The role of risk rationing in rural credit demand and uptake: lessons from Kyrgyzstan

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Abstract

Purpose – Lack of access to credit is commonly held responsible for slow agricultural and rural development in low- and middle-income countries. This paper aims to investigate the contribution of demand- and supply-side factors, particularly the role of risk rationing, on credit application and uptake in the case example of Kyrgyzstan.

Design/methodology/approach – Toward this aim, the study explores the determinants of credit behavior of 1,738 Kyrgyz sample farm households from 2013 to 2016 waves of the nationally representative "Life in Kyrgyzstan" (LIK) dataset along a hierarchical regression model, differentiating between factors influencing individual demand for credit and factors influencing supply for credit.

Findings – The results of our analysis indicate the relative importance of demand-side factors for credit applications, reflecting farmers' perceived risk of credit default and loss of collateral. Meanwhile, supply-side factors, such as real credit constraints and collateral requests, have a stronger influence on credit uptake rates and overall loan sums. These findings highlight the role of risk rationing for agricultural investment, suggesting a stronger focus of development policy on improving risk-sharing mechanisms for farmers, e.g. by developing the agricultural insurance sector.

Originality/value – The paper contributes novel evidence on the role of risk rationing in shaping the demand for formal credits for increasing agricultural and rural investment in low-income transition economies. Previous research has mostly focused on the role of credit supply, thus underrating the potential contribution of individual risk attitude, risk experience and risk sharing.

Keywords Rural development, Credit rationing, Risk aversity in agricultural finance, Credit uptake

Paper type Research paper

1. Introduction

Rural credit, and agricultural credit in particular, has the potential to significantly improve rural incomes by inciting economic growth within and outside of agriculture (Burgess and Pande, 2005; Nadolnyak *et al.*, 2017). Meanwhile, smallholder farming systems are often characterized by systematic underinvestment as a symptom of credit constraints among farm households. Three main factors make smallholder agriculture particularly susceptible to credit constraints: First, interest rates and collateral requirements are particularly high in

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agriculture due to information asymmetries and difficulties enforcing payments (Petrick, 2005; Hoff and Stiglitz, 1990). Second, credit constraints particularly occur for long-term investments, for which returns are subject to uncertainty (Garicano and Steinwender, 2016). Being highly dependent on variable weather conditions, uncertainty is one of the formative characteristics of smallholder agriculture. Third, banks often use farm size as a proxy for unobserved farm characteristics, thus discriminating against small farms (Carter, 1988). Overall, the inability to borrow funds, which has long been identified as the most pervasive credit market imperfection (Stigler, 1967), can be seen as the major reason the spread of credit and underinvestment among farm households has been slow.

Motivated by this high susceptibility of agriculture to credit constraints, previous studies have assumed the agricultural sector to be credit rationed, a situation under which credit demand exceeds the amount of loans that lenders are willing to provide at the current market rate (Turvey and Weersink, 1997). Meanwhile, the strong focus on supply-side factors may lead to a neglect of farmers' demands for credit and thus an overestimation of credit rationing (Kochar, 1997). This paper aims to expand the discussion beyond well-known credit market imperfections by taking a closer look at the role of intrinsic credit demand and in particular the role of risk in credit demand.

On a practical level, risk is defined as the probability of a particular, typically adverse event (Aven, 2010) or, in statistical terms, the noise to a random variable (Rothschild and Stiglitz, 1970). While loan default is the main risk for financial institutions, farmers face risks like yield defaults or other income fluctuations, leading to an inability to repay credits and thus the risk of losing collateral and other material or immaterial assets. Research by Binswanger and Sillers (1983) has shown that, with few variations across cultures, income levels or production environments, most farmers are risk-averse, with risk aversion being defined as the dislike of individuals toward increased risk or, in other words, the prevalence of a concave utility function (Rothschild and Stiglitz, 1970). In practice, risk aversion leads to the preference of high interest rates over collateral requirements, as fluctuations in interest rates can be controlled for in loan contracts, while monthly or annual repayments depend on farming income, for which the likelihood of an adverse event, such as harvest default, is considerable. As a result, this inability to control for the risk of credit defaulting on the side of the farmer and the subsequent withdrawal from credit markets is termed "risk rationing" (Boucher *et al.*, 2008).

Risk rationing impacts access to formal credit markets (i.e. state-regulated financial institutions), as opposed to informal lenders like private and commercial lenders outside of state control (Boucher and Guirkinger, 2007). Meanwhile, it has been argued that the general conservative and risk-averse nature of farmers may lead to low formal credit demand even in the presence of sufficient credit supply due to the high collateral requirements of formal lenders and a general preference of informal credits lenders (Lerman and Zedik, 2009; Pal, 2002).

This article argues that the consequences of risk rationing may go beyond formal credit: The inability to control for risk related to the ability to repay loans not only implies a loss of collateral, but also social prestige and pressure from lenders, and thus may lead to complete withdrawal from any credit market in the smallholder environment. While development initiatives have long focused on increasing the supply of low-interest credit lines (i.e. assuming an excess demand for credit), further insights into the role of risk and risk-sharing might provide a whole new angle for practical applications in the area of rural and agricultural credit. Despite the high potential value of a better understanding of the role of risk and individual attitudes toward risk (i.e. risk adversity/risk aversity) in credit demand and uptake, the topic remains under-researched. This is especially true for transition economies, which are characterized by low trust between financial institutions and farmers, as well as by unstable market environments (e.g. Baydas *et al.*, 1994). Therefore, this article aims to investigate the source of credit constraints and the low uptake of credit in rural areas of transformation economies, with a particular focus on differentiating between supply-side

factors and demand for credit as a result of the risk-rationed conditions of farmers in low- and middle-income countries.

Toward this aim, we conducted a hierarchical regression analysis of several waves of rural credit data, taking into account both demand- and supply-side factors. The empirical analysis was conducted using a sample of 1,738 Kyrgyz farm households from the nationally representative "Life in Kyrgyzstan" (LIK) dataset (Brück *et al.*, 2014). Our findings underline the significant contribution of demand-side factors, particularly for credit applications, suggesting the need to further support the development of risk-sharing in smallholder agriculture to increase rural and agricultural credit uptake.

This paper is organized as follows: Section 2 will provide a review of the theoretical and empirical literature on the topic, followed by Section 3, which contains an overview of the credit market structure of Kyrgyzstan, an exemplary developing country characterized by low credit uptake in agriculture. Section 4 introduces the empirical model and the employed data. Section 5 presents the empirical results, which are discussed in the final chapter.

