



Credit and Ethnic Consumption Inequality in the Central Highlands of Vietnam

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Abstract

Credit is commonly considered an important instrument to relieve financial capital constraints of poor households and subsequently to improve their welfare. However, the empirical impact of credit on consumption inequality remains ambiguous. We use a 2-year panel dataset collected in Daklak, a province in the Central Highlands of Vietnam, to investigate the differences in access to credit and its impact on household consumption and consumption inequality between ethnic groups. Our results show that the differences in access to credit and in its impacts on household consumption between the ethnic majority and the migrant ethnic minority groups are insignificant. However, households from the indigenous ethnic minority group face more disadvantages in accessing formal credit and rely more on informal credit than those from the ethnic majority. They also face a higher collateral ratio and the amount of formal loans they could access is lower. The impact of formal credit on consumption of the majority is also higher than that of the indigenous minority, consequently causing a significant increase in consumption inequality between the ethnic groups. Our findings call for assistance programs to support indigenous households to improve their access to formal credit as well as to enhance the effectiveness of these loans.

Keywords Inequality · Ethnicity · Credit · Conditional-mixed process (CMP) · Triple difference with fixed effects (DDD) · Vietnam

1 Introduction

Increasing inequality is considered a major threat to sustainable development in developing countries (Kanie et al. 2014; United Nations 2013). In many of these countries, strong economic growth in recent decades has improved households' living standards. However, the benefits of economic growth appear not to be proportionately distributed among different

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population groups (Bui et al. 2017; Fosu 2017; Nguyen et al. 2019). In particular, ethnic minority groups have been found to benefit least from economic growth (Baulch et al. 2012). They are likely to be left behind in the development process because of their difficult access to markets, low level of education, vulnerability to shocks and social discrimination (Baulch et al. 2007; van de Walle and Gunewardena 2001).

Credit is an important source of finance for households as it relieves their financial constraints which prevent them from accessing markets and adopting modern technologies (Barslund and Tarp 2008; Diagne et al. 2000). It increases productivity, improves household living standards, reduces poverty and enhances welfare equality (see Abosedra et al. 2016; Clarke et al. 2006; Guirking and Boucher 2008; Khandker 2005; Liverpool and Winter-Nelson 2010; Shahbaz et al. 2015; Tran et al. 2019). In addition, access to credit has been shown to increase household's capacity against shocks, promoting them to pursue productive livelihood strategies (Diagne et al. 2000; Islam and Maitra 2012; Nguyen et al. 2020). However, ineffective use of credit may cause households to fall into the situation of over-indebtedness or default, causing heavy stress, and undermining their welfare (Seng 2018; Tsai et al. 2016). Furthermore, in case benefits from the credit market are not proportionately distributed across population groups, inequality and social instability are possibly unintended consequences (Claessens and Perotti 2007; Jauch and Watzka 2016).

A common feature of the credit market in developing countries is the coexistence of formal and informal credit (Barslund and Tarp 2008; Guirking 2008). Formal credit refers to loans from formal financial institutions such as banks, credit organizations and saving funds (Ambrosius and Cuenca 2016). Meanwhile, informal credit refers to loans from private money lenders, business partners, friends and relatives (Swaminathan et al. 2010). In general, formal and informal loans differ in several aspects. Informal loans are typically small, available on short notice, have a wide disparity in interest rates and are used for diverse purposes (Barslund and Tarp 2008; Duong and Izumida 2002). Formal loans typically have a higher value, a capped interest rate, stricter requirements of application procedures and are mainly used for productive purposes (Barslund and Tarp 2008). Due to these distinctions, it is highly recommended to differentiate between formal and informal credit in investigating the borrowing behaviors and their effects on household welfare (see Swaminathan et al. 2010).

Our study area is in Daklak, a province in the Central Highlands of Vietnam. This is one of the two main living areas of ethnic minorities in this country but hardly any research has been done on the ethnic economic disparity.¹ This region is characterized by a large share of ethnic minority population, a high poverty incidence and high income inequality (see GSO 2016; World Bank 2009). In general, the ethnic majority has higher levels of education, better access to markets, and higher living standards than minority ethnic groups (USAID 2008). Another unique demographic characteristic of this region is that the ethnic minorities include the indigenous minority and migrant minority groups. In the past, this region was populated by the indigenous minority. However, the massive migrant inflows of the ethnic majority (Kinh) and other minority groups from other regions in recent decades have caused significant changes in the population composition in this region (ADB 2002). The indigenous ethnic people have become the minority in their homeland, accounting for less than 30 per cent of the total population (World Bank 2009). Their livelihoods

¹ Vietnam has 54 ethnic groups with high differences in culture, language, socioeconomic conditions and living areas. A number of studies has been conducted in the northern Mountains, another main living area of the ethnic minority groups (see Nguyen et al. 2017; Tran et al. 2015; Tran 2016).

and access to natural resources have been significantly affected by migrant inflows, triggering conflict and tensions between settlers and the indigenous (see Fujii 2018; World Bank 2009).

Our research aims (1) to investigate the differences between ethnic groups in accessing credit, particularly in credit sources, amount, interest rate and the collateral ratio, (2) to examine the differences between ethnic groups in the impact of formal and informal credit on household consumption, and (3) to analyze the impacts of formal and informal credit on the ethnic consumption inequality. Our research is expected to shed light on how to reduce economic disparities between ethnic groups and consequently to reduce conflict and social instability.

2 Literature Review

The coexistence of formal and informal credit markets is prevalent in developing countries (Barslund and Tarp 2008; Linh et al. 2019; Madestam 2014). It is argued that the imperfection of the former may lead to the existence of the latter (see Boucher and Guirking 2007; Kislat 2015; Linh 2019). Households who are not able to access formal credit rely on informal sources to satisfy their finance demand (Cui et al. 2017; Guirking 2008). However, informal loans are shown to have some advantages over formal loans (see Karaiyanov and Kessler 2018). Low transaction costs, low requirements of application procedures, and availability on short notice are some of the factors promoting households to take an informal credit rather than a formal one (Guirking 2008; Kislat et al. 2017; Lainez 2014; Nguyen and van den Berg 2014). This explains why the informal credit market is still prevalent in Vietnam as well as in many other developing countries, despite the rapid expansion of banks and the credit organizations (Guirking 2008; Lainez 2014; Nguyen and van den Berg 2014). These two markets coexist and complement each other (Linh et al. 2019). Households mainly use formal loans for production and asset accumulation, while informal loans are used for diverse purposes such as consumption, health expenditure, and production as well as asset accumulation. BIRTHAL et al. (2017) show that households with a larger land area are able to borrow more formal than informal credit. Barslund and Tarp (2008) show that households in Vietnam with more adults, more land and more assets are more likely to access formal sources. In contrast, households with a lower level of education and fewer assets are more likely to borrow from informal sources (Barslund and Tarp 2008; Chai et al. 2019).

Literature shows controversial impacts of credit on household welfare (Linh et al. 2019). Regarding formal credit, many studies show that formal credit positively affects household welfare by improving household consumption or household income (Bhuiya et al. 2016; Imai and Azam 2012; Li et al. 2016; Phan et al. 2019), reducing poverty (Imai et al. 2010; Khandker 2005) and enhancing welfare equality (Lacalle-Calderon et al. 2019). Access to formal credit may also contribute to a long-lasting increase in household welfare via promoting investment in income-generating activities, improving labor productivity, progressing the accumulation of human and physical capital and enhancing household's capacity against shocks (Hermes and Lensink 2011). However, some other studies show that the impact of formal credit on household welfare is not significant or even negative (see Sayvaya and Kyophilavong 2015; Seng 2018). It is argued that the ineffective use of loans can push households into over-indebtedness, consequently undermining their welfare (Seng 2018; World Bank 2009). While there is a bulk of studies on the effects of formal credit,

the number of studies on the effects of informal credit is much more limited. Heltberg and Lund (2009) show that taking informal loans is an important shock-coping strategy in Pakistan. Imai et al. (2010) show that households in India with access to informal credit are less likely to be poor. Nguyen and van den Berg (2011) report that informal loans have significant effects on poverty reduction, but the impacts on consumption inequality are negligible in Vietnam. Luan et al. (2016) show that informal credit positively affects household income in Northern Vietnam. Seng (2018) shows that informal credit negatively affects household consumption in Cambodia because of its high interest rate and the use of these loans for non-productive purposes.

