2.6	10.0***
Household characteristics				
Head is female	14.5	20.9***	16.0	25.7***
At least one member is disabled	10.1	11.2	12.4	10.4
At least one member is 65 or older	6.9	11.6***	5.9	14.0***
At least one adult is able-bodied	98.4	97.2	99.9	93.2***
Household size *(number)*	6.2	5.6***	5.6	4.4***
Age of household head (years)	45.5	45.5	45.3	45.1
Proportion aged 15+ who are literate	96.3	90.2***	96.7	88.2***
Characteristics of home				
Light home with electricity	17.1	22.8***	35.9	33.9
Use charcoal, electricity or gas (not wood)	5.0	15.5***	3.1	18.9***
Roof uses clay tiles	44.8	37.5***	39.6	32.7**
Mud floor	80.3	75.5**	75.9	71.4

Type of habitat				
Umudugudu	73.3	62.1***	76.4	72.8
Scattered resettlement	19.0	25.2***	17.0	17.2
Unplanned clustered housing areas	7.7	12.6***	6.6	10.0
Health insurance				
Community/public health insurance	75.4	66.8***	76.7	69.5**
Private health insurance	2.1	5.5***	1.5	5.6**
No health insurance	22.5	27.7**	21.8	24.9
Sample size	632	16 258	275	15 961

Notes: Statistical significance of raw difference between beneficiaries and non-beneficiaries is shown by *** (1%), ** (5%) and * (10%). *Umudugudu* are the new recommended rural resettlements or organised villages.
Sources: NISR (2015, 2018a)

5. Estimation

A straightforward approach to measuring the impact of VUP-FS loans on the outcomes of interest would be to estimate a regression adjustment equation of the form

$$Y_i = \beta_0 + \beta_1 T_i + \sum_{k>1} \beta_k X_{ki} + \varepsilon_i, \quad (1)$$

where Y_i represents the outcome of interest (such as volume of livestock, or consumption per adult equivalent), T_i is a binary variable indicating whether the individual or household is treated (here, borrows from VUP-FS), and the X_{ki} are observable control variables that are unaffected by the treatment but may have some influence on the outcome. The inclusion of the control variables helps ensure that the assumption of conditional independence is satisfied, which requires that the assignment of the treatment (T_i) is independent of the potential outcomes (Y_i).

One difficulty with estimating Equation (1) is that it gives equal weight to all households in the sample, even to those that would typically be ineligible for VUP-FS loans (such as well-off households). A better solution would be to put more weight on observations of households that are otherwise similar to VUP-FS borrowers, using a matching procedure, so that the estimates are largely derived from the overlap ('area of common support') between the samples of treated and non-treated households (Heinrich *et al*. 2010).

So, for the cross-section data from the large EICV4 and EICV5 samples, we first estimated a propensity score equation that models the estimated probability that a household borrows under the VUP-FS programme. We used a logit model, and used covariates that were correlated with treatment status but were not themselves affected by the outcomes of treatment in the baseline period, 2014 (Imbens 2015).

We then estimated a version of Equation (1) using inverse probability weights derived from the propensity score equation given by

$$w_i = \begin{cases} 1 & \text{for treated cases} \\ \hat{p}_i / (1 - \hat{p}_i) & \text{for non} - \text{treated cases} \end{cases}$$

where the $\hat{p}_i$ are the estimated propensity scores. The result is an inverse probability weight regression adjustment (IPWRA) estimator, which is one of a family of 'doubly robust' methods that combine a form of matching with the use of control variables. The estimator has been found to work well, provided that the propensity scores are neither very low nor very high. However, matching methods such as this (and others, such as propensity score matching) are unable to account for any unobserved

differences between the treatment and control groups (Austin 2016; Pirracchio *et al*. 2016). A partial solution is to use panel data.