2. Literature review

From a theoretical perspective, a wide range of studies have discussed the sources of credit constraints. Special attention has been received by credit rationing, which has been defined as a setting wherein credit demand exceeds the amount of loans that lenders are willing to provide at the current market rate (Turvey and Weersink, 1997). In practice, credit rationing is exerted, for instance, by imposing caps on the total volume of credit lines. Stiglitz and Weiss (1981) argue that credit rationing also takes place when banks cannot or will not adapt the interest rates to the actual default risk. Instead, credit access is restricted via non-price terms, such as high transaction costs or high collateral requirements. In this case, customers are not denied access *per se*, but are crowded out to informal credit markets, or they completely refrain from taking a credit (Boucher *et al.*, 2009). Alternatively, credit rationing can also occur when the loan volume is adjusted below the level of the loan requested by the applicant, although the interest rate remains at the initially agreed level (Jaffee and Russell, 1976) [1].

As a result, applicants are *quantity rationed* if they do not receive a loan even though they are willing to accept the related interest rates and collateral requirements. Under a slightly different scenario, individuals refrain from an application because they assume that it will be unsuccessful. This internal self-selection is, according to Baydas *et al.* (1994), most common in developing and emerging economies. In cases where the underlying assumption about the availability of credits is accurate, this phenomenon can also be classified as quantity rationing. Otherwise, this *ex ante* self-selection is a mere expression of low demand or risk aversion on the side of the farmer, which prevents them from making enquiries into the availability of credits.

Equilibrium markets, in which banks use interest rates and collateral requirements to screen for the risk of credit default, meanwhile, should not be regarded as a case of credit rationing (Bester, 1985). Credit agencies might decide to deal with the risk resulting from information asymmetries or a generally high default risk by raising the credit rates. According to a framework proposed by Verteramo Chui *et al.* (2014), potential applicants would thus again decide not to apply for credit when confronted with high interest rates, resulting in internal *price rationing*.

Boucher *et al.* (2008) proposed that information asymmetries and the resulting transfer of credit default risk to the borrower translate into high collateral requirements. Farmers in these markets might see a lower benefit in taking credit and coping with extensive transaction costs and the risk of losing collateral, as compared to low-value, but safe production. These farmers refrain from filing a credit application or reject a loan offer, and thus are *risk-rationed* (Boucher *et al.*, 2008).

Based on these possible outcomes of the decision-making processes, we conclude with a process as depicted in Figure 1. The question of whether or not an individual's credit application is rejected or not is a rather clear-cut question of quantity rationing. Whether or not applicants decide to apply in the first place, or whether they decide to take on a proposed credit line, could point to quantity rationing, price rationing and risk rationing alike.

From an empirical perspective, the literature identifies various factors contributing to credit applications and uptake. From the supply side, the most prominent aspect is the availability of collateral, which is also provided as a main factor in Figure 1. This aspect can be represented by various variables: Past studies have investigated the impact of household income (e.g. Sekyi, 2017); off-farm income, both positive (Muhongayire *et al.*, 2013) and negative (Jia *et al.*, 2010); household capital endowment (Duy *et al.*, 2012); or ownership of livestock and consumption goods (Angioloni *et al.*, 2018) on credit uptake. While the value of land holdings depends, among other things, on national land regulations and land titling systems, they are, when acting as collateral, a decisive factor for credit access (Swain, 2002). The importance of geographic proximity to financial institutions was highlighted for instance by Muhongayire *et al.* (2013). Social status meanwhile can be linked to credit

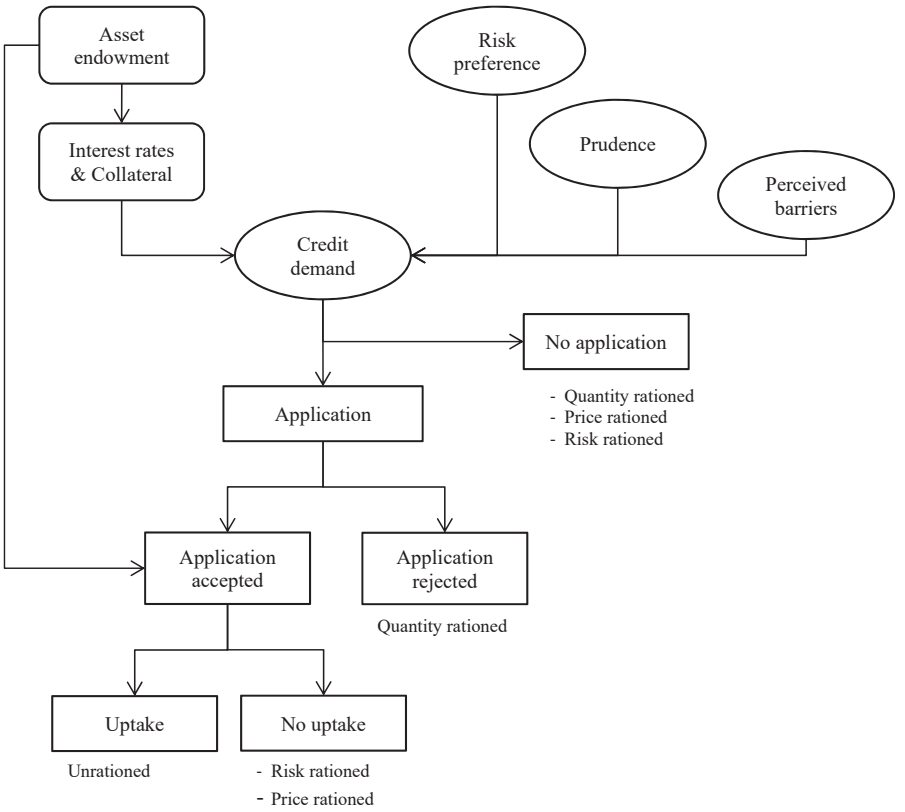

Figure 1.
Credit application and uptake scheme

Source(s): Adaption of Verteramo Chui *et al.* (2014)

applications via collateral, but may also point to elite capture (Jia *et al.*, 2010). Recent research has further confirmed the significant positive influence of access to local social networks on microcredit access (Wydick *et al.*, 2011; Asante-Addo *et al.*, 2017).