The impact of credit on household welfare is also found to be not homogenous among different household groups (Islam 2015). Liverpool and Winter-Elderson (2010) report that the effect of formal credit is not uniformly distributed in rural Ethiopia. They show that the access to formal credit appears to only benefit non-poor. Kislat (2015) shows that in Thailand access to informal loans positively affects the consumption of only the rich and male-headed households, while it even causes negative effects on female-headed households. In contrast, Copestake (2002) shows that access to formal credit has a more positive effect on poor households than on non-poor households. He argues that the poor suffer more from financial constraints, which prevent them from accessing markets, adopting modern technology and investing in income-generating activities. Therefore, it is reasonable that poor households benefit more from access to credit.

A limited number of studies also investigate the impact of credit on welfare equality and their results are mixed (Hermes 2014). On the one hand, some studies show that credit markets contribute to reducing income or consumption inequality (see Beck et al. 2007; Clarke et al. 2006; Lacalle-Calderon et al. 2019; Shahbaz et al. 2015). Theoretically, this is due to the principle of diminishing marginal return to capital; the poor, who suffer more from financial constraints, will benefit more from access to credit. On the other hand, credit markets could widen the welfare gap (Claessens and Perotti 2007; De Haan and Sturm 2017; Jauch and Watzka 2016). Due to the imperfection of credit markets, rich households generally have more advantages of accessing low-interest credit sources. In addition, they have better education, more market information, and more financial management skills. Therefore, they may manage loans more effectively.

Regarding the heterogeneous impact of credit on different ethnic groups in Vietnam, Tu et al. (2015) and Luan and Bauer (2016) are the only ones who separate the effects of access to credit on household welfare of minority and majority ethnic groups. Tu et al. (2015) use a dataset of 1400 observations collected in 2011 and 2013 in Vietnam. They use fixed-effect models to investigate the impact of credit on household income, job creation, food nutrition and access to medical services of minority and majority ethnic groups in Northern Vietnam. Their result shows a positive and significant impact of credit on income improvement and job creation. In addition, credit also positively affects food nutrition of minority households. Luan and Bauer (2016) apply Propensity Score Matching to analyze the effects of access to credit on household income of minority and majority ethnic groups in the Northern Uplands of Vietnam. They use data of 1338 households collected from the Vietnam Access Resources Household Survey in 2012. While these studies are steps forward, they still raise some research gaps that we would like to contribute to. First, no studies have investigated the impact of credit on inequality between ethnic groups. Second, we differentiate between the effects of formal and informal credit on the consumption of not only the majority ethnic group but also of two different ethnic minority groups. Third, we also investigate the difference in interest rates and collateral ratios between ethnic groups. Furthermore, our econometric methods, namely triple differences with fixed effects, could

deal with endogeneity problems related to access to credit and statistically compare the effect of credit on household consumption between ethnic groups.

3 Study Area and Methodology

3.1 Study Area and Data Source

Our study uses a dataset from the research project “Impact of shocks on the vulnerability to poverty: Consequences for the development of emerging Southeast Asian Economies” which was funded by the German Research Foundation (DFG) (see Amare and Hohfeld, 2016; Do et al. 2019; Hardeweg et al., 2012). The project collected data of rural households in three provinces of Vietnam (Ha Tinh, Thua Thien Hue, Daklak). Among these provinces, only Daklak is in the Central Highlands populated by the ethnic majority group (Kinh), next to the migrant ethnic minority and indigenous ethnic minority groups. The data collection in Daklak follows a three-stage random sampling technique. In the first stage, 38 communes were selected based on the population share. In the second stage, two villages in each selected commune were chosen with the probability proportional to the size of their population. In the third stage, a sample of ten rural households in each sampled village was randomly chosen from the village’s list of households. The surveys (2007 and 2010) were conducted by enumerators from the Leibniz University Hannover, Germany, and the Institute for Policy and Strategy for Agriculture and Rural Development, Vietnam. All enumerators had previous experience in conducting household surveys and were intensively trained before the surveys took place. Each enumerator conducted face to face interviews at households’ homes. Each interview took, on average, two hours. Collected data from each interview was first cross-checked for consistency and plausibility by another enumerator and then by the team leaders at the end of the day; in case of missing or implausible data, the responsible enumerator had to collect the information again, either by phone or by another visit to the household. Only when the questionnaire was complete, the data was passed on for the data entry process. Data entry took place at the field team’s base and partially helped cleaning and detecting the missing cases and implausible information. If there was a problem with the data, they were sent back again to the enumerators. In addition, during the data collection process, there were free days for all enumerators to catch up with all the checking.

Two survey instruments were used for data collection: the household questionnaire for household heads (see “Online Appendix 1”) and the village questionnaire for village officials (see “Online Appendix 2”). The household questionnaire with more than 60 pages and 400 variables contains nine sections collecting information on household individuals (e.g. health, education, ethnicity), land, shocks, household income-generating activities (e.g. farming, livestock rearing, hunting, non-farm employment, and self-employment), assets, investments, housing condition, and separate sections on credit and consumption expenditure in the last 12 months. With regard to borrowing, households were asked whether they had any loans in the past 12 months. If the answer was yes, they were asked about the amount, interest rate, repayment schedule, source, purpose, duration, and collateral of loans. In the consumption expenditure section, households were asked to recall their expenditures for a detailed list of above 50 consumption items for food, transportation, communication, education, health and other non-food items. Households’ self-produced consumption is also recorded. The village

questionnaire with three pages and 90 variables captured information on the villages' population, infrastructure, geography, and socioeconomic conditions.

As this study focuses on ethnic groups in the Central Highlands of Vietnam, we use the data collected in Daklak, the most populous province in the Central Highlands. The other two provinces in Vietnam, Ha Tinh and Thua Thien Hue, belong to the Central Coast and are much more homogenous in terms of demographic composition. For example, less than one per cent of the surveyed households in Ha Tinh belong to ethnic minority groups. Our sample includes 1350 observations from 675 households with complete data collected in 2007 and 2010. Daklak is characterized by a large share of the minority population, a high poverty incidence and high income inequality (see GSO 2016; World Bank 2009). The economy is mainly based on agriculture production, and is among the largest coffee producing areas in Vietnam (Ho et al. 2017). Before the twentieth century, this region was populated by the indigenous groups Ede, Mnong and Jarai (World Bank 2009). However, in recent decades a large number of Kinh and other ethnic minorities from northern and lowland regions have moved to the Central Highlands because of the resettlement programs of the Vietnamese government and the attraction of the exploding coffee industry (Doutriaux et al. 2008; World Bank 2009). This has caused significant changes in the population composition in the region (ADB 2002) and turned Kinh to be the majority ethnic group there, accounting for about 60 per cent of the total population (World Bank 2009). Kinh households generally have higher levels of education and higher living standards than the minority groups. Meanwhile, due to the lack of knowledge, low assets and education levels, the indigenous have the lowest social indicators (USAID 2008). In recent decades, conflicts and tensions have occurred between the ethnic groups in the region because of the competition for land and other natural resources as well as the differences in culture and language (see Baulch et al. 2007; World Bank 2009).

3.2 Methodology

3.2.1 Investigating the Differences in Access to Credit Between Ethnic Groups

Credit is classified into formal and informal sources. The likelihood of households' access to formal credit and its amount are correlated with the probability of households' access to informal credit and its amount. In other words, the error terms of the borrowing decisions (formal and informal) are correlated and need to be controlled for (see Table 3 in Sect. 4 for the evidence of these correlations). Because of these characteristics, we apply the conditional-mixed process model (CMP) to estimate simultaneously household borrowing decisions (access to formal credit (Eq. 1a), the amount of formal loan (Eq. 1c), access to informal credit (Eq. 1b), the amount of informal loan (Eq. 1d)) as the model allows us to control for these correlations. CMP is fundamentally built as a seemingly unrelated regression (SUR), and has the advantage of allowing us to estimate different types of econometric models such as probit and linear regressions (Roodman 2011; Sekyi et al. 2017). The model is specified as follows:

$$\text{Prob}(F_{it} = 1) = \Phi(\alpha + \epsilon_1 G_i + \tau_1 H_{i,t-1} + \varphi_1 S_{it} + \vartheta_1 V_{it} + \epsilon_{1it}) \quad (1a)$$

$$\text{Prob}(I_{it} = 1) = \Phi(\rho + \epsilon_2 G_i + \tau_2 H_{i,t-1} + \varphi_2 S_{it} + \vartheta_2 V_{it} + \epsilon_{2it}) \quad (1b)$$

