Business and financial risks of small farm households in China

Calum G. Turvey

*Department of Applied Economics and Management, Cornell University,
Ithaca, New York, USA, and*

Rong Kong

*College of Economics and Management, Northwest A&F University,
Xianyang, People's Republic of China*

Abstract

Purpose – The purpose of this paper is to investigate the relationships between business risks and credit choices of 400 farm households surveyed in Shaanxi province in October 2007 in the Yangling district. More specifically, this paper investigates whether or not rural farm households in China balance business risks from agricultural production with financial risk from the use of debt.

Design/methodology/approach – The data were collected through a survey of 400 farm households in Shaanxi province conducted in October 2007. Four separate regressions are run using a credit measure as the dependent variable and measures of profitability, risk, risk aversion, and demography, and debt source (formal versus informal lending) as independent variables.

Findings – The model shows evidence of risk balancing. That is, there is strong evidence that Chinese farmers reduce credit use and financial risk, as business risks increase.

Practical implications – The results suggest that Chinese policy makers could encourage the use of finacial leverage and prudent debt use by offering risk reducing programs such as crop insurance, weather insurance, or price insurance.

Originality/value – This paper uses a unique survey form to collect production risk data as well as gather information on credit use and sources. Data were collected so that risk measures could easily be computed using a triangular distribution. Furthermore, this is believed to be the first empirical validation of the risk balancing hypothesis.

Keywords Credit, China, Loans, Rural economies, Risk management, Agriculture

Paper type Research paper

Introduction

Rural finance in China is comprised of a mix between informal lending between friends and relatives or by moneylenders and a formal sector operating primarily through Rural Credit Corporations and to a lesser extent commercial banks. Wide spread credit rationing by the formal market is partly to blame for informal activities and credit

rationing is particularly harsh on the poorer farm households who hold neither collateral in balance, or means to protect against crop loss or market price fluctuations. It is posited in theory that there exists a risk balancing between the business risks faced by the farm and the amount of credit it can obtain. More specifically, an increase in business risk has an inverse relationship with the optimum amount of debt held by the farmer. Optimality in this context refers to credit choices made by the farmer. Sub-optimal credit choices, that are a choice of credit that cannot reasonably be managed without default, will likely be rationed by the lender but in addition to this the lender may ration credit below optimality. This paper investigates the relationships between business risks and credit choices of 400 farm households surveyed in Shaanxi province in October 2007 in the Yangling district. Triangular estimates of business (yield, price and revenue) risk will be correlated with farmers' credit choices under the null that the greater the business risk the lower will be the amount of debt held by the farmer from all (formal and informal) sectors; that farmers with higher business risks will be more likely to borrow from friends or relatives; and external credit rationing by formal lenders will be higher for high-risk farms.

The significance of this paper goes beyond its factual findings. The strength of China's rural economy will ultimately determine the growth pattern of China's overall economy (Rozelle *et al.*, 2002; Yao, 2002). The ability to leverage growth away from persistent poverty is one of the key elements of development policy and if as we find, risk constrains credit, and credit constrains growth then China's agricultural economy will continue to lag the urban sector and the urban-rural poverty gap moted by Turvey and Kong (2008) will not so easily be resolved.

Background on rural credit in China

Much has been written in recent years regarding rural credit in China, but no formality has been placed on the relationship between risk and lending as we do in this paper. In this section, we review the current state of rural finance in China to place our model in context. This includes the roles of Rural Credit Cooperatives and other formal sources of loans, money lending and informal sources. Being the principal provider of nearly 92 per cent of formal credit in China, Rural Credit Cooperatives have been active since the 1950s. Services span deposits and loans throughout rural China with over 37,000 township centric cooperatives, with over 60,000 staff in 2,500 county RCC unions (Xie, 2003). Regulated and overseen by the Peoples Bank of China, the RCC portfolio makes up about 13 per cent of total savings deposits among all Chinese financial institutions with over 80 per cent from rural households. Nearly, 40 per cent of RCC loans are dedicated towards the agricultural production of crops and livestock, which contrasts with only 8 per cent of loans to agriculture by the Agricultural Bank of China (Xie, 2003). In addition to agricultural loans recent regulatory approvals have allowed for RCCs to issue micro-loans.

In general, research suggests that the effective money demand of Chinese farmers may not be met by the effective money supply through formal markets (Wu and He, 2006). Whether any supply imbalance is imposed by formal credit rationing or a misallocation of financial resources between the urban and rural sector is not entirely clear, but in a model that regressed credit, land and labour against the gross value of agricultural production over the period 1985-2002, the credit elasticity after accounting for time trend was about 0.19 and 0.585 in normal terms. In other words, a 1 per cent

increase in the use of credit by Chinese farmers could increase output by somewhere between 0.19 and 0.585 per cent. Consequently, farmers are highly reliant on informal types of finance and this aspect of credit cannot easily be ignored.