From the demand side, trust issues, risk attitude, high risk of credit default or other individual factors can influence applying for credit and uptake. Most prominently, farmers' risk preferences might inhibit the demand for credit. Binswanger and Sillers (1983) argue that farmers and the rural population are on average more risk-averse than the main population. Asante-Addo *et al.* (2017) have found that fear of loan default, and thus loss of collateral, is the most important reason deterring farm households from joining credit programs. Instead, farmers seeking credit are likely to turn to the informal sectors offering low-collateral loans at high interest rates; as pointed out by Binswanger and Silas (1983), risk-averse individuals prefer high interest over collateral requirements to avoid high additional costs at the default stage. Possner *et al.* (2021) analyzed Cambodian smallholders' credit demand and found that less risk-averse individuals tend to take up riskier and generally more expensive informal loans. Beyond risk attitude, actual or perceived risk can also influence the demand for credit. Saqib *et al.* (2016) have found a positive correlation between credit demand and perceived risk of production shocks. Shocks in the broadest sense refer to a materialized risk that causes a significant negative welfare effect (Heitzmann *et al.*, 2002). Steiner *et al.* (2009) have found empirical evidence on the impact of households' risk assessments and past exposure to shocks on the usage of savings products, loans and insurance in Ghana. Dang *et al.* (2020) took research one step further by differentiating between types of shock experiences, finding that legal risk, production risk and financial risk are positively significant in relation to credit uptake, while market risk is negatively correlated with credit uptake in Vietnam.

Finally, there are several individual characteristics among farmers that may influence credit uptake from both the demand and supply side. Education, for instance, was found to influence not only credit rationing (Barslund and Tarp, 2008; Jia *et al.*, 2010), but also credit demand (Mpuga, 2010) and thus credit market participation on the whole (Muhongayire *et al.*, 2013). Gender may play a role in both credit access and demand. In particular, women's lower access to formal collateral like land titles may worsen credit access (Fletschner, 2009; The World Bank, 1999). Gender differences in credit demand have been found (Mpuga, 2010), which may, however, vary with cultural and political backgrounds. Baydas *et al.* (1994), for instance, found no significant differences in credit demand and credit rationing between genders in Ecuador. Finally, previous research found empirical evidence for a positive relationship between crop insurance and credit access and demand (Mishra, 1994). However, since Kyrgyzstan has not yet developed agricultural insurance markets, this last item is beyond the scope of this study.

The above literature review illustrates that low credit uptake can be a consequence of (1) low credit supply in terms of the overall amount at given market rates or the lack of flexibility in adapting rates and collateral requirements to individual credit applications and/or (2) a lack of demand for credit with certain interest rates and collateral requirements caused by risk rationing and/or internal price rationing on the side of the farmer. For given credit rates and collateral requirements, demand for credit is the result of a complex cost–risk assessment, taking into account existing risk coping strategies, potential investment gains, but also individual risk-related factors like risk preferences, as well as objective default risk. So far, the role of each of these demand- and supply-side factors in determining both applying for credit and credit uptake has not been weighed against each other. Deeper insights into this issue are essential for assessing the risk rationing of smallholder farmers in rural credit markets, a topic that is also of high practical relevance in the area of rural development. This study contributes to closing this research gap by empirically testing the contribution of demand-side variables and agricultural risk in particular toward credit application and uptake.

3. Agricultural credit in Kyrgyzstan

In Kyrgyzstan, our case example, agriculture employs a significant share (26%) of the country's population (The World Bank, 2019). While climatic conditions are comparatively favorable, agriculture fails to provide meaningful incomes due to a high land fragmentation, with the typical farm size being below 2 ha (Mogilevskii *et al.*, 2017). During the past 15 years, the value-added of agriculture in Kyrgyzstan has hardly increased, unlike in other former Soviet countries in Eastern Europe and Central Asia, or in regional benchmark neighboring countries. Between 2001 and 2016, for example, the value added in agriculture, forestry and fishery increased by 52% in Kazakhstan, by 154% in Uzbekistan, by 201% in Tajikistan and by 55% in Ukraine, but only by 33% in Kyrgyzstan (FAO, 2020). Low financial liquidity among farm households is likely to be one of the reasons for the under-development and thus low profitability of Kyrgyz agriculture: Overall, Kyrgyzstan features a relative credit uptake that is among the lowest in the countries of the Commonwealth of Independent States (CIS) (Table 1). Research has suggested a wide range of measures for modernizing Kyrgyz agriculture, highlighting the necessity to modernize production methods in terms of adopting new production technologies toward the more efficient usage of production inputs, in particular irrigation (Pomfret, 2016). With low levels of private credit and agricultural investment, the spread of new technology and production methods may be limited to knowledge-based innovations or community-based investment.

Before starting with our analysis, we provide a short introduction of the Kyrgyz credit market. In slight modification of Boucher and Guirkinger (2007), we define formal and informal loan sectors as follows: The formal sector consists of commercial banks (both state and private banks) and credit unions. Unlike Boucher and Guirkinger, we also understand micro-finance institutions to be part of the formal sector, as they operate within and are subject to government legislation. The informal sector consists of unregulated sources like moneylenders, input supply dealers, traders, agro-processing firms and family and friends.

First, we shall shed light on state-owned banks and state-subsidized credit lines offered by private banks: For smallholders, a limited number of loans at state-subsidized rates were first introduced in 2013 under the name *Affordable Loans for Farmers* (Gicquel *et al.*, 2016).

Country	Agricultural land (in 1,000 ha)	Credit to agriculture In local currency (million)	Credit to agriculture In $ PPP (million)**	Credit to agriculture In $ PPP per ha agricultural land
Georgia	2,394	24.56	28.57	11.93
Kazakhstan	216,992	681,757.30	5,879.27	27.09
Tajikistan	4,738	1,036.78	441.31	93.14
Kyrgyzstan	10,541	19,360.56	991.39	94.05
Russian Federation	217,722	822,540.00	31,931.61	146.66
Republic of Moldova	2,441	2,552.19	402.08	164.72
Azerbaijan	4,773	441.30	1,059.14	221.90
Ukraine*	41,508	68,430.00	14,986.12	361.04
Armenia	1,677	100,612.26	624.03	372.11
Belarus	8,533	2,872.90	5,095.99	597.21
Estonia	1,003	419.20	794.09	791.71
Germany	16,657	50,602.00	67,228.74	4,036.07

Note(s): *data for 2015; **PPP: Purchasing power parity
Source(s): Data source: FAO, 2020

Table 1.
Agricultural loans in CIS countries, 2016

The most favorable rate of 10% is given for crop and livestock production activities as well as developing rural cooperatives. Credits at higher rates of about 20% (still lower than the market rate) are distributed for rural entrepreneurship activities such as processing and marketing. The state compensates its partner banks the difference between the subsidized loan interest rate of 10% and the average market interest rate. The total amount of loans amounted to KGS7bn in 2018 (about US$1m) (The Government of the Kyrgyz Republic, 2017). Concessional credit lines for the agriculture sector were extended to the Aiyl Bank, the Financial Company for Support and Development of Credit Unions, RSK Bank, Bakai Bank, Bank Kyrgyzstan and Kyrgyz Investment and Credit Bank. Subsidized credit lines targeting the agriculture sector have also been made available by the State Economic Development Fund under the Ministry of Finance and by the National Bank of the Kyrgyz Republic (IBP, 2016). The volume of support, however, is again limited (FAO, 2020).