For the panel data, we were able to apply double differencing. In principle, this has the advantage of reducing sample bias because it removes time-invariant unobservable influences – such as the vigour and ambition of a household – that may bias the results of the cross-sectional estimates. The standard approach to measuring double differences while allowing for controls is to estimate a model of the form

$$Y_{it} = \beta_0 + \beta_1 R_i + \beta_2 T_i + \beta_3 (R_i T_i) + \sum_{k>3} \beta_k X_{ki} + \varepsilon_i. \quad (2)$$

Here, R_t is a time dummy variable set to 1 in the relevant year (2013/2014 or 2016/2017 in our case), and to 0 otherwise. The double-difference measure of the impact of treatment is given by the estimate $\widehat{\beta_3}$. This is the most basic version of the two-way fixed effects model, which is widely used in impact measurement. It requires us to assume parallel trends, so that the outcomes of the treated (i.e. VUP-FS borrowers) and the non-treated would have evolved in parallel in the absence of the lending programme.

The VUP-FS project was introduced gradually, starting with the poorest administrative sectors in each region. Since this was not a randomised experiment, sector-level unobservable characteristics could potentially affect both treatment and outcomes. We addressed this by including sector fixed effects, which gave the following estimating equation:

$$Y_{it} = \sum_s \beta_{s0} + \beta_1 R_i + \beta_2 T_i + \beta_3 (R_i T_i) + \sum_{k>3} \beta_k X_{ki} + \varepsilon_i, \quad (3)$$

where the s refers to the sectors, and the β_{s0} are the sector-level fixed effects.

In applying double differences, it is important that the comparison group be similar to the treatment group, because too much heterogeneity in the initial conditions can create bias in the estimates (Chen & Ravallion 2004; Karlan & Valdivia 2011; Mutisya & Yarime 2014; Banerjee *et al*. 2015; Helfand *et al*. 2019). So, we first estimated a propensity score equation using the panel data observations for 2013/2014, and used the inverse probability weights generated by this equation when estimating Equations (2) and (3). The gradual rollout of the programme made it easier to find households, typically in other administrative sectors, that were similar to the borrowing households.

The identification of the effects of borrowing using double differences only works if some households change their borrowing status from one period to the next. Among panel households, 98 borrowed from VUP-FS in both 2013/2014 and 2016/2017, 198 only borrowed in the first period, and 63 only borrowed in the second period. The remaining 2 511 did not borrow. Implicit in our use of Equations (2) and (3) is the idea that borrowing has a symmetric effect, so taking on a loan has the same impact, but with the opposite sign, as ending a loan. Likewise, the comparison group consisted of both those who had never borrowed, and those who borrowed in both periods, because neither of these groups saw a change in their borrowing status between one time period and the next. This might be reasonable if borrowing only has a short-term effect – for instance, by enabling the household to buy fertilisers for immediate use – but is harder to defend if loans are used to accumulate assets. That said, the time interval between the two surveys was three years, and loans were extended for no more than two years, so the identification strategy is defensible. A bigger problem may be the small numbers of borrowers in our sample, which means the measurement of any impacts on the basis of the panel data is not expected to be very precise.

5.1 Intermediate results

Before presenting our measures of impact, we first reported the estimates of the propensity score equation for the EICV4 (2013/2014) cross-sectional data (NISR 2015). The results for estimates based on the EICV5 data and the panel data are similar, and are not reported here. Table 5 shows the estimated coefficients of the logit ('propensity score') equation, along with the marginal effects (averaged over all observations) of unit increases in the independent variables on the probability of borrowing from the VUP-FS.

The results indicate that households with members who are literate or living in planned resettlements (*Umudugudu*) or scattered resettlements are more likely to access VUP-FS loans than those with illiterate members or living in unplanned, clustered housing areas. In contrast, households with elderly members, or who use charcoal (a high-quality fuel), electricity or gas for cooking are less likely to borrow from the VUP-FS programme than households with young family members or who use firewood or other cooking fuel.

One way to check whether the propensity score model is working well is to examine whether it leads to 'balance' in the sense that the average values of the control variables for the treated households (i.e. borrowing) should be similar to those for the matched (non-treated) households. This is done in the last two columns of Table 5. First, we show the raw difference between the treated and comparison group before matching (or equivalent weighting), and then the difference after matching. In our case, the latter is achieved by applying the inverse probability weights to the data. The use of these weights greatly reduces the raw differences, and makes it more plausible that the treated and (weighted) control samples are as if drawn randomly.