$$FA_{it} = \Omega + \epsilon_3 G_i + \tau_3 H_{i,t-1} + \varphi_3 S_{it} + \vartheta_3 V_{it} + \epsilon_{3it} \quad \text{if } F = 1 \quad (1c)$$

$$IA_{it} = \sigma + \epsilon_4 G_i + \tau_4 H_{i,t-1} + \varphi_4 S_{it} + \vartheta_4 V_{it} + \epsilon_{4it} \quad \text{if } I = 1 \tag{1d}$$

where Eqs. 1a and 1b are the probit type, Eqs. 1c and 1d are the classical linear type. F_{it} , I_{it} indicate household i access to formal and informal credit in year t , respectively. FA_{it} , IA_{it} represent the amount of formal and informal loans taken by household i in year t . G_i represents the ethnic group of household i . The sampled households are grouped into three main ethnic groups: Ede, Mnong and Jarai households belong to the indigenous ethnic minority group. The migrant ethnic minority group includes households from other ethnic minorities such as Tay, Thai, Muong, Nung, Meo, Hoa, Dao, Sanchay and Bru. The majority ethnic group consists of Kinh households. $H_{i,t-1}$ is the vector of household characteristics in year $t - 1$. S_{it} is the vector representing shocks faced by household i in year t . V_{it} is the characteristics of the village where household i lives in year t . Because household's borrowing decisions may affect household characteristics such as household assets, land, demographic characteristics, we use household characteristics in year $t - 1$ to avoid potential reverse causality. Meanwhile, shocks and village characteristics are not likely affected by household borrowing decisions, therefore, we use these characteristics in year t .

Household characteristics (H) include agricultural land, livestock, motorbikes, tractors, televisions, remittances, household size, share of children (age < 15 years), share of old members (age > 64), and share of adults who graduated from secondary school and above. Shocks (S) include weather shocks and health shocks which household i has faced during the last 12 months. Village characteristics (V) are represented by the distance to the nearest bank and whether the village has paved roads. The detailed definition of explanatory variables is in "Appendix 1".

To investigate the differences in the collateral ratio and interest rate, we also apply CMP models with loan amount being replaced by collateral ratio and interest rate in Eqs. 1c and 1d. The Huber-White robust standard errors are used to control for possible heteroscedasticity. To detect potential perfect multicollinearity, we apply the collinearity diagnostics test and the result rejects the hypothesis of perfect multicollinearity (see "Appendix 2"). All monetary variables are measured in 2005 Purchasing Power Parity US dollar.

3.2.2 Examining the Differences in the Impact of Formal and Informal Credit on Household Consumption Between Ethnic Groups

To examine the heterogeneous impacts of credit on ethnic majority and minority groups, we apply the triple difference with the fixed effects approach (DDD). This DDD method is an extension of the Difference in Difference method (DID), which is well-known as a powerful approach to deal with endogenous selection (see Cerulli 2015; Khandker et al. 2009). This DDD method measures the differences in impacts of credits between ethnic groups. Comparing with the Propensity Score Matching with Difference in Difference (PSM-DID) method ("Appendix 3"), which is also used to deal with endogeneity of access to credit, the DDD method has an advantage of allowing us to statistically compare the effects between ethnic groups. Nevertheless, the results of PSM-DID method, as reported in "Appendix 3", are also highly consistent with those of DDD method. Our estimation of DDD method is specified as:

$$Y_{it} = \alpha_5 + \beta_5 F_{it} * T * E + \delta_5 I_{it} * T + \gamma_5 J_{it} * T * E + \theta_5 I_{it} * T + \pi_5 E * T + \mu_5 T + \tau_5 H_{it} + \varphi_5 S_{it} + \vartheta_5 V_{it} + \omega_{it} + u_i \tag{2}$$

where Y is the household consumption per adult equivalent. The adult equivalent scale is measured by assigning a weight of 1 to the household head, 0.7 to each additional adult,

and 0.5 to each child (see Haughton and Khandker 2009). T is the time dummy ($T=1$ if year=2010, $T=0$ if year=2007), E is the ethnic dummy variable ($E=1$ if the household is ethnic minority, $E=0$ if the household is ethnic majority). F , I , H , S and V are defined in the above CMP model.

With regard to formal credit, the impact of formal credit on household consumption in the minority group is:

$$\begin{aligned} \text{DID}_{1a} = & \left[E(Y_{t=1}^{E=1, F=1} | H, S, V) - E(Y_{t=0}^{E=1, F=1} | H, S, V) \right] \\ & - \left[E(Y_{t=1}^{E=1, F=0} | H, S, V) - E(Y_{t=0}^{E=1, F=0} | H, S, V) \right] \end{aligned} \quad (3a)$$

$$\text{DID}_{1a} = \beta_5 + \delta_5 \quad (3b)$$

The impact of formal credit on household consumption in the majority group is:

$$\begin{aligned} \text{DID}_{1b} = & \left[E(Y_{t=1}^{E=0, F=1} | H, S, V) - E(Y_{t=0}^{E=0, F=1} | H, S, V) \right] \\ & - \left[E(Y_{t=1}^{E=0, F=0} | H, S, V) - E(Y_{t=0}^{E=0, F=0} | H, S, V) \right] \end{aligned} \quad (4a)$$

$$\text{DID}_{1b} = \delta_5 \quad (4b)$$

The difference in the impact of formal credit between the minority and majority groups is:

$$\text{DDD}_1 = \text{DID}_{1a} - \text{DID}_{1b} = \beta_5 \quad (5)$$

The impact of informal credit on household consumption in the minority group is:

$$\begin{aligned} \text{DID}_{2a} = & \left[E(Y_{t=1}^{E=1, IF=1} | H, S, V) - E(Y_{t=0}^{E=1, IF=1} | H, S, V) \right] \\ & - \left[E(Y_{t=1}^{E=1, IF=0} | H, S, V) - E(Y_{t=0}^{E=1, IF=0} | H, S, V) \right] \end{aligned} \quad (6a)$$

$$\text{DID}_{2a} = \gamma_5 + \theta_5 \quad (6b)$$

The impact of informal credit on household consumption in the majority group is:

$$\begin{aligned} \text{DID}_{2b} = & \left[E(Y_{t=1}^{E=0, IF=1} | H, S, V) - E(Y_{t=0}^{E=0, IF=1} | H, S, V) \right] \\ & - \left[E(Y_{t=1}^{E=0, IF=0} | H, S, V) - E(Y_{t=0}^{E=0, IF=0} | H, S, V) \right] \end{aligned} \quad (7a)$$

$$\text{DID}_{2b} = \theta_5 \quad (7b)$$

The difference in the impact of informal credit between the minority and majority groups is:

$$\text{DDD}_2 = \text{DID}_{2a} - \text{DID}_{2b} = \gamma_5 \quad (8)$$

To further compare the effects between ethnic minority groups, we use this model on a subsample of the majority and indigenous minority, the majority and migrant minority, and the indigenous and migrant minority groups. In addition, to capture the extent of the involvement of formal and informal credit, we replace the credit dummy variables by the amount of loans (in logarithm form) in Eq. 2. The collinearity diagnostics tests are applied to detect multicollinearity, and the results reject the hypothesis of perfect multicollinearity (see Appendices 4 and 5).

3.2.3 Analyzing the Impact of Formal and Informal Credit on Ethnic Consumption Inequality

To investigate the impact of formal and informal credit on consumption inequality, we construct two counterfactual scenarios: first, households with access to formal credit would not borrow, and second, households with access to informal credit would not borrow. Then, we compare the inequalities in the observed scenario with the results in each counterfactual scenario. More precisely, the propensity score matching method (PSM) is applied to estimate the counterfactual outcomes and the Theil's L decomposition method is applied to decompose consumption inequality between ethnic groups.

The PSM method includes two steps. In the first step, we use the probit models as in Eqs. 1a and 1b to estimate the propensity scores of access to formal credit and of access to informal credit, respectively. In the second step, we use the Kernel Based Matching method (KBM) with common support and with bandwidth 0.06 to estimate the counterfactual outcomes of not accessing formal credit and not accessing informal credit.