Credit supply and risk rating in rural China
The current credit regime in China has to some extent been refocused on smaller loans to agriculture, and it was not until 2003 that the Chinese government encouraged the use of foreign and private capital to establish micro-finance institutions (MFI) to provide capital to agriculture. The Peoples Bank of China started to pilot credit-only MFIs in May 2005 (He, 2006a). Interest rates charged on MFI loans were unregulated and ranged from 9.396 to 23.4 per cent for one MFI and 15.66-22.3 per cent (with an average of 20.05 per cent) for another. In comparison, informal credit ranged from 3.5 to 21.6 per cent with a weighted average of 10.53 per cent, while interest rates on RCC loans ranged from 8 to 12 per cent. It is likely that in He's (2006a) case study the informal rate was between friends and family, for he found that the effective rate for pawnshops averaged 42 per cent with a high of 60 per cent.

In He's case study, 60.8 per cent of loans were unsecured and although some engaged in Grameen-type lending, the bulk of the activity was involved in the non-collateral market. Even though the majority of MFI unsecured loans were small and offered at higher than RCC interest rates, in the period between He's case MFI's initiation in April, 2006 and August 2006, 100 per cent of 183 loans made were current.

He (2006b) also conducted a study of farm household micro-lending of RCCs. The role of Rural Credit Cooperatives is fast increasing in rural China and the RCCs are the primary suppliers of micro-credit to farm households. As of 2002, 92.64 per cent of RCCs across China provided micro-credit facilities and 49.98 per cent developed group lending activities. The micro-lending facility is based upon the creditworthiness of the borrower but the micro-loans are made without mortgage or security. The system of credit rating is based upon past credit history and trust. The credit history is based first on the concept of a credit village or a credit township. These are referred to as financial safety zones where each village is rated on any recorded history of payment and default (above 80 per cent of households in village), public order and control of usury. The trust element is based upon a village or county review panel called the Village Credit Committee (VCC). Once credit worthiness is established the borrower is provided a letter of credit which states the credit worthiness and the allowable credit limit. This letter can be tendered at any RCC. The VCC provide input (screens) into individuals' credit worthiness and works to ensure that the loans are used for intended purposes, that borrower households follow best management practices, and encourages repayment of loans. The VCC is an integral part of the system for it is based on the judgment of the VCC whether any individual receives a loan. Since collateral and security are not at issue with RCC micro-loans, the VCC individual recommendation is largely based on trust. Furthermore, while not explicitly mimicking the role of group lending, the VCC screening and monitoring activities provide the requisite social encouragement to repay loans in a timely fashion.

He's (2006b) commentary is in agreement with the specific utility-trust argument that is argued in Turvey and Kong (2008). In particular, the VCC activities promote social responsibility in lending while the incentives for further borrowings encourage repayment. Indeed, He (2003) shows that for Hongze and Laozishan

counties in Jiangsu Province that the RCC micro-credit model is working reasonably well with non-performing loans falling from 24.6 and 17.2 per cent in 2001 to 3.4 and 2.9 per cent in 2006. Interestingly, prior to initiating micro-credit loans in 2001, around 50 per cent of RCCs incurred operating losses from loan portfolios. Since 2001, the losses fell considerably as micro-lending increased. For example, prior to 2001 lending to the poor on an unsecured basis was virtually non existent among RCCs. By 2006, unsecured loans exceeded 90 per cent in He's study area, operating profits increased from 1.4 to 37.4 per cent of business income, and the cost ratio fell from 96.2 to 59.4 per cent. suggesting that lending to the poor on an unsecured basis will result in lower costs of default and higher profit margins. This seems to be consistent with He's (2006b) findings. The results by He are by no means universal and as he suggests not all RCCs are profitable or efficient. Huang and Wen (2006) report on RCCs in Xinyu city that reveal substantial micro-credit losses with default rates increasing from 2.3 per cent in 2001 to 16.4 per cent in 2005.

Credit rationing
Although micro-credit through RCCs has increased substantially between 2001 and 2006, and overall loan performance and profitability has improved, there is still substantial evidence of credit rationing the poor. In a study of farm household demand for credit in Tongren/Guizhou provinces, He and Li (2005) found that 84 per cent of surveyed households ($N = 720$) indicated that they needed loans. The demand increased inversely with income with 87.8 per cent of poor households, 83.9 per cent of middle income households and 77.1 per cent of high-income households demanding credit. Approximately, 1/3rd of households (34.5 per cent) had never received a formal loan. Of this group 22 per cent of high income, 31.2 per cent of middle income and 47.5 per cent of lower income had not received loans. In other words, nearly 50 per cent of the poorer farm households appear to be credit constrained. It is unclear however if credit constrained are linked with home economics for He and Li provide evidence for RCCs that seems to indicate a bias in awarding loans to cooperative members over non-cooperative members. Nonetheless, He and Li provide evidence that not only are large numbers of farm households excluded from formal credit markets entirely, but also of those that received loans nearly 59 per cent state that the loan award was insufficient to meet their total credit needs. It is unclear whether this is a result of biased lending by the RCCs or just prudent lending behaviour for unsecured credit. The credit constraints imposed by formal lenders is most likely prudential in that only 47 per cent of total credit needs were for agricultural or other productive uses while 53 per cent was for private use such as tuition, medical, weddings and funerals, etc. In our context, the incidence of credit rationing is blurred when risk is introduced. Our model suggests that on their own, utility maximizing farmers will reduce their demand for credit as risks increase or farmers are become more risk averse. This is not to say that credit rationing is not prevalent, but that credit choices are as much determined by endogenous risk aversion and production and market uncertainties as well as external influences. Thus, we explicitly ask our respondents whether and to what extent they have been denied credit.