5.2 Impacts

Our estimates of the impacts of the VUP-FS programme are summarised in Table 6. The first two columns of numbers are based on the inverse probability weighted regression adjustment models for 2013/2014 and 2016/2017, and the other columns report the results of the difference-in-difference models, without and with sector fixed effects.

All of the models agree on one thing: borrowing from the VUP-FS increased the number of livestock owned by households by about 0.2 tropical livestock units (TLUs), representing about a quarter of the value of animals owned by beneficiary households. A cow is counted as 0.7 TLUs, and a chicken as 0.01 TLUs. This is consistent with the finding that 29% of VUP-FS borrowers said that the main use to which they put their borrowing, of which the median value was 100 000 RWF (about USD 120), was to buy livestock.

Livestock plays a significant role in the household and national economy of Rwanda and contributed about 4% to the national gross domestic product (GDP) in 2018/2019, compared to 28% for agriculture as a whole (Beyi & Dahl 2016; NISR 2019). Livestock provide food and manure, draft power for crop cultivation, and a store of value for the rural population. Livestock also help achieve food security in terms of protein availability and poverty alleviation (Republic of Rwanda 2020). The results are similar to the findings of Taj *et al*. (2012), who found a 39 percentage point increase in ownership of livestock as an effect of the Punjab Rural Support Programme (PRSP) in Pakistan. This programme aimed at supporting women so that they can expand their income-generating activities.

Table 5: Model of results for VUP-FS programme participation ('propensity score equation') at the baseline period in 2014

	Logit model			Difference (treatment – comparison)	
	Coefficient	**Standard error**	**Marginal effect**	**Raw**	**With inverse probability weights**
Gender of household head					
Female (vs. male)	-0.057	0.182	-0.005	-0.446	-0.001
At least one aged 65+	-0.530*	0.312	-0.046*	-0.576	-0.020
Presence of able-bodied adult					
No able-bodied adult (reference)					
At least one able-bodied adult	0.685	0.475	0.059	0.568	-0.005
Household size	0.261***	0.038	0.023***	0.766	0.008
Age of household head (years)	-0.019***	0.007	-0.002***	-0.557	-0.016
Proportion 15+ who are literate	0.782***	0.266	0.068***	0.583	-0.009
Main source of home lighting					
Electricity, batteries, candle and oil lamp (reference)					
Lantern	-0.482**	0.229	-0.042**	-0.175	0.027
Firewood	-0.187	0.337	-0.016	-0.155	-0.017
Main source of cooking fuel					
Firewood or other (reference)					
Charcoal, electricity or gas	-0.830***	0.299	-0.072***	-0.159	-0.002
Type of habitat					
Unplanned clustered housing areas (reference)					
Umudugudu	1.088***	0.309	0.094***	0.195	0.020
Scattered resettlement	0.791**	0.334	0.069**	-0.112	-0.017
Roof materials of household dwelling					
Clay tiles (reference)					
Metal sheets	0.059	0.208	0.005	0.050	0.025
Sample size	2565			2565	
Pseudo R^2/adjusted R^2	0.187				

Notes: *, ** and *** represent statistical significance at the 10%, 5% and 1% level respectively. The dependent variable is whether or not the household receives VUP-FS (yes = 1) after excluding those who received loans before 2014. 'Marginal effect' measures the average effect on participation of a unit change in the relevant independent variable. District dummies are included but not presented here. *Umudugudu* is the new recommended rural resettlement or organised villages. In the last two columns, each row shows the difference in the standardised value of the variable for households receiving VUP-FS loan payments in the last 12 months and those who do not: first the raw difference, and then the differences after inverse probability weights are applied (using the propensity score equation results shown on the left-hand side of the table.

The cross-sectional results show clearly that VUP-FS loans are associated with substantially higher spending on farm inputs – up by between a third and a half. The main components are spending on hand tools (62%), for hiring labour (15%), and on fertilisers and insecticides (9%) and seeds (9%). This breakdown reflects the relatively basic technological level of most Rwandan farming. The return on hand tools is likely to be spread over several years, which helps explain why it is difficult to pick up an immediate effect on farm profits or income.