To decompose inequality between ethnic groups, we apply Theil's L decomposition (see Haughton and Khandker 2009; Howell 2017). The decomposition is specified as:

$$L = \sum_j \left(\frac{N_j}{N} \right) L_j + \sum_j \left(\frac{N_j}{N} \right) \ln \left(\frac{\bar{Y}}{\bar{Y}_j} \right) \quad (9a)$$

$$\text{with } L_j = \frac{1}{N_j} \sum_{i=1}^{N_j} \ln \left(\frac{\bar{Y}_j}{\bar{Y}_{ij}} \right) \quad (9b)$$

where T and T_j present Theil's L of total population and of ethnic group j , respectively. N and N_j are total households of the whole sample and of the ethnic group j , respectively. \bar{Y} and \bar{Y}_j are the mean of household's consumption in the whole sample and in the ethnic group j , respectively. Y_{ij} is the consumption of household i in ethnic group j .

Equation (9a) comprises of two inequality measure components. The first $\sum_j \left(\frac{N_j}{N} \right) T_j$ measures within-group inequality and the second $\sum_j \left(\frac{N_j}{N} \right) \ln \left(\frac{\bar{Y}}{\bar{Y}_j} \right)$ represents between-group inequality. We decompose the inequality in each scenario (observed, counterfactual of no access to formal credit, counterfactual of no access to informal credit), then compare the outcomes between the observed scenario and the counterfactual scenarios to see how formal and informal credit affects inequality. The propensity score distribution of access to formal and informal credit is in "Appendices 6 and 7". The qualifying test of the PSM model is in "Appendix 8".

4 Results and Discussion

4.1 Household and Loan Characteristics

The descriptive statistics in Table 1 illustrate the differences in household and village characteristics between ethnic groups. Generally, the majority households have the highest

Table 1 Household and village characteristics by ethnic groups

	Majority (1)	Indigenous minority (2)	Migrant minority (3)
Consumption per adult equivalent (PPP\$)	2081 ^{1a***;2a***}	1074 ^{1a***;3a***}	1281 ^{2a***;3a***}
Agricultural land (ha)	0.90 ^{2a***}	0.88 ^{3a***}	1.35 ^{2a***;3a***}
Livestock (tropical livestock unit)	1.04 ^{2a***}	0.87 ^{3a***}	1.66 ^{2a***;3a***}
Television (yes = 1, no = 0)	0.96 ^{1b***;2b***}	0.85 ^{1b***;3b*}	0.78 ^{2b***;3b*}
Motorbike (yes = 1, no = 0)	0.86 ^{1b***;2b***}	0.58 ^{1b***}	0.64 ^{2b***}
Tractor (yes = 1, no = 0)	0.33	0.37 ^{3b*}	0.26 ^{3b*}
Remittance (PPP\$)	101.50 ^{1b***;2b***}	3.94 ^{1b***}	12.58 ^{2b**}
Age head (years)	46.74 ^{1a***;2a***}	44.12 ^{1a***}	42.25 ^{2a***}
Household size (people)	4.29 ^{1a***;2a***}	5.53 ^{1a***;3a***}	4.68 ^{2a***;3a***}
Old share (%)	5.64	4.26	4.08
Child share (%)	27.47 ^{1a***}	34.38 ^{1a***;3a**}	30.08 ^{3a**}
Secondary share (%)	41.49 ^{1a***;2a***}	15.70 ^{1a***;3a**}	21.43 ^{2a***;3a**}
Weather shock (yes = 1, no = 0)	0.19 ^{1b***;2b***}	0.30 ^{1b***}	0.29 ^{2b***}
Health shock (yes = 1, no = 0)	0.17 ^{1b***}	0.26 ^{1b***;3b***}	0.15 ^{3b***}
Vill distance bank (minutes)	26.05 ^{1a***;2a***}	31.74 ^{1a***;3a***}	48.34 ^{2a***;3a***}
Vill paved road (yes = 1, no = 0)	0.11 ^{1b***;2b***}	0.04 ^{1b***}	0.03 ^{2b***}
No. of observations	834	366	150

*Significant at 10%. **significant at 5%, ***significant at 1%; ^aT-test, ^bnon-parametric two-sample test: Rank sum test; ¹compare column (1) with column (2); ²compare column (1) with column (3); ³compare column (2) with column (3)

living standards. Their consumption is approximately twice as much as that of the minorities. They have more assets, higher levels of education, smaller household sizes, fewer children, more remittances, and live in villages with better infrastructures (having paved roads and being nearer to banks). They are less likely affected by extreme weather events. Disaggregating the minority into indigenous and migrant minority groups, households from the migrant minority group appear to have higher living standards than those from the indigenous minority group. They have higher levels of consumption and education, more tractors, more televisions and are less exposed to health shocks. They even have more agricultural land and livestock than those of the majority group.

Table 2 reports descriptive characteristics of credit sources by ethnicity of borrowers. Generally, in all ethnic groups, informal and formal loans are significantly different in almost all aspects, except for loan value. Formal loan is more likely to be used for productive purposes than informal loan. It also has a longer duration, a lower interest rate, but requires a higher ratio of collateral. These findings are consistent with those of Barslund and Tarp (2008), which show that formal loan generally has a higher value, a higher duration and stricter collateral requirements, and is more likely to be used for productive purposes. Regarding the loan amount, the value of formal loan is much higher than that of informal loan in the majority group, meanwhile no significant differences are found in minority groups.

Comparing characteristics of formal loan by ethnicity of borrowers, the loan amount that the indigenous and migrant minorities receive is much lower than that of the majority. The indigenous appear to be less likely to use formal loan for productive

Table 2 Loan characteristics by ethnic groups

	Majority			Indigenous minority		Migrant minority	
	Formal credit	Informal credit		Formal credit	Informal credit	Formal credit	Informal credit
	(1)	(2)	(3)	(4)	(5)	(6)	
Productive purpose (yes = 1, no = 0)	0.81 1b***, 4b***	0.59 1b***	0.68 2b***, 4b***	0.57 2b***, 9b*	0.79 3b*	0.67 3b*, 9b*	
Duration loan (years)	1.60 1a***, 5a**	1.07 1a***, 7a***	1.69 2a***	0.85 2a***, 7a***	1.95 3a***, 5a**	0.93 3a***	
Annual interest rate (%)	9.70 1a***, 4a***	16.89 1a***, 7a***, 8a***	13.84 2a***, 4a***, 6a*	23.90 2a***, 7a***	7.87 3a***, 6a*	27.80 3a***, 8a***	
Collateral ratio (ratio)	2.36 1a***, 4a***	0.22 1a***	5.58 2a***, 4a***	0.08 2a***	3.12 3a***	0.06 3a***	
Loan value (PPPs)	2119 1a***, 4a***, 5a***	1252 1a***, 7a***, 8a**	607 4a***	666 7a***	726 5a***	845 8a***	

*Significant at 10%, **significant at 5%, ***significant at 1%; standard errors in parentheses; ^aT-test, ^bnon-parametric two-sample test; Rank sum test; ¹compare column (1) with column (2); ²compare column (3) with column (4); ³compare column (5) with column (6); ⁴compare column (1) with column (3); ⁵compare column (1) with column (5); ⁶compare column (3) with column (5); ⁷compare column (2) with column (4); ⁸compare column (2) with column (6); ⁹compare column (4) with column (6)

purposes than the majority. Their loan also has a higher interest rate than that of other ethnic groups and a higher collateral ratio than that of the majority. Regarding informal loan, similar to formal loan, the loan amount the majority households take is much higher than those of the minority groups. It also has a lower interest rate than those of both minority groups and a higher duration than that of the indigenous. Comparing between the two ethnic minority groups, almost all characteristics of informal loan are similar, except for the purpose aspect; the migrant minority are more likely to use informal loan for productive purposes than the indigenous.

4.2 Difference in Access to Credit Between Ethnic Groups

Table 3 illustrates the determinants of formal and informal credit. Columns 1 and 2 show the estimations of accessing formal and informal loans. Meanwhile, the estimations of formal loan amount and informal loan amount are shown in columns 3 and 4.

Generally, access to credit and the loan amounts are significantly different between ethnic groups. Indigenous minority households appear to have more disadvantages in accessing formal credit than majority households. They borrow less from formal sources, but more from informal sources. Meanwhile, no significant difference in access to credit sources is found between migrant minority and majority households. The amount of informal and formal loans taken by households in both minority groups are much lower than those of majority households. ADB (2002) and the World Bank (2009) report that the lack of access to credit is one of the biggest production constraints for minority households in Vietnam. Compared to the majority, minority households generally face more obstacles in taking formal loans because of lacking collateral requirements and limited knowledge of banking procedures.