The role of guarantees is by western standards critical to lending. Turvey and Kong (2008) argue that utility and trust are sufficient to encourage repayment of loans and that collateral may not be important when lending to the poor. Only 8.3 per cent of

He and Li's respondents required a mortgage on property leaving 91.7 per cent without collateral. Of this group nearly all (95 per cent) provided no guarantee at all. About 27 per cent of all loans (RCC, family and friends, and money lenders) from respondents were not repaid at maturity. The majority cause was that the farm households simply did not have the cash on hand at the time the loan was due. But such results are masked. That a loan was not repaid at maturity does not mean that it was not repaid at all. For example, 19.6 per cent of RCC loans were not repaid at maturity, yet the default rate on RCC loans in 2006 was only about 3 per cent. In other words because of the sequencing, timing and risk of cash flow in farm households, the inflexibility of terms may be more of contributing factor than unwillingness to repay. In an aspect of our survey which we do not focus on in this paper, we find that 75.4 per cent of 400 farm households moderately or strongly disagree that without collateral the RCC would lend to them because of trust and 86.5 per cent indicate the same for banks (and equivalently money lenders). While a significant number of respondents had been late in repaying a loan to relatives or friends (36 and 26 per cent), only 11.9 per cent reported being late on a payment to an RCC or bank. But this did not translate into loan losses. Repayment was 93.5 per cent on loans to family members, 96.2 per cent on loans from friends, 97.4 per cent repayment to RCC, and 99.7 per cent repayment to banks.

Liang (2003) argues that RCC lending activities may actually be less risky than commercial lending because RCCs impose more restrictive covenants on farmer borrowing than non-farm borrowing. Importantly, Liang makes the argument that the RCCs are very much aware of the high-utility value of money and the need for repeated, cyclical borrowing by farmers. Thus, the long-term sustainability of trade is sufficient reason for farmers to accept whatever restrictions the RCCs impose including prompt repayment. According to a survey in Gaozhou city, Guangzhou province, farm households were sorted by credit class into four groups, namely excellent, good, normal and bad. Certificates were delivered to all groups except the bad group with maximum credit with 8,000 yuan to the excellent group, 5,000 yuan to the good group, and 1,000-3,000 yuan to normal group and found that credit risk is very low generally, with no evidence of differences between the groups. An investigation by Gaozhou RCC in August 2002 showed that over 31 per cent of borrowers out of 61,929 farmer households repaid loans initially and more than 22 per cent of borrowers returned loans ahead of the due date. This suggests that about 47 per cent of borrowers from across the various classes did not repay the loans on schedule, but by the end of 2002, the rate of repayment of micro-credit loans in all RCCs in Gaozhou city was as high as 94. 5 per cent, the rate of default was only 5.5 per cent but it did not indicate those defaulted loans would not be repaid in the future.

Huang and Wen argue that much of this is due to inefficiencies at the RCCs themselves, including collections. They do not seem to insinuate any dishonesty on the part of borrowers. Huang and Wen (2006) provide an interesting anecdote about borrower behaviour and RCC risk rating. They report a situation in which 40.2 per cent of total farmer households (79,687) in Xinyu city received credit certificates while only 9.44 per cent of households were actually worthy of receiving the certificates. An error in lending, perhaps due to insufficient monitoring was no doubt made, but 20-30 per cent of farmer households repaid loans and interests initially, and about 45 per cent of farmer households returned principals and interests on time. About 15 per cent of households altered original borrowing utilizations (restructured the loans), while only 5 per cent of households cheated RCCs and defaulted on purpose.

While Huang and Wen were using this story to illustrate inefficiencies in RCC management, it can also be used to illustrate how Type II error (refusing a loan when the borrower is a good credit risk, see Turvey, 1991) can be made. In this case, thousands of farm households were provided loans when according to the risk rating they should not have. Yet, despite the negative credit rating the vast majority ultimately repaid the loan.

Our study also confirms these findings. When asked if they had available 1,000 RMB who would they pay back first the vast majority said that they would pay back a money lender first (42.1 per cent), RCC second (27 per cent) and banks third (17.6 per cent). Only 11.8 per cent indicated that they would repay friends or relatives first. This could be because the formal lenders would always have a supply of funds with which to make further loans, or it could be because of the formality of contract and obligation. Nonetheless, it appears that this group of 400 Chinese farmers feels more obligated to repaying loans in the formal market even if they would not feel extremely guilty by not repaying the loan.