Furthermore, about eight private banks offer rural credits at commercial rates (Japan International Cooperation Agency, 2014). Many of these credit lines feature high interest rates due to the significant transaction costs when collecting information on financial histories of small farmers (Angioloni *et al.*, 2018). Further hindrances are collateral requirements: In formal banks, collateral is necessary if the debtor makes a down payment of less than 30% of the total value only (Japan International Cooperation Agency, 2014). According to Kyrgyz legislation, commercial banks cannot own agricultural land; farmland is not accepted as collateral (Akramov and Omuraliev, 2009). Mortgaging of houses is not an option for remote areas and for real estate that does not meet certain quality standards (FAO and EBRD, 2006). In general, houses in rural areas are of very low value, which in most cases is not enough for a mortgage (Japan International Cooperation Agency, 2014). To respond to the low availability of formal collateral, some banks have launched so-called borrow-group programs for low-income borrowers. Several potential borrowers team up for a credit application and guarantee each other's loan repayments. In return, the bank does not require collateral or other indicators of credit-worthiness (FINCA Bank, 2018).

The need for low-collateral credit lines has also turned non-bank financial institutions into a popular credit source (Swinnen *et al.*, 2011). The microfinance system has been in place since 1994; by 2013, there were 249 microfinance institutions across the country (Japan International Cooperation Agency, 2014). However, these institutions' unsubsidized interest rates are high, 39% on average. The size of loans provided is usually very small, up to only US$110 (Swinnen *et al.*, 2011). In contrast to larger banks, the microfinancing sector has suitable outreach capacities to service poor rural households. Additionally, regulations concerning borrowing history and collateral are less strict than for state-owned and private banks (Angioloni *et al.*, 2018).

Additional credit agencies are credit unions that are being promoted by the government and donors in the rural areas of the Kyrgyz Republic. Last reports found about 270 credit unions in the country, however again with rather high interest rates of 18–35% per annum (Akramov and Omuraliev, 2009).

As a result, the sources of agricultural credit have been shifting, as illustrated in Figure 2. While in 2008 commercial banks provided KGS2,312m to farmers, this increased to KGS24,663m in 2016, or by 967%. At the same time, there was an increase in credits provided by non-bank financial institutions. In particular, the total value of loans from microfinance institutions grew, from KGS94m in 2004 to KGS2,884m in 2017, an increase of 2,968%. The decrease in absolute loans from microfinance institutions since 2015 can be explained by the conversion of several microfinance institutions into banks.

Nevertheless, credit conditions are less than stable and connected to considerable uncertainty. As illustrated in Figure 3, interest rates in the 1990s were fluctuating considerably around an average of 50%. Following a constant decrease during the 2000s, interest rates have stabilized around 20% over the past 15 years, but still fluctuate between

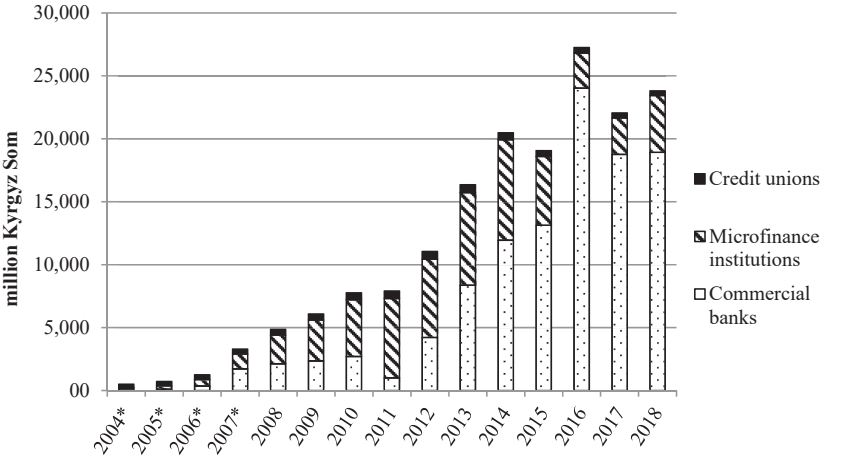

Figure 2.
Loans extended to agriculture since 2004, by credit agencies

Note(s): *for 2004-2007 no data on commercial banks was published
Source(s): National Bank of the Kyrgyz Republic (2019)

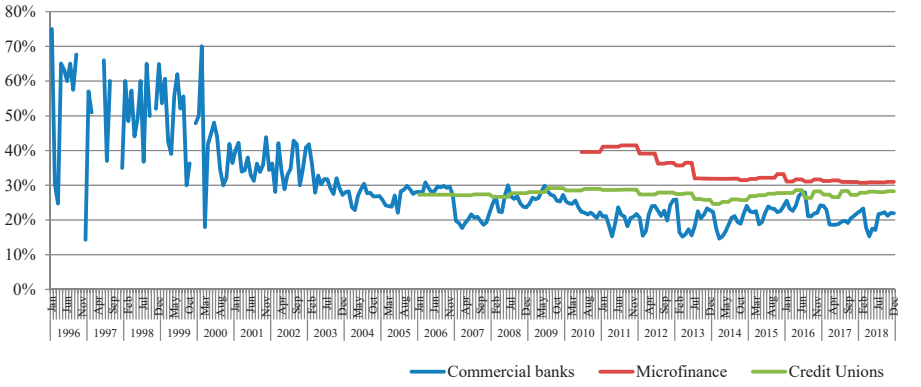

Figure 3.
Average weighted interest rates for agricultural credits by source

Note(s): Data is provided in monthly interval for commercial banks, biannual and quarterly interval for microfinance and credit unions
Source(s): National Bank of the Kyrgyz Republic, 2019

15 and 31%. Interest rates for credits by microcredit agencies and credit unions were more stable, at about 34 and 28%, with fewer fluctuations (ranging between 31–42% and 25–29%, respectively). In the period between 2008 and 2018, the interest rates of both credit unions and microfinance were usually considerably higher than commercial bank credits, which featured average rates of 24% during that period.