With respect to other characteristics, land area is positively associated with the likelihood that households borrow formal loan and also with their loan amounts. This is reasonable because land, a high-value fixed asset, is commonly used to meet collateral requirements. Birthal et al. (2017) also report that households who have larger land areas are able to borrow more formal credit rather than informal one. Our results also confirm the important role of informal credit as a major shock-coping strategy. Households are more likely to borrow from informal sources in response to health and weather shocks. In terms of demographic characteristics, households with older household heads and higher shares of old members are less likely to borrow from formal sources. This possibly reflects their lower demand for investment activities. Regarding education, households with higher levels of education tend to borrow less from informal sources.

Table 4 shows impacts of ethnicity on the collateral ratio (Panel A) and on the interest rate of loans (Panel B). Column 3 of panel A shows that to access formal credit sources, the indigenous minority households appear to face a higher collateral ratio than majority ones. This may explain why indigenous minority households are less likely to access formal credit and rely more on informal one. The World Bank (2009) also reports that bank officers may have prejudices against ethnic minority households assuming that they are not credit worthy and thus discouraging them from taking large loans. Therefore, they face stricter collateral requirements when applying for loans. With regard to interest rate, panel B shows no statistically significant impact of ethnicity on the average interest rate of both formal and informal loans.

Table 3 Determinants of formal and informal credit

Variables	Conditional mixed process model (CMP)			
	Formal loan (access) (1)	Informal loan (access) (2)	Formal loan (amount) (3)	Informal loan (amount) (4)
migrant minority	-0.23 (0.17)	0.11 (0.18)	-0.52** (0.23)	-0.35* (0.21)
indigenous minority	-0.29** (0.13)	0.29** (0.13)	-0.51*** (0.19)	-0.84*** (0.18)
owned agri land	0.13** (0.07)	-0.07 (0.07)	0.20** (0.09)	0.00 (0.10)
livestock	0.00 (0.02)	-0.01 (0.02)	-0.00 (0.03)	-0.03 (0.03)
television	0.37** (0.17)	0.07 (0.16)	0.39* (0.22)	0.42** (0.19)
motorbike	-0.07 (0.13)	-0.12 (0.13)	0.25 (0.18)	0.40*** (0.15)
tractor	0.12 (0.12)	-0.07 (0.12)	0.52*** (0.18)	0.35** (0.17)
remittance	0.06* (0.04)	-0.00 (0.04)	0.04 (0.05)	-0.03 (0.04)
age head	-0.01* (0.01)	-0.01 (0.01)	-0.00 (0.01)	0.01 (0.01)
hhsize	0.07** (0.04)	0.02 (0.04)	0.02 (0.05)	0.06 (0.05)
child share	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	0.01 (0.00)
old share	-0.01** (0.01)	-0.00 (0.00)	-0.01 (0.01)	0.00 (0.01)
secondary share	-0.00 (0.00)	-0.00*** (0.00)	0.00 (0.00)	0.00 (0.00)
weather shock	0.14 (0.09)	0.20** (0.09)	0.01 (0.12)	0.10 (0.11)
health shock	-0.02 (0.12)	0.35*** (0.12)	-0.04 (0.17)	0.21* (0.12)
vill distance bank	0.00 (0.00)	-0.00 (0.00)	0.00 (0.00)	-0.00 (0.00)
vill paved road	-0.08 (0.17)	0.29* (0.17)	0.09 (0.23)	0.80*** (0.22)
Constant	-0.44 (0.34)	0.20 (0.35)	5.96*** (0.53)	5.75*** (0.48)
No. of observations	675	675	244	300
Wald Chi ² (68)	304.40			
Prob. > Chi ²	0.0000			
Test of independence equations (rho12=rho13=...=rho34=0)				
Chi ² (6)	54.99			
Prob. > Chi ²	0.0000			

*Significant at 10%, **significant at 5%, ***significant at 1%; robust standard errors in parentheses

Table 4 Effect of ethnicity on collateral ratio and interest rate

Conditional mixed process models (CMP)				
	Formal loan (access) (1)	Informal loan (access) (2)	Formal loan (collateral ratio) (3)	Informal loan (collateral ratio) (4)
<i>Panel A: effect of ethnicity on collateral ratio</i>				
migrant minority	-0.18 (0.18)	0.11 (0.18)	-0.01 (1.20)	0.00 (0.22)
indigenous minority	-0.23* (0.14)	0.29** (0.13)	2.89** (1.15)	-0.25 (0.25)
(ethnic majority is control group)				
Control variables	Yes	Yes	Yes	Yes
No. of observations	675	675	244	300
Wald Chi ² (68)	158.26			
Prob. > Chi ²	0.000			
Test of independence equations ($\rho_{12} = \rho_{13} = \dots = \rho_{34} = 0$)				
Chi ² (6)	33.77			
Prob. > Chi ²	0.000			
<i>Panel B: effect of ethnicity on Interest Rate</i>				
migrant minority	-0.18 (0.18)	0.11 (0.18)	-1.88 (2.05)	1.01 (4.05)
indigenous minority	-0.23* (0.14)	0.29** (0.14)	6.43 (5.37)	2.38 (3.29)
(ethnic majority is control group)				
Control variables	yes	yes	yes	yes
No. of observations	675	675	244	300
Wald Chi ² (68)	129.67			
Prob. > Chi ²	0.000			
Test of independence equations ($\rho_{12} = \rho_{13} = \dots = \rho_{34} = 0$)				
Chi ² (6)	22.96			
Prob. > Chi ²	0.000			

*Significant at 10%, **significant at 5%, ***significant at 1%; robust standard errors in parentheses; ethnic majority is control group, full results in "Appendices 9 and 10"

4.3 Differences in the Impact of Formal and Informal Credit on Household Consumption Between Ethnic Groups

Table 5 reports the differences in impacts of credit on household consumption between the majority and minority groups with panel A presenting the impact of credit amount and panel B showing the impact of access to credit sources. More specifically, the differences in the impacts between (i) the ethnic majority and both minority groups, (ii) the majority and the indigenous minority, (iii) the majority and the migrant minority, and (iv) the indigenous minority and migrant minority are reported in columns 1, 2, 3, and 4, respectively.

In Panel A, regarding formal credit, the negative and significant coefficient β_5 (interaction of formal loan amount, time and ethnic group) in column 1 shows that the impact of

Table 5 Differences in the impact of credit on the consumption between ethnic groups

Variables	Triple difference approach with fixed effects			
	Majority and minority (full sample) (1)	Majority and indigenous minority (2)	Majority and migrant minority (3)	Indigenous and migrant minority (4)
<i>Panel A: the impact of credit amount</i>				
formal_amount*time (δ_5)	43.24*** (15.38)	44.14*** (15.46)	42.89*** (15.59)	7.690 (11.68)
formal_amount*time*ethnic (β_5)	-37.09* (18.89)	-38.92** (19.24)	-34.11 (27.14)	7.753 (22.37)
informal_amount*time (θ_5)	10.32 (13.85)	10.72 (13.82)	10.61 (13.80)	-11.44 (13.35)
informal_amount*time* ethnic (γ_5)	-22.09 (18.00)	-23.27 (19.47)	-16.47 (24.61)	4.640 (26.14)
Control Variables	Yes	Yes	Yes	Yes
Wald test ($\delta_5 + \beta_5 = 0$)				
Prob.> Chi ²	0.56	0.65	0.67	0.75
Wald test ($\theta_5 + \gamma_5 = 0$)				
Prob.> chi ²	0.31	0.36	0.78	0.44
No. of observations	1350	1200	984	516
R ² within	0.24	0.23	0.26	0.25
R ² between	0.30	0.30	0.23	0.20
R ² overall	0.29	0.28	0.24	0.21
Prob.> Chi ²	0.000	0.000	0.000	0.000
<i>Panel B: the impact of credit access</i>				
formal_access*time (δ'_5)	292.3** (116.6)	299.5** (117.3)	288.5** (118.2)	68.03 (86.56)
formal_access*time* ethnic (β'_5)	-239.7* (142.5)	-246.7* (145.6)	-200.4 (197.4)	62.97 (160.0)
informal_access*time (θ'_5)	25.17 (101.2)	27.89 (100.9)	24.32 (100.7)	-66.60 (87.23)
informal_access*time* ethnic (γ'_5)	-120.6 (124.5)	-95.91 (130.7)	-145.3 (177.9)	-54.95 (176.5)
Control variables	Yes	Yes	Yes	Yes
Wald test ($\delta'_5 + \beta'_5 = 0$)				
Prob.> chi ²	0.49	0.43	0.54	0.35
Wald test ($\theta'_5 + \gamma'_5 = 0$)				
Prob.> chi ²	0.20	0.54	0.42	0.42
No. of observations	1350	1200	984	516
R ² within	0.23	0.23	0.25	0.25
R ² between	0.30	0.29	0.22	0.20
R ² overall	0.28	0.27	0.23	0.21
Prob.> Chi ²	0.000	0.000	0.000	0.000