Informal lending in China

The extent of informal lending in China cannot so easily be measured since many transactions are between friends or relatives rather than through money lenders, yet it is crucial to our analysis. Guo (2006) refers to competition between the formal and informal sector as the financial dual structure that virtually disappeared during the planned economies era. Then central control made interest bearing loans amongst friends and family illegal, but zero interest loans flourished. The opening of the economy in 1979 renewed informal lending but further reforms starting in 1990 forced informal lending underground. Informal lending is therefore difficult to measure and with such caveats in place Guo (2006) place the outstanding balance of informal loans at between 200 and 275 yuan billion in 2002 representing between 14.6 and 20.1 per cent of all rural loans and 22.3 and 29.3 per cent of all RCC loans, results which are consistent with earlier estimates by Feder *et al.* (1990). Guo and He (2006) would agree that the absence of adequate formal finance would lead to an increase in informal finance. The two are imperfect substitutes, but the inadequacy of supply in the former no doubt gives rise to the latter out of necessity. As He and Guo state "the shackle of rural economic development is the scarcity of capital". Informal financing includes free credit (amongst friends), illegal private banks (money lenders), Rotating Savings and Credit Associations, pawn broking, private pooling of funds, private discount, and others. In fact, the prevalence of informal finance is not in dispute. He and Guo cite a number of studies indicating that informal finance for farm households in some provinces range from 24 to 95 per cent of loans outstanding and that in some districts the percentage of informal borrowing is around 70 per cent of farm household's total debt. He and Guo's calculations suggest that the monetary intensity of informal lending to farmers ranges between 1.89 and 2.6 times formal lending, a range which is consistent with the proportions we find in our survey, which is about the same for self-employed labour or privately run enterprises in rural areas. These proportions were higher, in aggregate, than for all loans in china including those in urban areas. Indeed, so prevalent is informal credit in China that He and Guo call for its legitimization and recommend that formal credit to rural areas should recognize the realities of agriculture.

He and Li (2005) provide survey data on informal credit in Tongren/Guizhou provinces. Noting that the break point between "legal" and usury interest rates is 40 per cent, only 19.33 per cent of borrowers from informal lenders knew of rates that were below 40 per cent while 80.67 per cent knew rates to be above 40 and 23.1 per cent knew of usury rates above 100 per cent. These seem to be extreme rates and perhaps linked to local economies. In fact, only 13.5 per cent of farm households actually used informal lending at usury rates above 40 per cent but across the various counties in He and Li's study the variance was high ranging from 1.67 per cent of farm households to 34.17 per cent of farm households. The main reason for accepting loans at usury rates was because no alternative formal finance was available or awarded at the amounts required.

When interpreted together He and Guo, and He and Li suggests, quite strongly that looking towards the informal market as an indicator of credit rationing or credit constraints could be a mistake. Although they do not talk about it, comparing the two studies suggest that in communities in which informal lending is largely between family and friends the low use of formal credit may be because the strength of informal lending actually crowds out RCC activity. It would appear that if the prevalence of "money lenders" is high relative to formal lending then that would be indicative of wide spread credit rationing, whereas a high-prevalence ratio of informal lending between friends and family relative to RCC or other formal loans would indicate something other than credit rationing.

In He and Li, while nearly 55 per cent of respondents obtained 1 or more loans from the RCC, nearly 41 per cent obtained non-usurious loans from family and friends. All told only 5 per cent of loans taken by He and Li's respondents had rates in excess of 22.3 per cent which indicates that for the most part money lenders have been crowded out by RCC lending practices and rates and the use of benevolent friends and relatives. The transition in credit use before and after micro-credit reform in 2001 has also been noted by Huo and Qu (2005) who conducted a longitudinal survey of farmers between 2000 and 2004. They found that in 2000 only 31 per cent of households in their sample ($N = 102$) held commercial debt but by 2003, 61.2 per cent held debt. They also confirm some other findings regarding borrowing activity namely that, borrowing from the Agricultural Bank is minimal (1.29 per cent), Rural Credit Cooperatives moderate (17.2 per cent) while non-usurious informal loans between individuals accounts for 76.6 per cent of all loans. In fact, they find that of informal loans 92.3 per cent required no interest at all with the remaining loans ranging from 39.13 to 60.87 per cent. Interestingly, the authors are quite explicit in acknowledging that amongst this group of surveyed households disputes among friends is virtually non-existent and money lending is too rare to have social consequence. These results seem to suggest, at least through 2003, that there exists an excess demand for credit that is satisfied by neither the commercial lenders nor RCCs. In this community informal lending between friends and family is very common, and this level of activity crowds out the money lenders. It is not entirely clear however whether the borrowing from friends at no or little interest is the cultural norm or whether it is a consequence of credit rationing. Furthermore, it may not be so much that the farmers are credit constrained in the usual sense, but that many of the RCCs in the study area are inefficient and the loan repayment is poor. The authors find that in 25 counties in the north area of Wei River, 65.48 per cent of the county-level credit cooperatives have non-performing loans