For two of the outcomes – hours worked, and household business profit – we were unable to find any statistically significant effects, in any of the models, that could be attributed to VUP-FS borrowing. Theoretically, as noted above, the effect on hours worked is ambiguous. And, to the extent that the payoff to borrowing is delayed, it is not surprising that household business profit is unaffected. This may also be because households boost production of their own food, so the payoff from borrowing appears as more food rather than more profit.

In this respect, our results contrast with those of Lensink and Pham (2012), who found an average 15 to 22 percentage point increase in self-employment benefits for households who borrowed from the

microcredit programme of the Vietnam Bank for Social Policies (VBSP); and Swaminathan *et al*. (2010), whose findings indicate that formal access to credit increases the likelihood of programme participants engaging in off-farm self-employment activities in Bangladesh. Similar contrasting results are found in the case of Ecuador (Weiss & Montgomery 2005).

On the other hand, the cross-sectional model that uses data from the 2013/2014 EICV4 survey shows that borrowing from VUP-FS raised household consumption, mainly via a boost to own-food consumption. It is plausible that this effect is working through the increased spending on agricultural inputs, especially fertilisers and seeds. The higher spending on hand tools may also contribute to higher productivity, raising output without increasing hours worked.

The consequence of higher consumption is lower poverty. The cross-sectional model for 2016/2017 also shows higher consumption of home-produced food, and a lower poverty gap rate (which suggests that the relatively poor are helped more), but this model does not pick up an effect on total consumption.

Both cross-section models find that net enrolment rates in secondary schools rise as a result of VUP-FS borrowing. At first sight this is surprising, because only 3% of VUP-FS loans in 2016/2017 were earmarked for educational spending. However, if borrowing for 'productive' purposes frees up monies for educational expenses, or allows households to forgo some of the farm work done by children, this outcome is certainly possible. It also suggests that there may be financial barriers to education, which non-borrowers may have difficulty crossing.

As measured by the double-difference model, borrowing from VUP-FS had no other statistically significant effects. This may reflect both the challenge of finding small effects with small samples, and the underlying assumptions about the symmetry of the effects of taking on, or giving up, a loan, as discussed above. A number of other researchers have also failed to find any effect of microcredit on consumption, including studies conducted in India (Hoffmann *et al*. 2020), in Morocco (Crépon *et al*. 2015), in Bangladesh (Khandker 2005; Imai & Azam 2012), and in Bosnia-Herzegovina (Augsburg *et al*. 2012). Jiang *et al*. (2020) found no effect of a microcredit programme on education and health expenditure in Yunan county of the Guangdong province of China, nor did they find any effect of the programme on both long-term and short-term assets. The findings of the study by Seng (2018), on the impact of a microcredit programme in Cambodia, actually show negative effects of the programme on food consumption.

6. Conclusions and policy implications

Developing countries consider microcredit programmes to be one of the key tools for boosting the productivity of rural households and thereby alleviating poverty. However, the evidence that microcredit is successful in achieving the underlying policy goal of reducing poverty and increasing the consumption of poor borrowers is surprisingly elusive. There have also been relatively few rigorous evaluations of microcredit in the African context.

Table 6: Estimates of the impact of VUP-FS on key outcomes

Outcome variable	2014	2017	Panel: 2014 to 2017	
	IPWRA	IPWRA	PSM-DID	DID-FE
Farm expenditure	**0.491**	**0.335**	0.299	0.325
	0.000	*0.000*	*0.548*	*0.251*
Tropical livestock units	**0.192**	0.085	**0.245**	**0.235**
	0.000	*0.150*	***0.007***	***0.044***
of which: goats	**0.221**	**0.224**	-0.137	-0.121
	0.003	***0.071***	*0.152*	*0.400*
Household business profit	-0.112	0.085	-1.176	0.189
	0.745	*0.870*	*0.113*	*0.832*
Hours worked	12.801	13.260	-144.3	-56.9
	0.744	*0.840*	*0.235*	*0.559*
Consumption	**0.073**	-0.017	-0.043	-0.073
	0.001	*0.572*	*0.539*	*0.243*
of which: food	**0.060**	0.003	-0.01	-0.007
	0.003	*0.916*	*0.887*	*0.916*
of which: own food	**0.313**	**0.283**	0.031	-0.058
	0.000	***0.000***	*0.791*	*0.621*
Net secondary education enrolment	**0.065**	**0.082**		
	0.010	***0.034***		
Poverty headcount	**-0.066**	-0.045	-0.036	-0.013
	0.000	*0.107*	*0.525*	*0.769*
Sample size	16 890	16 236	2 870	2 870