*Significant at 10%, **significant at 5%, ***significant at 1%; robust standard errors in parentheses; additional control variables include household and village characteristics, shocks, year, interactions between year and ethnicity. In column 1, ethnic = 1 if households belong to ethnic minority groups, otherwise, ethnic = 0; In column 2, ethnic = 1 if households belong to the indigenous minority group, otherwise, ethnic = 0; In column 3 and 4, ethnic = 1 if households belong to the migrant minority group, otherwise, ethnic = 0

the formal loan on consumption is significantly lower for the minority than for the majority households. Disaggregating the minority into indigenous and migrant minority groups, the positive and significant coefficient β_5 in column 2 indicates that the impact of formal credit on household consumption is higher in the majority group than in the indigenous group. Despite being statistically insignificant, the negative sign of coefficient β_5 in column 3 and the positive sign in column 4 may indicate that the impact of formal credit is higher in the majority group than in the migrant group, and this effect is lower in the indigenous group than in the migrant group. Coefficient δ_5 (the interaction of formal loan amount and time) in columns 1, 2 and 3 presents the impact of formal credit on household consumption in the majority group. δ_5 is positive and significant, showing the important role of formal credit on ethnic majority households' welfare. The impacts of formal and informal loans on the consumption of both minority groups, estimated by Wald tests, are reported in columns 1, 2 and 3, respectively. These results are insignificant, indicating that minority households appear not to significantly benefit from loans. Regarding informal loan, the results show that it does not appear to significantly affect household consumption in all ethnic groups, and there are no significant differences in this impact between ethnic groups (see θ_5 and γ_5). This is reasonable because informal loan is more likely to be used for coping against shocks (see Table 3). Our results in panel A are highly consistent with the results in panel B, which report the impact of access to formal and informal credit, confirming the validity of our results. These findings are also supported by the results of the PSM-DID method, which are reported in "Appendix 3".

In sum, Table 5 shows that formal credit appears to benefit the majority more than indigenous minority households. This may be attributed to the fact that ethnic majority households have higher levels of education and more assets than indigenous households (see Table 1). ADB (2002) also reports that minority households have a low level of education, lack financial management skills and may not know how to use loans effectively. As a consequence, after the provision of credits ends, their welfare might not be significantly improved. Baulch et al. (2012), Imai et al. (2010) and van de Walle and Gunewardena (2001) also report that having a low level of education, which leads to low returns to productive activities and investments, is one of main reasons explaining why ethnic minority households have poor living standards. In addition, the indigenous minority use less formal loan for productive purposes (see Table 2). The World Bank (2009) also reports that the amount of formal loan which ethnic households can borrow is often relatively small and may not be sufficient for productive purposes.

4.4 Impacts of Formal and Informal Credit on Ethnic Consumption Inequality

Table 6 presents the decomposition of ethnic consumption inequality. Column 1 shows the decomposition of ethnic consumption inequality in the observed scenario. Columns 2 and 3 show the decomposition of ethnic consumption inequality in the counterfactual scenarios of not having formal credit and of not having informal credit, respectively. The impact of formal and informal credit on the changes in consumption inequality are presented in the next two columns.

Our results show that formal credit significantly increases the inequality between ethnic groups. This between-group inequality increases much more than within-group inequality and contributes by around 30 per cent to total inequality increases. These results are consistent with our previous ones that ethnic majority households, the richest, do not only have

Table 6 Decomposition of ethnic consumption inequality

	Observed scenario (1)	Counterfactual scenarios		Change (%)	
		No formal credit (2)	No informal credit (3)	(1 – 2)/2	(1 – 3)/3
Total inequality (a + b)	0.17	0.11	0.13	54.55	30.77
Between-group inequality (a)	0.04	0.02	0.03	100.00	33.33
Within-group inequality (b)	0.13	0.09	0.1	44.44	30.00
Contribution to between-group inequality a/(a + b) %	23.53	18.18	23.08	29.41	1.96
Contribution to within-group inequality b/ (a + b) %	76.47	81.82	76.92	– 6.54	– 0.59

Theil's L Decomposition; counterfactual scenarios constructed by PSM model with Kernel matching algorithm, common support and band width 0.06

more opportunities in accessing formal credit, but also its impact on their consumption is significantly higher than for minority households. Informal credit also positively affects the between- and within-group inequality, but the change is lower than for those affected by the formal loan. In comparison, the impact of informal credit is negligible, as it contributes by only 2 per cent to between-group inequality. This confirms our previous results that no significant difference in the impact of informal credit on household consumption between ethnic groups exists. Nguyen and van den Berg (2011) also report that the impact of informal credit on household consumption inequality in Vietnam is relatively negligible.

5 Conclusion

The literature highlights the importance of welfare inequality in sustainable development as economic growth might widen income gaps and lead to further disempowerment of marginal human groups. In a multiethnic country, ethnic minority groups are likely to benefit least from economic growth. In poor rural areas where most ethnic minorities reside, credit plays an important role in relieving their financial capital constraints for improving their consumption. However, the heterogeneous effects of credit on consumption across ethnic groups remain ambiguous, and the effects on ethnic consumption inequality have not been investigated in the literature. These were the main motivations for our study aimed at investigating the differences in access to credit and its impacts on household consumption and consumption inequality between ethnic groups. We use a two-year balanced dataset collected in Daklak, a province in the Central Highlands, populated by majority, indigenous minority and migrant minority ethnic groups. Methodologically, we first apply a conditional-mixed process model to examine the difference between ethnic groups in access to credit. We then apply the triple difference with fixed effects approach to investigate the difference in the impact of formal and informal credit on household consumption between ethnic groups. Last, we use propensity score matching and Theil's L inequality decomposition method to investigate the impact of formal and informal credit on ethnic consumption inequality.

Our results show that even though we do not find significant differences in access to credit and its impact on household consumption between the majority and the migrant minority, the indigenous minority households appear to have more disadvantages in accessing formal credit sources than the Kinh majority. They are less likely to access formal sources and rely more on informal ones to satisfy their financial demand. To access formal credit, they face a higher collateral ratio and the amount of formal credit they could access is lower than for the Kinh majority. In addition to ethnicity, household's owned land area and education level as well as income shocks are found to have significant effects on access to credits. Regarding the impact of credit on consumption, we find that access to credit significantly and positively affects household consumption of ethnic majority households and this impact is significantly higher than that of indigenous minority households. Furthermore, our findings show that a formal credit market may worsen the inequality between ethnic groups in the region due to the disadvantages of indigenous minority households in accessing formal credit as well as their lower efficiency in using loans. Meanwhile, the impact of informal credit on household consumption in each ethnic group as well as on the consumption inequality between ethnic groups is shown to be not statistically significant. Informal credit is likely to be used as a main coping strategy against income shocks.

Our findings indicate the need for taking into account the ethnic dimension in credit policies and lead to several important policy implications. First, credit policies should be designed and implemented with more support for the indigenous minority group to mitigate obstacles of accessing formal credit. This could imply for example simplifying collateral requirements. Second, financial supporting programs for indigenous minority households should take into consideration the utilization and effectiveness of loans. To improve the return from loans, subsidized credit programs may need to go along with training, monitoring and regular technical assistance for indigenous households.

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Appendix 1

See Table 7.