In addition to general availability of credit, several trust- and transparency related issues have been reported: For one, farmers often lack information and instructions concerning the loan application process and the related paperwork (The World Bank, 1999). Furthermore, the same study showed that many Kyrgyz farmers were very much aware of the risk of a credit default following production loss, and thus refrained from applying for a credit in the

first place (The World Bank, 1999). Another study confirmed that some farmers gave up having a consultation with a bank due to anxiety about the failure of repayment, although they were interested in taking a credit (Japan International Cooperation Agency, 2014). Furthermore, numerous banking crises during transition created a general lack of confidence in the banking system of Kyrgyzstan (Akramov and Omuraliev, 2009). As an example, a World Bank study revealed that farmers did not even try to apply for one of the subsidized loans, many of them with the firm belief that access without a "shapka," a bribe, was impossible (The World Bank, 1999). The same study reports on fraud in the Naryn region, where scammers charged villagers for support in obtaining a loan without delivering true access to credit (The World Bank, 1999).

All in all, Kyrgyz farmers might not face general quantity rationing, but rather a mix of price, risk and quantity rationing, as the number of credits at affordable rates is limited. In practice, most farmers will not have access to subsidized credits due to the limited number of this credit line, which translates into quantity rationing for this particular credit market. Those farmers who accept high interest rates and satisfy collateral requirements of credits at market conditions are unconstrained. However, for some farmers, the high rates and transaction costs of commercial credits may be unacceptable. Here, internal price rationing takes place, as farmers decide not to borrow at the given market prices and other transaction costs. Some applications for commercial credits are certain to be rejected because of missing collateral, resulting in quantity rationing, i.e. supply-side constraints.

4. Empirical strategy and data

Based on the literature review and the theoretical framework presented above, we established an empirical model as follows: To estimate the relative effect of the demand- and supply-side factors, we conducted a hierarchical regression analysis. This type of regression analysis allows for testing of whether a specific set of independent variables explains a statistically significant amount of variance in a dependent variable after accounting for other variable blocks (Cohen *et al.*, 2002). Firstly, we added the block of individual variables, then the two blocks of demand- and supply-side independent variables. Following the natural process of decision-making, we added demand-side variables at the second stage and then supply-side variables at the third stage. Since the sequence in which the blocks of variables are added matters for the interpretation of the analysis, we conducted a second regression for reasons of robustness testing. In this second regression, supply-side variables entered the model at the second stage, while demand-side variables were added last.

The choice of dependent variables is based on the literature review and the conceptual framework established in Section 2: In terms of dependent variables, the dataset at hand provides us with three variables representing credit demand and credit uptake. First, we used a binary variable if a rural household had ever applied for formal credit (Table 2), i.e. credit from banks, credit unions or the microfinance sector. Second, the dataset includes a variable on whether a household had taken credit in the past 12 months from either formal or informal sources. Third, the dataset specifies the original volume of credit taken within the past 12 months.

Following Binswanger and Sillers (1983), we discerned between explanatory variables of supply- and demand-side restrictions, following the empirical evidence on assumed impact factors in detail, as exhibited in the literature review section and adapted to the specific case of Kyrgyzstan. Finally, the model was complemented by three control variables, namely, gender, age and education, as all of which could influence both demand and supply and thus were not assigned to either the demand or supply side specifically.

Thus, we conducted three series of hierarchical ordinary least squares (OLS) and logit multivariate regression analyses, given as:

Credit uptake	Absolute	Relative*
Ever applied for bank loan or microcredit		
No	1,451	84.61%
Yes	265	15.39%
Of which: did your application ever get rejected?		
No	230	88.80%
Yes	29	11.20%
Loan taken in the past 12 months (0/1)		
No	1,509	86.82%
Yes	229	13.18%
Of which: source of credit		
Microcredit agency	103	44.98%
Commercial bank	57	24.89%
Private person	33	14.41%
Credit union	25	10.92%
Commercial organization	9	3.93%
Other	1	0.04%
Not answered	1	0.04%
Of which: purpose of credit (multiple entries)		
To purchase agricultural machinery and seeds	59	20.00%
To cover the household's current living	48	16.27%
To start business	35	11.86%
To build a house	29	9.83%
To cover expenses of customs (weddings, etc.)	27	9.15%
To pay tuition fees for education	23	7.80%
To pay for healthcare services	10	3.39%
To purchase a house/flat/land plot	5	1.69%
Other purpose	59	20.00%

Table 2.
Credit demand and uptake among the sample population, 2016

$$A_h = \beta_1 I_h + \beta_2 D_h + \beta_3 S_h + \varepsilon_h \quad (1)$$

$$C_h = \beta_1 I_h + \beta_2 D_h + \beta_3 S_h + \varepsilon_h \quad (2)$$

$$L_h = \beta_1 I_h + \beta_2 D_h + \beta_3 S_h + \varepsilon_h \quad (3)$$

The three models differed mostly in terms of the dependent variable. A_h is a binary variable capturing whether or not a household h has ever applied for a formal credit. C_h is a binary variable capturing whether or not a household h has taken a credit during the past 12 months; L_h is the original sum of the loan taken by household h within the past 12 months. Each of these independent variables features a different step in the decision-making process of borrowers, as depicted in Table 1, and thus allows us to differentiate between underlying reasons for credit constraints.

For each of these regressions, we introduced three sets of explanatory variables. First, we introduced I_h, a vector of control variables describing gender, age and education of the household member that makes decisions about household finances and credits. The definition of the decision makers was based on self-stated decision-making processes inside the household.