exceeding 45.50 per cent of the loan portfolio and a large proportion of the credit cooperatives were already insolvent (in 2003, recall the recovery of the RCCs by 2006 discussed above). Similar results have also been reported by Song and Li (2006) from a survey in Taian city, Shandong province that showed that 107 out of 135 farm households obtained money from informal channels such as borrowing from relatives, friends and money lenders, while only 47 farm households received loans from the RCC. Based on a survey of 140 farmer households in Xinyu city, 82.6 per cent used informal lending most of which occurred between relatives with no interest or lower interest (Huang and Wen, 2006).

The point of this discussion is that when examining issue of credit it is often too simple to assume that credit choices are exogenously determined by supply forces. An analyses is needed that examines the endogenous choices made by farmers with respect to profitability, risk and utility. Furthermore, the unique structure of the Chinese credit market suggests that these choices cannot be made irrespective of supply sources from informal and formal markets. Our theoretical framework and empirical analysis follows.

Model framework

We start with the models of risk balancing as presented by Collins (1985) and Featherstone *et al.* (1988) to represent our notion of risk balancing. The model provides a theoretical look at the optimum amount of debt under conditions of risk and in the presence of risk aversion. We define profitability using the definition of expected equity returns (ROE) as a function of expected returns on assets (ROA), and financial leverage, $\delta = D/E$ and the cost of debt i:

$$E[\text{ROE}] = E[\text{ROA}][\delta + 1] - i\delta. \tag{1}$$

And its variance:

$$\sigma_{\text{ROE}}^2 = \sigma_{\text{ROA}}^2(1 + \delta)^2. \tag{2}$$

The variance of the returns to equity represents the total risk facing the firm. It is broken down into two marginal effects. The first, business risk, is measured by the variability in the return on assets and the second, financial risk represents the incremental increase in the variability of equity returns due to increases in debt relative to equity. We assume that expected utility can be represented by:

$$\text{EU}[\text{ROE}] = (E[\text{ROA}][\delta + 1] - i\delta) - \frac{\alpha}{2}\sigma_{\text{ROA}}^2(1 + \delta)^2, \tag{3}$$

where α represents risk aversion. The derivative of equation (3) with respect to δ is:

$$\frac{\partial \text{EU}}{\partial \delta} = (E[\text{ROA}] - i) - \alpha\sigma_{\text{ROA}}^2(1 + \delta) = 0. \tag{4}$$

And solving for the optimum debt to equity ratio is:

$$\delta^* = \frac{E[\text{ROA}] - i}{\alpha\sigma_{\text{ROA}}^2} - 1. \tag{5}$$

Under this measure the optimum debt is a function of expected profits (and all of its constituent parts), the interest rate, risk aversion and risk. The relevant calculus is given by:

$$\frac{\partial \delta^*}{\partial E[\text{ROA}]} = \frac{1}{\alpha \sigma_{\text{ROA}}^2} > 0, \tag{6}$$

$$\frac{\partial \delta^*}{\partial i} = -\frac{1}{\alpha \sigma_{\text{ROA}}^2} < 0, \tag{7}$$

$$\frac{\partial \delta^*}{\partial \alpha} = -\frac{E[\text{ROA}] - i}{\alpha^2 \sigma_{\text{ROA}}^2} < 0, \tag{8}$$

and:

$$\frac{\partial \delta^*}{\partial \sigma_{\text{ROA}}} = -2\frac{E[\text{ROA}] - i}{\alpha \sigma_{\text{ROA}}^3} < 0. \tag{9}$$

In words, equation (6) states that there is a positive relationship between profitability and use of debt, equation (7) states that the demand for credit will fall as interest rates or the cost of debt rises, equation (8) states that more risk averse individuals will use less debt than less risk averse individuals, and equation (9) states that the more risk faced by the firm the lower will be the use of debt.

The question is, do Chinese farmers behave in a manner that is consistent with this model and framework? To investigate, 400 farm households surveyed in Shaanxi province in October 2007 in the Yangling district. Each household was interviewed by either one or two graduates students from Northwest Agriculture and Forestry University over a three-day period. The students recorded interviewee responses on a paper survey form which was later entered into a database. The survey itself dealt exclusively with financial decision making and risk and was restricted to farm households. Each survey took approximately 20 minutes, and each respondent was given a gift of powdered soap.

The characteristics of these communities are as follows. The average number of years farming was 28 years, and the average farm size is 5 mu (about 5/6th of an acre). On average there are about five people living in each household. Household income averages about $13,147 RMB/year with about 70 per cent of household income coming from farm activities. The average debt per household was 6,973 RMB. The average debt to assets calculated from all borrowing sources and all assets was about 17 per cent.