Table 7 Name and definition of explanatory variables

Name	Scale	Definition
migrant minority	Binomial, yes = 1, otherwise = 0	The household belongs to the migrant minority group in the Central Highland (Tay, Nung, Thai, Muong, Nung, Meo, Hoa, Dao, Sanchay, Bru)
indigenous minority	Binomial, yes = 1, otherwise = 0	The household belongs to the indigenous minority group in the Central Highland (Ede, Muong and Jarai)
formal access	Binomial, yes = 1, otherwise = 0	Household has borrowed from formal sources (banks, social and credit organizations) in past 12 months
informal access	Binomial, yes = 1, otherwise = 0	Household has borrowed from informal sources (money lenders, friends, relatives, business partner and others) in past 12 months
formal amount	PPP\$	The logarithm in the amount of formal loans household receive in past 12 months
informal amount	PPP\$	The logarithm in the amount of informal loans household receive in past 12 months
year	Binomial, yes = 1, otherwise = 0	year is 2010
owned agri land	ha	Land area are mainly used for planting crops
livestock	tropical livestock unit	The number of livestock the household owns
television	Binomial, yes = 1, otherwise = 0	Household has at least a television
tractor	Binomial, yes = 1, otherwise = 0	Household has at least a tractor
motorbike	Binomial, yes = 1, otherwise = 0	Household has at least a motorbike
remittance	PPP\$	The logarithm in the amount of remittances household receive in past 12 months
secondary share	proportion	The share of adults members (age > 18) who have secondary degree and above
child share	proportion	The share of children members (age < 15)
old share	proportion	The share of old members (age > 64)
age head	year	age of household head
hhsiz	people	Household size
weather shock	number	Number of severe weather shocks in past 12 months
health shock	number	Number of severe health shocks in past 12 months
vil distance bank	minutes	Time from the village to the nearest bank
vil paved road	Binomial, yes = 1, otherwise = 0	Village has paved roads

Appendix 2

See Table 8.

Table 8 Collinearity test in CMP model

Name	VIF	1/VIF
migrant minority	1.49	0.67
indigenous minority	1.30	0.77
owned agri land	1.39	0.72
livestock	1.05	0.95
television	1.25	0.80
motorbike	1.48	0.68
tractor	1.27	0.79
remittance	1.06	0.94
age head	2.17	0.46
hhsiz	1.57	0.64
child share	1.82	0.55
old share	1.46	0.68
secondary share	1.26	0.79
weather shock	1.11	0.90
health shock	1.09	0.92
vil distance bank	1.22	0.82
vil paved road	1.07	0.93
Mean VIF	1.36	

Appendix 3

See Table 9.

Table 9 Robustness check for DDD model: PSM-DID model

Matching algorithm	Majority	Minority	Indigenous minority	Migrant minority
<i>Impact of access to formal credit on the change in household consumption per adult equivalent</i>				
KBM ^a	303.87**	86.00	108.58	-222.30
	119.80	89.10	102.23	203.92
Radius ^b	302.08**	81.47	115.91	-241.15
	119.83	88.93	102.52	203.30
<i>Impact of access to informal credit on the change in household consumption per adult equivalent</i>				
KBM ^a	-36.12	-25.85	-21.39	159.75
	110.08	76.31	85.03	179.86
Radius ^b	-44.82	-12.18	-30.88	156.35
	111.34	73.62	84.33	174.63

*, **, *** significant at 10%, 5%, and 1%, respectively; standard errors bootstrapped 1000 replications; ^aKBM=Kernel matching with common support and band width 0.06. ^bRadius matching with common support, band width 0.06 and caliper 0.06

Appendix 4

See Table 10.

Table 10 Collinearity test in the DDD model (full sample)

Full sample (majority vs. ethnic minority)		
Name	VIF (access)	VIF (amount)
formal_access*time*minority	2.35	
informal_access*time*minority	3.41	
formal_access*time	2.13	
informal_access*time	2.49	
formal_amount*time*minority		2.17
informal_amount*time*minority		2.97
formal_amount*time		1.99
informal_amount*time		2.20
minority_year	3.97	3.82
year	2.67	2.65
owned agri land	1.31	1.32
livestock	1.05	1.05
motorbike	1.37	1.37
tractor	1.23	1.23
television	1.2	1.2
remittance	1.06	1.06
age_head	2.14	2.14
hhsiz	1.46	1.46
secondary share	1.21	1.21
child share	1.78	1.78
old share	1.52	1.52
weather shock	1.11	1.11
health shock	1.05	1.05
vil distance bank	1.11	1.11
vil paved road	1.04	1.04
Mean VIF	1.75	1.69

Appendix 5

See Table 11.

Table 11 Collinearity test in the DDD model (sub sample)

Name	Sub-sample Majority versus indigenous minority		Sub-sample Majority versus migrant minority		Sub-sample Indigenous versus migrant minority	
	VIF	VIF	VIF	VIF	(Access)	(Amount)
	(Access)	(Amount)	(Access)	(Amount)		
formal_access*time*indigenous_minority	1.75	–	–	–	–	–
informal_access*time* indigenous_ minority	2.14	–	–	–	–	–
formal_amount*time* indigenous_minor- ity	–	1.71	–	–	–	–
informal_amount*time* indigene- ous_minority	–	2.05	–	–	–	–
year* indigenous_minority	2.71	2.66	–	–	–	–
formal_access*time*migrant_minority	–	–	2.21	–	2.15	–
informal_access*time* migrant_minority	–	–	3.46	–	2.59	–
formal_amount*time* migrant_minority	–	–	–	2.06	–	2.16
informal_amount*time* migrant_minor- ity	–	–	–	3.04	–	2.58
year* migrant_minority	–	–	4.24	4.00	3.49	3.33
formal_access*time	1.59	–	1.91	–	2.04	–
informal_access*time	1.68	–	2.22	–	2.63	–
formal_ amount*time	–	1.56	–	1.81	–	2.02
informal_ amount*time	–	1.61	–	1.98	–	2.55
year	2.07	1.29	2.42	2.40	3.22	3.02
owned agri land	1.29	1.05	1.36	1.36	1.59	1.6
livestock	1.05	1.36	1.04	1.04	1.22	1.23
motorbike	1.36	1.21	1.34	1.34	1.39	1.39
tractor	1.21	1.22	1.26	1.27	1.32	1.32
television	1.22	1.07	1.17	1.17	1.23	1.23
remittance	1.07	2.04	1.06	1.06	1.05	1.05
age_head	2.04	1.43	2.26	2.25	2.28	2.26
hhsiz	1.43	1.29	1.53	1.52	1.47	1.47
secondary share	1.17	1.17	1.21	1.21	1.15	1.15
child share	1.73	1.73	1.81	1.81	1.96	1.95
old share	1.56	1.56	1.59	1.59	1.37	1.37
weather shock	1.10	1.10	1.12	1.12	1.11	1.11
health shock	1.05	1.05	1.06	1.06	1.06	1.06
vil distance bank	1.15	1.15	1.10	1.10	1.11	1.11
vil paved road	1.04	1.04	1.04	1.05	1.04	1.04
Mean VIF	1.50	1.48	1.73	1.68	1.74	1.71

Appendix 6

See Fig. 1.

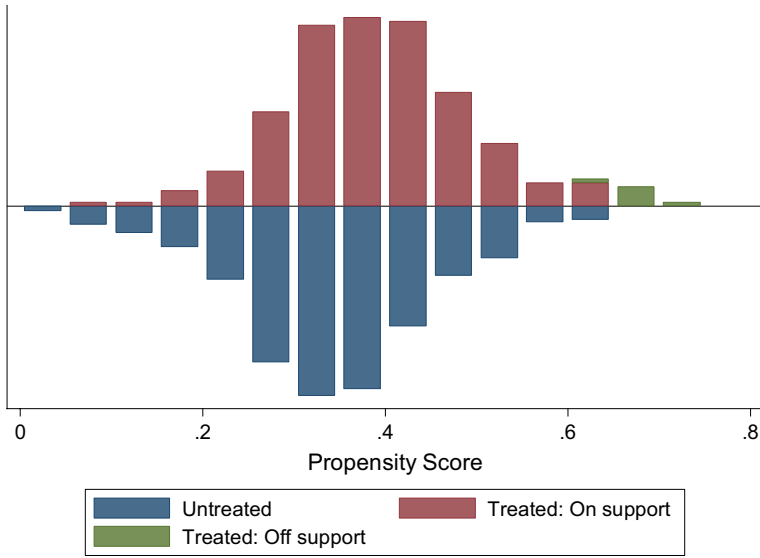


Fig. 1 Propensity score distribution of access to formal credit. ‘Treated: on support’ represents households in the no-formal credit group that have a suitable match, while ‘Treated: off support’ represents households in the no-formal credit group that do not have a suitable match, and ‘Untreated’ represents households in the group of have access to formal credit

Appendix 7

See Fig. 2.