Notes: p-values are shown in italics under the coefficients. VUP-FS: the Rwandan government microcredit programme; IPWRA: inverse probability weight regression adjustment model (modified Equation (1)); PSM-DID: propensity score matching used to trim data, then difference-in-difference estimation (from Equation (2)); DID-FE: two-way fixed effects difference-in-difference estimator, with fixed effects by sector (Equation (3)). Only the impacts – i.e. estimates of coefficient $\widehat{\beta_3}$ in Equations (2) and (3) – are shown here; equations also include the variables listed in Table 4 as controls. Sources: The IPWRA estimates are based on survey data from NISR (2015, 2018a); the other estimates use a panel of households from 2014 and 2017, collected at the same time and using the same questionnaire as the EICV surveys.

Using models based on high-quality cross-section and panel data from Rwanda for 2013/2014 and 2016/2017, we sought to measure the effectiveness of the VUP-FS programme on farm assets (especially livestock), the use of agricultural inputs, hours worked, secondary school enrolment, and consumption and poverty, by estimating the average treatment effect on the treated. Although the VUP-FS programme has been in place for nearly a decade and a half, it remains relatively small, accounting for just 2% of the value of microcredit (including informal credit). During the period under consideration, VUP-FS loans required collateral, were only granted for 'productive' purposes, and charged interest rates of 12% annually. The coverage of the programme includes both poor and non-poor households. The formal organisation of the programme has changed over time, and the most recent reforms, which date from 2017, have sought to make loans cheaper and less bureaucratic.

Although just over half of Rwandan households report borrowing, 87% of these loans are made by friends and relatives, informal lenders or tontines, with a median value of just 10 000 RWF (USD 12). The VUP-FS programme aims to provide credit for productive activities at a scale that is sufficiently large (median value 100 000 RWF) to boost household income appreciably, while providing access for households that may not have good alternative sources of credit of this magnitude.

The evidence is not watertight, but it does suggest that VUP-FS loans have a measurable positive effect on the treated, certainly on the acquisition of livestock, but also on the use of farm inputs, household consumption (especially home-produced food), and hence on poverty. They may also help raise secondary school enrolments. Boosters of microcredit may find these results disappointing, but the findings are in line with the modest effects that research on microcredit has found elsewhere (Pakistan, Bangladesh and Ghana).

In principle, estimating double differences using panel data should give clearer results than simple cross-section data, because the panel data allow us to remove unobservable time-invariant influences. But this comes at a cost: the number of borrowers in the panel sample is small, and it becomes less representative of the target population over time.

Should the VUP-FS programme be expanded? We do not have a clear answer to this question because there are other potential ways to make credit more accessible to lower income households in Rwanda – for instance, through more SACCO or cooperative lending, or expanded outreach by commercial banks. Whether this would be more effective than expanded VUP-FS loans is unclear and would require a fuller analysis. But our work suggests that the VUP-FS programme is targeted at a real need and can be helpful. Changes made recently (in 2017) that were designed to make it less bureaucratic may enhance its appeal, but will change little if funding remains at its current low level.

It may make sense for policy makers in Rwanda, and elsewhere, to consider more ambitious models of credit provision to poorer households, perhaps along the lines of the Thailand Village Fund (Boonperm *et al*. 2013), or the Vietnam Bank for Social Policy (Nguyen *et al*. 2007; Haughton & Khandker 2016). The VUP-FS provides a foundation that could potentially be scaled up to do this.

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