Second, a set of demand-side variables D_h of household h entered the regression. This vector includes the self-assessed risk aversion of the decision maker on a ten-point scale. Furthermore, it includes the incidence of a drought shock experienced by the household during the past year and during 2013, which captures the risk of economic losses and thus the risk of inability to

repay a loan. The scale is based on a shock index drawing on a list of 28 different shocks, including environmental shocks (e.g. frost, drought), individual shocks (e.g. illness or death of the major breadwinner) or various market shocks with financial consequences (e.g. border closures for goods, land disputes). For a complete list of shock items, see Appendix. A principal component analysis (PCA) was used to reduce the dimensionality at the same time, minimizing information loss (e.g. compiling all 28 different shock items into one index). PCA or factor analysis has been widely used to generate statistical weights in index generation, especially within development economics (see, e.g. Filmer and Pritchett, 2001). Similarly, PCA has been used to generate resilience and vulnerability indices in various studies (Asmamaw *et al.*, 2019; Borja-Vega and La Fuente, 2013). For generating our composite risk index, we utilized the first principal component of the full set of 28 binary variables representing the incidence of the most frequent production risks. Thus, we identified the linear combination of those variables with maximum variance, assuming that a high variance in risk represents high production uncertainty. Finally, the vector included a variable for the reception of remittances from a household member as a proxy of access to informal credit. To avoid reverse causality, this block of variables originated from earlier waves of the survey, thus introducing a time lag.

Third, the regression included a vector of assets, S_h, of supply-side factors. First, this vector included three variables proxying the collateral of a household. The first collateral proxy is house ownership as a binary variable. The second collateral proxy is land holdings in hectares. Two further supply-side variables are a binary variable on the existence of a credit agency branch in the community, to represent physical access to a financial institution, and membership in a local borrowing group. For the third model, a binary variable for commercial banks was added, for which caps on loan sizes are distinctly different from other lenders. All computations were conducted with the software STATA, version 16.

For conducting our analysis, we employed a dataset based on the "Life in Kyrgyzstan" study. LIK is an open access, longitudinal survey of 8,000 individuals in 3,000 households. Due to a stratified two-stage random sampling in all seven Kyrgyz oblasts, as well as the cities of Bishkek and Osh, the data are representative at the national and regional level (East, West, North and South). The survey was first conducted in 2010; credit items are included since 2012 (Brück *et al.*, 2014). For this paper, we made use of the time-series character of the survey: While we were interested in credit decisions in 2016, we employed many time-lagged indicators from earlier waves of the survey to avoid endogeneity issues and to allow for causal inference.

The 2016 wave also covers credit behavior and some more detailed agricultural data. The 2013 and 2012 waves provide the data for most time-lagged dependent and control variables. After compiling the different waves, there are 1,738 rural households for which we have valid observations from both 2016 and time-lagged variables from earlier waves for credit uptake and credit volume and 1,715 observations for credit applications.

Table 2 provides a few descriptive statistics on the credit demand of the sample households in 2016. In total, 265 of the sample households stated they had applied for a loan at a microfinance agency, bank or credit union during or before 2016, i.e. they had applied for a loan in the formal sector. Among those 265 households, 88.8% succeeded with each of their applications, which is an indicator that a large share of the selection took place before the actual application. Furthermore, 230 sample households (13%) had taken a loan or bank credit during the past 12 months, this time including both the formal and informal sector, which explains the relatively high number of uptake, as compared to the 265 households that took a formal credit at least once in an undefined time period [2]. With a share of 45%, the most frequent lenders were microcredit agencies, followed by commercial banks (25%), private lenders (14%) and credit unions (11%). Among the most frequent purposes for taking credit was the purchase of agricultural machinery (20%), covering current household consumption (16%) and funding business launches (12%).

Following the study design by Verteramo Chui *et al.* (2014), the sample can, thus, be disaggregated into the following groups: 1,451 households reported having never applied for a loan. These households might be either price rationed (i.e. deterred from applying for a loan due to a high interest rate); risk rationed (deterred from applying for a loan due to high collateral requirements and/or the fear of losing this collateral); or quantity rationed (i.e. deterred from applying for a loan, knowing they would be denied the loan anyway). Among these three groups, only the quantity-rationed group would be restricted from the supply side. Among the 265 households that reported to have ever taken a formal loan, 29 household reported a rejected application. At least 29 households were thus truly quantity constrained, suffering from credit rationing, as defined by Turvey and Weersink (1997).

Summary statistics on model variables are given in Table 3. As mentioned above, 15% of the households filed a loan application, and 13% took up a credit. The mean loan volume taken by sample households was KGS86,082 (US$1,235). About 26% of the decision makers were female, the rest male. The average age of the decision maker was 54 years; 13% had a higher education degree. Overall, 28% of the respondents can be labeled as risk-averse, defined by a score of 0–4 on an 11-level scale. On a PCA-based shock scale ranging from 0 to 1, the average household scored 0.6 in 2016 and 0.12 in 2013. Further, 12% of the households received remittances from relatives working abroad or outside their hometown. And, 84% of the sample households owned their house, a pattern that is typical for rural areas. The mean size of owned land was 0.84 ha, or 0.96 ha when not taking households with zero own land holdings into account. These low average land holdings are a consequence of agricultural restructuring during the past decades (Mogilevskii *et al.*, 2017). Nearly 50% of the sample households had access to a credit agency in their community, but only 1.7% were organized in a borrowing group. In addition, 25% of the credits taken in the past 12 months had been allocated by a commercial bank.

5. Results

Table 4 displays the results from our three estimation models introduced above. Marginal effects for the probit regressions are presented in Table 5. For continuous or categorical variables, marginal effects are reported for changes from the mean of sample observations.

Table 3. Summary statistics model variables

Variable	Obs.	Unique	Mean	Min	Max	Label
Application	1,715	2	0.154	0	1	Ever applied for bank loan or microcredit (0/1)
Takeup	1,738	2	0.132	0	1	Commercial loan taken in the past 12 months (0/1)
Volume	229	36	76,320.840	2,000	880,000	Amount of loan taken (in KGS)
Gender	1,738	2	0.264	0	1	Female decision maker (0/1)
Age	1,738	71	53.840	19	89	Age decision maker (in years)
Education	1,738	2	0.128	0	1	University degree decision maker (0/1)
Riskaversion	1,738	2	0.279	0	1	Risk aversion (0/1)
Shock2016	1,738	456	0.062	0	1	Shock score in 2016 (0/1)
Shock2013	1,738	506	0.118	0	1	Shock score in 2013 (0/1)
Remittances	1,738	2	0.121	0	1	Remittances (0/1)
Realestate	1,738	2	0.868	0	1	House ownership (t–1)
Land	1,738	393	0.843	0	28.95	Land in ha (t–1)
Creditagency	1,738	2	0.482	0	1	Local credit agency (0/1)
Borrowinggroup	1,738	2	0.017	0	1	Member borrowing group (0/1)
Commercialbank	1,738	2	0.033	0	1	Commercial bank (0/1)