The model

The main analyses applies the general linear model using a maximum likelihood heteroskedastic robust estimator. In all we present four linear multivariate regressions that differ only in the definition of the dependent variable. The first model relates the independent variable to a simple zero-one (0-1) dependent variable where a 1 is recorded if the farmer holds debt from any formal or informal source and zero otherwise. The purpose of this model is to gauge the relative importance of factors affecting decisions to acquire debt or not. This is a different question to determining the factors that influence

"how much" debt is acquired. We apply the linear model rather than the LOGIT or PROBIT model because our intent is to explain rather than to predict or define propensity in terms of probability. Furthermore, the linear regression results will be consistent in sign and interpretation with regression results from LOGIT and PROBIT[1].

The second model includes as the dependent variable the nominal amount of debt acquired from all sources, including zero values. The third model examines the nominal amount of debt but only for the subsample that had debt greater than zero. The fourth model is similar to the third model except the debt to asset ratio is used rather than debt. This model normalizes farms to account for economies of scale or size.

Independent variables

We define the independent variables into three categories, each designed to capture the effects of business risk, risk aversion, and profitability.

Measuring risk. Our measure of risk is based on the variability of gross revenues for the two major crop enterprises on the farm. In the survey form farmers were asked to identify for each of their two primary enterprises the most pessimistic, most likely and most optimistic prices and yields. Because these are elicited rather than historic they should be viewed as subjective rather than objective measures of risk. For each price and yield the expected revenue was computed as the product of most likely price and most likely yield. The measure of variance was calculated assuming a triangular distribution. The calculation was as follows:

$$\sigma_{P,Y}^2 = \frac{\text{low}^2 + \text{likely}^2 + \text{high}^2 - (\text{low} \times \text{likely}) - (\text{low} \times \text{high}) - (\text{likely} \times \text{high})}{18}. \quad (10)$$

For each enterprise, gross revenue variance is computed as:

$$\sigma_{\text{GR},i}^2 = P^2 \sigma_Y^2 + Y^2 \sigma_P^2, \quad (11)$$

portfolio variance as:

$$\sigma_{\text{GR}}^2 = \sigma_{\text{GR},1}^2 + \sigma_{\text{GR},2}^2. \quad (12)$$

The measure of risk we use is the coefficient of variation computed as:

$$\text{CV} = \frac{\sqrt{\sigma_{\text{GR},1}^2 + \sigma_{\text{GR},2}^2}}{E[P_1]E[Y_1] + E[P_2]E[Y_2]}. \quad (13)$$

Under the theoretical model the use of debt should fall with increased risk. Equation (13) provides a buffer to this because it accounts for two effects. On the one hand, holding portfolio gross revenues constant an increase in risk will increase CV and therefore reduce debt. But as enterprise revenues increase, CV falls. Thus, if revenues increase with risk then the effect of risk should be dampened. However, as the ratio of risk to benefit increases we would expect the amount of debt to fall.

Measures for risk aversion. We do not impute a measure of risk aversion but use a series of questions about risk taking and risk mitigating behaviour that would reflect such attributes. On risk mitigation we asked respondents to rank on a five-point ordinal scale the extent to which they use:

- enterprise diversification;
- geographic or spatial diversification;

- irrigation;
- spreading sales throughout the year;
- forward contracts;
- participation in government programs;
- maintaining financial reserves; and
- investing off-farm.

All of these factors are risk mitigating and are designed to reduce the risk premium. It is therefore hypothesized that each of these factors should lead to an increase in the use of debt.

But attitudes towards risk may also be important. We asked three questions to capture this; Again on a five-point scale, does the respondent take risks in terms of:

(1) new production choices;

(2) new technologies; and

(3) new management practices.

Increasingly positive responses would indicate that the respondent is less risk averse, and hence we would expect in theory that these attributes would lead to an increase in the use of debt.

Measures for profitability. The third factor we are concerned with is expected profitability. We capture some of this in our measure of the coefficient of variation, but in addition we include household income and other household conditions. Specific variables include:

- household income;
- whether livestock is raised;
- number of years in farming;
- proportion of household income from farming;
- land in production (mu);
- number of people residing in household;
- number of children in high school;
- number of children in university; and
- whether there has been a recent and serious illness in the family.

We exclude interest rates because they are biased away from market rates due to the extensive use of informal credit in this group. To capture mixed effects between formal and informal credit we include binary variables for whether the respondent held:

- informal credit (friends and family); and/or
- formal credit (Rural Credit Cooperatives and commercial banks) with other sources of credit being imbedded in the intercept, and to capture aspects of credit risk; and
- whether the respondent had ever been denied a loan.

Finally, we include dummy variables for each of the four villages (holding one to the intercept) to account for any village differences.