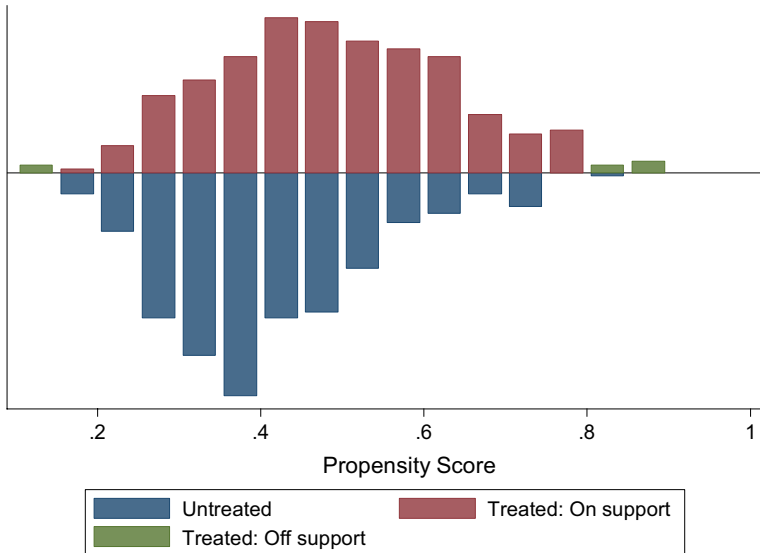


Fig. 2 Propensity score distribution of access to informal credit. ‘Treated: on support’ represents households in the no-informal credit group that have a suitable match, while ‘Treated: off support’ represents households in the no-informal credit group that do not have a suitable match, and ‘Untreated’ represents households in the group of have access to informal credit

Appendix 8

See Table 12.

Table 12 Qualifying test of PSM in the ethnic-based consumption inequality model

Matching algorithm	Pseudo R2 before matching	Pseudo R2 after matching	LR test (<i>p</i> -value) before matching	LR test (<i>p</i> -value) after matching	Mean standardised bias before matching	Mean standardised bias after matching	Percent bias reduction
<i>Access to formal credit</i>							
KBM ^a	0.043	0.001	38.30	0.86	10.1	1.8	82.20
Radius ^b	0.043	0.002	38.30	1.01	10.1	2.1	79.21
<i>Access to informal credit</i>							
KBM ^a	0.061	0.002	56.72	1.89	15.3	2.3	85.00
Radius ^b	0.061	0.002	56.72	1.69	15.3	2.4	84.31

^aKBM = Kernel matching with common support and band width 0.06. ^bRadius matching with common support, band width 0.06 and caliper 0.06

Appendix 9

See Table 13.

Table 13 Effect of ethnicity on collateral ratio

Variables	Conditional mixed process model			
	Formal loan (access) (1)	Informal loan (access) (2)	Formal loan (collateral ratio) (3)	Informal loan (collateral ratio) (4)
migrant minority	-0.18 (0.18)	0.11 (0.18)	-0.01 (1.20)	0.00 (0.22)
indigenous minority	-0.23* (0.14)	0.29** (0.13)	2.89** (1.15)	-0.25 (0.25)
owned agri land	0.12* (0.07)	-0.07 (0.07)	0.17 (0.46)	-0.36** (0.18)
livestock	0.00 (0.02)	-0.01 (0.02)	-0.07 (0.05)	0.01 (0.04)
television	0.38** (0.18)	0.07 (0.17)	-0.07 (0.96)	-0.25 (0.21)
motorbike	-0.11 (0.13)	-0.12 (0.13)	1.42 (0.87)	0.51* (0.27)
tractor	0.06 (0.12)	-0.07 (0.12)	1.35 (0.84)	0.03 (0.25)
remittance	0.07* (0.04)	-0.00 (0.04)	-0.07 (0.13)	0.06 (0.10)
age head	-0.01* (0.01)	-0.01 (0.01)	0.08 (0.06)	0.01 (0.01)
hhsiz	0.09** (0.04)	0.02 (0.04)	0.31 (0.31)	0.01 (0.07)
child share	-0.01** (0.00)	-0.00 (0.00)	0.04** (0.02)	0.01 (0.01)
old share	-0.01* (0.01)	-0.00 (0.00)	0.07 (0.05)	-0.01* (0.01)
secondary share	-0.00 (0.00)	-0.00*** (0.00)	0.01 (0.01)	0.00 (0.00)
weather shock	0.14 (0.09)	0.20** (0.09)	-1.46** (0.65)	-0.12 (0.12)
health shock	-0.02 (0.12)	0.34*** (0.12)	-0.61 (0.69)	-0.26 (0.18)
vill distance bank	0.00 (0.00)	-0.00 (0.00)	-0.02 (0.02)	-0.01 (0.00)
road	-0.04 (0.17)	0.28* (0.17)	-0.48 (0.75)	-0.40 (0.26)
constant	-0.44 (0.35)	0.21 (0.35)	-4.76 (3.07)	-0.10 (0.43)
No. of observations	675	675	244	300
Wald Chi ² (68)	158.26			

Table 13 (continued)

Variables	Conditional mixed process model			
	Formal loan (access) (1)	Informal loan (access) (2)	Formal loan (collateral ratio) (3)	Informal loan (collateral ratio) (4)
Prob. > Chi ²	0.0000			
Test of independence equations (rho12 = rho13 = ... = rho34 = 0)				
Chi ² (6)	33.77			
Prob. > Chi ²	0.0000			

*Significant at 10%, **significant at 5%, ***significant at 1%; robust standard errors in parentheses

Appendix 10

See Table 14.

Table 14 Effect of Ethnicity on Interest Rate

Variables	Conditional mixed process model			
	Formal loan (access) (1)	Informal loan (access) (2)	Formal loan (interest rate) (3)	Informal loan (interest rate) (4)
migrant minority	-0.18 (0.18)	0.11 (0.18)	-1.88 (2.05)	1.01 (4.05)
indigenous minority	-0.23* (0.14)	0.29** (0.14)	6.43 (5.37)	2.38 (3.29)
owned agri land	0.12* (0.07)	-0.07 (0.07)	-0.25 (0.86)	-2.26 (1.75)
livestock	0.00 (0.02)	-0.01 (0.02)	0.06 (0.19)	0.88 (1.05)
television	0.38** (0.18)	0.07 (0.17)	2.83 (5.08)	-5.45 (4.73)
motorbike	-0.10 (0.14)	-0.12 (0.13)	-3.39 (4.50)	2.28 (2.95)
tractor	0.06 (0.12)	-0.07 (0.12)	-1.51 (1.69)	0.71 (2.81)
remittance	0.07* (0.04)	-0.00 (0.04)	0.51 (0.62)	0.08 (0.70)
age head	-0.01* (0.01)	-0.01 (0.01)	-0.02 (0.14)	0.19 (0.14)
hhsiz	0.09** (0.04)	0.02 (0.04)	-0.43 (0.79)	1.28 (0.92)
child share	-0.01** (0.00)	-0.00 (0.00)	0.12* (0.07)	-0.03 (0.07)
old share	-0.01* (0.01)	-0.00 (0.00)	-0.01 (0.07)	-0.12 (0.10)

Table 14 (continued)

Variables	Conditional mixed process model			
	Formal loan (access) (1)	Informal loan (access) (2)	Formal loan (interest rate) (3)	Informal loan (interest rate) (4)
secondary share	-0.00 (0.00)	-0.00*** (0.00)	0.04 (0.06)	-0.02 (0.03)
weather shock	0.14 (0.09)	0.20** (0.09)	-1.88 (2.86)	-0.80 (1.78)
health shock	-0.02 (0.12)	0.35*** (0.12)	6.31 (5.71)	-3.23 (2.42)
vill distance bank	0.00 (0.00)	-0.00 (0.00)	-0.03 (0.06)	0.07 (0.06)
road	-0.04 (0.17)	0.28* (0.17)	-3.14 (2.55)	-3.98 (3.84)
constant	-0.44 (0.35)	0.21 (0.35)	6.00 (6.73)	10.84 (7.91)
No. of observations	675	675	244	300
Wald Chi ² (68)	129.67			
Prob.> Chi ²	0.0000			
Test of independence equations (rho12=rho13=...=rho34=0)				
Chi ² (6)	22.96			
Prob.> Chi ²	0.0000			

*Significant at 10%, **significant at 5%, ***significant at 1%; robust standard errors in parentheses

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