	(1) Application		(2) Takeup		(3) Volume	
Main						
CONTROL						
Gender	−0.231	(−1.91)	−0.0199	(−0.25)	−0.0211	(−0.15)
Age^2	0.0000742*	(2.13)	0.0000135	(0.45)	−0.0000481	(−0.96)
Education	0.164	(1.02)	0.183	(1.43)	0.324	(1.68)
DEMAND						
Riskaversion	−0.411*	(−2.55)	−0.0943	(−0.71)	0.00568	(0.03)
Shock2016	−2.823**	(−2.92)	−1.866**	(−2.60)	−0.677	(−0.60)
Shock2013	1.325*	(2.15)	0.984*	(2.40)	−0.149	(−0.40)
Remittances	0.342*	(2.05)	0.281*	(2.30)	0.206	(1.31)
SUPPLY						
Realestate	−0.124	(−0.41)	0.108	(0.57)	0.690**	(3.18)
Land	0.0145	(0.49)	0.0561**	(3.17)	0.0647***	(5.34)
Creditagency	0.144	(0.61)	0.146	(1.07)	−0.226	(−1.37)
Borrowinggroup	0.582	(1.54)	0.875*	(2.52)	0.454*	(2.54)
Commercialbank					0.797***	(5.72)
Constant	−1.179***	(−3.40)	−1.456***	(−6.59)	10.06***	(34.92)
Observations	1,715		1,738		229	

Note(s): t statistics in parentheses; $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$

Table 4. Regression results (probit/OLS regression)

	(1) Margin1		(2) Margin2	
CONTROL				
Gender	−0.0513	(−1.83)	−0.00407	(−0.25)
Age^2	0.0000164	(2.03)	0.00000276	(0.45)
Education	0.0363	(1.02)	0.0374	(1.43)
DEMAND				
Riskaversion	−0.0911	(−2.54)	−0.0193	(−0.71)
Shock2016	−0.626	(−2.56)	−0.382	(−2.49)
Shock2013	0.294	(2.07)	0.201	(2.41)
Remittances	0.0758	(1.89)	0.0575	(2.22)
SUPPLY				
Realestate	−0.0275	(−0.41)	0.0221	(0.57)
Land	0.00321	(0.50)	0.0115	(3.17)
Creditagency	0.0319	(0.61)	0.0298	(1.06)
Borrowinggroup	0.129	(1.46)	0.179	(2.49)
Observations	1,715		1,738	

Table 5. Marginal effects, probit regression (Models 1 and 2)

The first model estimates the impact of a set of variables on the application decisions of the sample farmers. Among our variables of interest, we found demand-side variables to be mostly relevant for credit application and uptake: Both risk aversion and external shock events in the same year had apparently deterred credit application, with both regression coefficients being negative and statistically significant. While risk-averse decision makers were less likely to apply for a credit by nine percentage points (p.p.), a unit change of the shock

score decreased the odds of applying for a credit by 63 p.p. These findings suggest that past risk experience or being uncomfortable with risk deterred farm households from taking another risk in the form of potential credit defaults.

Model 2 features results for credit uptake within the past 12 months. While risk aversion was not statistically significant, recent shocks did significantly decrease credit uptake: A decimal change in the 2016 shock score decreased the odds of credit uptake within the 12-month period by 38 p.p. Apparently, recent shocks put farm households into a worse position to receive or take up a credit, either due to self-selection following perceived high risk of a further shock in the format of a credit default or due to low credit-worthiness in the eyes of the bank.

On the other hand, shocks (as defined in Section 4) in the previous 2013 wave and remittances by family members were found to be positively correlated with past credit applications as well as credit uptake within a 12-month period. A decimal change in 2013 shocks was related to higher odds of a household applying for a credit by 29 p.p., while it increased the probability of taking up a credit within a 12-month period by 20 p.p. This finding can be interpreted in the following way: More distant shocks, after a period of informal risk-coping, led to increased efforts into either *ex ante* risk mitigation measures to be safeguarded from future risks, or the need for taking credit to reinvest to make up for past losses. Family remittances increased the probability of credit application by 8 p.p. and credit uptake by 6 p.p. The positive effect of remittances may be explained by the possible function of remittances in increasing the ability of households to meet the monthly repayments, thus decreasing the risk of credit default and loss of collateral for the household.

While supply-side factors were not correlated with credit applications, we found a significant positive correlation between credit uptake and land ownership as well as membership in borrowing groups. Land ownership increased the likeliness of credit uptake by 1.2 p.p. per ha, while a membership in a borrowing group increased the probability of uptake by 18 p.p.

Supply-side variables seemed to be much stronger at play in terms of credit volume. Since Model 3 features a linear regression, regression coefficients in Table 4 can be used as a basis of interpretation: Here, we found that both house and land ownership in 2013 were statistically significantly correlated with credit volume in 2016, very likely due to their function as collateral. With house ownership, the credit volume increased by 69%, and with each hectare of land ownership by 6.5%. At the same time, membership in a borrowing group significantly increased the credit volume by 45%. Finally, in cases in which the credit was given by a commercial bank, credit volume was higher by 80%, clearly since most other lenders typically award only small credits.

Tables 6–8 illustrate the explanatory power added by the three blocks of variables for Models 1–3. For Model 1 (Table 6), the higher increase in explanatory power for credit

Table 6. Hierarchical regression, Model 1

Variable group	R^2	F(df)	P	R^2 change	F(df) change	P
Default sequence						
Controls	0.007	1.534 (3,114)	0.21			
Demand	0.041	3.368 (6,114)	0.004	0.034	1.348 (3,114)	0.263
Supply	0.053	2.349 (11,114)	0.012	0.012	0.289 (5,114)	0.918
Reverse sequence						
Controls	0.007	1.534 (3,114)	0.210			
Supply	0.022	1.767 (8,114)	0.091	0.015	0.356 (5,114)	0.878
Demand	0.053	2.349 (11,114)	0.012	0.031	1.235 (3,114)	0.300

applications was introduced by the block of demand-side variables, reflected by a change in R^2 of 0.034. The addition of supply-side variables meanwhile only contributed to an R^2 change of 0.012. This observation is robust to a reversal of the sequence, according to which the two blocks entered the regression: Even if demand-side variables enter the regression last, they still generate a higher R^2 change (0.031) than the supply-side variables (0.015). The contribution of individual control factors was low, even though this block entered the regression first. These results indicate that, in fact, true self-selection driven by an intrinsic demand for credit or investment may indeed play an equally important role as self-selection motivated by credit-rationing.