Results

The theory suggests that there will be a negative relationship between production risks and debt. We find that this mostly holds true. In Table I, it is found that there is a negative and significant relationship between production risks and the use of debt for both the holding of debt in the portfolio and also the amount of debt held. This does not appear to be the case for the debt to asset ratio, which has a positive and insignificant coefficient for the Portfolio CV variable. We hypothesized that risk mitigation would lead to an increase in debt use but this does not hold to be true. In most cases of enterprise and geographic diversification, irrigation use, the spreading of sales or use of forward sales, government programs and financial reserves. Observationally, we can claim that the majority of coefficients are positive as anticipated but with the exception of government programs for the debt/asset ratio and financial reserves for the nominal amount of debt, none are statistically different from zero. This may be a result of the ordinal measure used, or it may be a result of lack of use, but even so the results do not seem to support the hypothesis at the 10 per cent level or better.

Nor does our measure of risk taking, an indicator of risk aversion, appear to have an affect. In fact, we hypothesized that an increase in willingness to accept risk would lead to the use of more debt. This does not appear to be the case. This is especially true for the dichotomous measure that differentiates those with debt than without. All three coefficients for accepting production risk, technological risk, and new management practices risk are negative, although not different from zero. Setting non-significance aside there appears to be a negative relationship between production risk and credit, but a positive relationship between technological and management risks and credits. This could simply be that production risks are more costly and that taking such risks must be done with prudence. In other words, it is not so much a willingness to accept risk (lower risk aversion) but an increase in risk that is being measured. Technological and managerial risks on the other hand may not be viewed as having huge impacts on revenue generation and production.

Income effects are mixed and do not appear to be significant. This is not to say that income does not influence credit decisions, for indeed that would be a refutable statement; but rather what these results suggest is that the variability in income has a far more influential role in credit decisions than income itself. What is significant is whether livestock is on the farm or not. For the nominal measures of farms with livestock it is found that those with livestock borrow less than those growing cash crops. How long the household has been farming shows no significance in any model. In other words there is no statistical difference in the use of debt between a farmer who has been raising livestock and crops for one versus ten years. There is some evidence, but only measured relative to debt/assets that farm size matters. This may be due to the data. Most farms were of equal size so there may not be enough variability to show significance. Household size matters against the debt/asset measure, but seems not to influence whether the household uses debts or how much. Even so the sign is negative, for the debt/asset measure which on its own suggests that the larger the family the less amount of debt, perhaps because of household labour or household members working outside the farm. Having children in high school appears to influence whether debt is in use. The nominal value of debt, significant at the 14.2 and 12.9 per cent is positive. Whether a child is in college does not seem to affect debt choice. Sickness in the household has a positive and significant affect on whether the household has debt, but

	Expect. sign	Farm has debt		Amount of debt		Amount of debt, borrowers		Debt/asset ratio	
		Coefficients	Wald χ^2 percentage	Coefficients	Wald χ^2 percentage	Coefficients	Wald χ^2 percentage	Coefficients	Wald χ^2 percentage
Intercept	–	0.035	0.769	−12,796.58	0.008	−14,425.40	0.008	−0.358	0.151
Portfolio CV	–	−0.054	0.000	−869.435	0.005	−884.079	0.006	0.426	0.471
Enterprise diversification	+	−0.013	0.287	247.452	0.507	270.139	0.499	0.025	0.341
Geographic diversification	+	0.006	0.580	−532.600	0.227	−625.126	0.193	0.008	0.788
Use irrigation	+	0.015	0.250	447.587	0.306	490.158	0.292	0.000	0.975
Spread sales	+	−0.013	0.208	396.328	0.307	429.748	0.298	−0.008	0.694
Use forward sales	+	0.016	0.126	−279.424	0.409	−323.372	0.377	−0.004	0.860
Government programs	+	0.001	0.953	−274.690	0.546	−190.472	0.708	−0.044	0.049
Maintain financial reserves	+	−0.001	0.928	640.460	0.089	762.959	0.068	0.030	0.207
Hold off-farm investment	+	0.011	0.291	140.428	0.697	105.049	0.788	0.018	0.406
Would accept production risk	+	−0.004	0.837	−458.738	0.293	−479.384	0.288	−0.023	0.530
Would accept technology risk	+	−0.002	0.921	775.851	0.170	551.005	0.356	0.055	0.349

(continued)