For the second model (Table 6), the uptake of credit was explained both by demand-side variables (R^2 delta: 0.015) and supply-side variables (R^2 delta: 0.019) to a near equal degree. When the sequence was changed, the supply-side variables' contribution power was higher (R^2 delta: 0.022) than that of demand-side variables (R^2 delta: 0.011). Again, individual factors were negligible.

In Model 3 (Table 8), the balance of explanatory power changed. As illustrated by the R^2 change, supply-side variables (R^2 delta: 0.188) contributed more strongly to explaining the size of loans than individual or demand-side variables (R^2 delta: 0.021). When supply-side variables entered the regression first, this balance shifted even more to the side of supply-side variables, contributing to a 0.196-point R^2 change, while demand-side and individual factors contributed minimally or not at all.

6. Discussion

Overall, both the number and volume of rural and agricultural credits in Kyrgyzstan have increased over the past years. However, our data reveal that credit markets of

Variable group	R^2	F(df)	P	R^2 change	F(df) change	P
Default sequence						
Controls	0.002	0.674 (3,114)	0.570			
Demand	0.016	3.077 (6,114)	0.008	0.015	0.566 (3,114)	0.638
Supply	0.035	3.548 (11,114)	0.000	0.019	0.445 (5,114)	0.816
Reverse sequence						
Controls	0.002	0.674 (3,114)	0.570			
Supply	0.024	3.192 (8,114)	0.003	0.022	0.514 (5,114)	0.765
Demand	0.035	3.548 (11,114)	0.000	0.011	0.452 (3,114)	0.716

Table 7. Hierarchical regression, Model 2

Variable group	R^2	F(df)	P	R^2 change	F(df) change	P
Default sequence						
Controls	0.005	0.586 (3.61)	0.627			
Demand	0.026	1.744 (6.61)	0.126	0.021	0.433 (3.61)	0.730
Supply	0.214	8.112 (12.61)	0.000	0.188	2.430 (6.61)	0.036
Reverse sequence						
Controls	0.005	0.586 (3.61)	0.627			
Supply	0.201	9.797 (9.61)	0.000	0.196	2.487 (6.61)	0.032
Demand	0.214	8.112 (12.61)	0.000	0.013	0.339 (3.61)	0.797

Table 8. Hierarchical regression, Model 3

larger loans, which are ultimately required to achieve higher agricultural productivity, are apparently underdeveloped. Very few rural households in our sample applied for or took up a larger investment credit. Regression results along a dataset of 1,738 rural households confirm that the application for formal credits was to a large degree driven by demand-side factors, in particular individual risk perception, external shocks and remittances from family members. Here, the risk of credit default and loss of collateral apparently made potential applicants refrain from applying for a formal loan, i.e. they risk rationed. In terms of uptake of both formal and informal credits, demand-side variables still had a considerable impact, even though supply-side variables had a stronger influence than just credit applications. Supply-side factors, both in terms of real credit constraints and screening of collateral, had the strongest impact on the size of loans. The volume of credits taken were only to a very minor degree impacted by demand-side or individual factors.

These findings challenge the narrative of quantity rationing as the main factor leading to credit constraints in transition economies like Kyrgyzstan. Our data show an increasing market for smaller credits, which is regulated mostly via demand – in other words, the individual willingness to take the risk of losing collateral or reputation. The relative dominance of risk-related factors points toward a high incidence of risk rationing, which is in line with empirical findings by Boucher *et al.* (2008) and Verteramo Chui *et al.* (2014). Meanwhile, our results disagree with studies like Saqib *et al.* (2016), which have found a positive impact of risk aversion and risk perception on credit uptake. The latter finding might be related to the developmental character of the featured credit program and the related lower risk of credit default, conditions under which credit lines can serve as an *ex ante* risk mitigation instrument.

The positive effect of remittances and borrowing groups on credit uptake indicates their importance as an instrument of risk sharing between market actors. When confronted with systemic risks like climate risks or economic fluctuations, these provisional risk management constructs, however, may not be sufficient to mitigate the effects. Households having recent experience with such financial shocks will continue to have a low demand for agricultural credits until more effective tools for risk management are created. Therefore, for transition economies like Kyrgyzstan, the introduction of additional risk-sharing instruments is highly recommended. Improved access to agricultural insurance especially, which is not yet developed in the country, may allow smallholder producers to invest in the modernization of agricultural production.

Our paper provides novel evidence on demand-side factors inhibiting credit uptake and investment in rural areas. Future research should put a more in-depth focus on the role of income volatility, which may influence both supply and demand rationing, but was beyond the scope of this study. Furthermore, the study was limited by the structure of the dataset at hand. Future analyses of the complex nature of decision-making processes in credit uptake would profit from a more specialized dataset, which, however, does not exist at the moment. Finally, our insights are limited by the relatively short time horizon covered by specialized credit modules of the survey. Future waves of the LIK dataset will enable the generation of panel data also with respect to credit uptake, and thus allow for a more nuanced analysis.

Notes

1. A complete overview of various definitions is e.g. provided by Jaffee and Stiglitz (1990).
2. Please note the different reporting periods of the two variables ("in the last 12 months" vs "ever").

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Appendix

PCA shock index

H701 – During the past 12 months, has your household been affected by the following shocks?

(1) Drought
(2) Too much rain or flooding
(3) Very cold winter
(4) Frosts
(5) Earthquakes
(6) Landslides
(7) Pest or diseases (crops or livestock)
(8) Fire
(9) Insufficient water supply for farming or gardening
(10) Political instability
(11) Theft of assets (cash, crops, livestock)
(12) Destruction of assets (housing, car)
(13) Inability to sell agricultural and other products
(14) Loss of job
(15) Sharp fall of remittances from abroad
(16) Death of a major breadwinner
(17) Death of another household member
(18) Death of close relative, non-member of household
(19) Illness of a major breadwinner
(20) Illness of another household member
(21) Divorce
(22) Disputes on land issues
(23) Accident
(24) Insufficient energy supply
(25) Increased violence in the neighborhood
(26) Border closure for people and goods
(27) Displacement
(28) Other

Source: *Panel survey "Life in Kyrgyzstan,"* 2016

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