Table I.
General linear model estimation

	Expect. sign	Farm has debt		Amount of debt		Amount of debt, borrowers		Debt/asset ratio	
		Coefficients	Wald χ^2 percentage	Coefficients	Wald χ^2 percentage	Coefficients	Wald χ^2 percentage	Coefficients	Wald χ^2 percentage
Would accept management risk	+	−0.015	0.444	592.527	0.309	880.799	0.191	0.034	0.453
Household income	+	0.000	0.112	−0.020	0.673	−0.038	0.482	0.000	0.020
Includes livestock		−0.037	0.577	−3,224.461	0.056	−5,412.336	0.066	−0.016	0.902
Percent income from farming	−	0.074	0.317	−293.899	0.916	−268.381	0.926	−0.101	0.550
Years farming		−0.002	0.126	47.717	0.538	50.252	0.541	−0.003	0.419
Farm size (mu)	+	0.002	0.884	1,276.389	0.159	1,393.857	0.148	0.066	0.074
Household size	+	0.001	0.927	−592.459	0.273	−584.097	0.306	−0.054	0.052
Children in high school	+	0.052	0.039	1,393.363	0.142	1,585.162	0.129	0.048	0.409
Children in college	+	0.034	0.408	−1,297.895	0.345	−1,392.089	0.324	−0.057	0.298
Sickness in family	+	0.094	0.065	−1,948.018	0.141	−1,976.359	0.153	0.022	0.872
Have formal debt		0.446	0.000	9,096.289	0.000	9,355.361	0.000	0.300	0.023
Have informal debt		0.577	0.000	12,872.88	0.000	13,132.95	0.000	0.314	0.028
Have been denied loan	−	0.016	0.740	2,433.765	0.127	2,766.574	0.092	−0.025	0.771
Village 2		0.029	0.615	5,501.885	0.013	6,066.680	0.010	0.329	0.012
Village 3		−0.127	0.051	56.908	0.974	−14.177	0.994	0.115	0.408
Village 4		−0.055	0.313	−196.352	0.886	−86.547	0.953	0.032	0.741

Table I.

oddly it does not appear to have a significant impact on the level of debt. In fact, when considering nominal debt the results suggest at the 14.1 and 15.3 per cent levels to lead to a reduction in debt. On the one hand, the result suggests a major sickness encourages the use of debt, perhaps for medical costs, but on the other hand it suggests that such risks cause aversion and reduce debt use; an obvious contradiction.

It does not appear that a previous denial of loan impacts credit use. In fact, when considering the nominal measures the results suggest that farm households who have been previously denied a loan use more debt than those who have not. This may simply be capturing the loan demand effect; farm households who demand more debt are more likely to have the request denied. This may be explained by the two dummy variables on use of informal versus formal credit. In all cases, the coefficient on informal credit is larger than for formal credit which indicates the magnitude and significance of informal lending. Furthermore, the positive impact on the loan denial variable is most likely capturing the fact that if a loan is denied in the formal market it can be acquired in the informal market.

The remaining variables indicate, in general, that there is no significant difference between the four villages surveyed[2].

Conclusions
Our results provide a unique perspective on the relationship between risk and credit in rural China. A survey of 400 farm households in the Fall or 2007 provide strong support that farmers credit choices are related to enterprise risk and to a weaker extent risk aversion and farm income. The importance of these results is that from an academic point of view the tradeoff between risk and credit offers support for Collins' risk balancing hypothesis. This hypothesis has been supported as mathematical explanation in optimization and simulation models in several aspects of risk choices, but this study is among the first that we are aware that has been able to provide evidence that in fact some form of risk balancing behavior takes place. This is quite significant. Our review of several studies in rural credit shows, in ways that are confirmed by our own survey, that rural credit in China is represented by ubiquitous and ambiguous relationships. The strength of argument that farmers are credit constrained is one aspect of the problem, but this paper sheds new light on the topic by providing evidence that at least part of the choices in the lender-borrower continuum is endogenously determined by price, yield and revenue risks at the farm level. Furthermore, as argued by Feder *et al.* (1990), the separability of consumption and investment decisions within a household may not hold true. The non-separability seems to be supported by our data. The confluence of joint household and production decisions may in fact be a reason why informal credit practices are found to be so strong, and in terms of risk management the spillover of production risk into consumption risk may explain why debt choices are more greatly influenced by variance of income rather than income itself, a proposition that is supported by Jalan and Ravallion (1999).

It remains to be resolved whether low levels of debt are predominantly determined by endogenous risk factors and risk balancing, or supply factors related to rationing. It is not so clear cut. One approach which was suggested within the review was to break out borrower behavior in terms of the propensity of money borrowed from money lenders versus informal borrowing by friends and relatives. In our study,

borrowing from money lenders was insignificant and in all four villages, the local governors told us that there was no usury. We find as other researchers have found that the number of households with no debt is high and of those that do have debt, informal borrowing between family and friends is almost twice that of formal lending. The next step is to determine whether the high rate of informal borrowing is because those households are rationed by the formal market, or whether the informal market crowds out the formal market. One possible explanation for the strength of informal lending may be related to the structure of RCCs. In theory, a member-owned town cooperative would seemingly be in a position to substitute for informal loans, at least those related to production. But the scope is too narrow leaving no formal avenue for consumer loans or even house construction loans. Furthermore, as Xie (2003) points out cooperative farmers may not see the RCC as being of benefit to them, since many operate with negative equity, and for the most part the members have no control over the administration or activities of the cooperative. Our results hint strongly that individuals are trusted more than RCCs perhaps because of this lack of control.

Nonetheless, if Chinese credit policy is to encourage greater use of formal rather than informal credit choices, the evidence of this paper suggests quite strongly that agricultural risks and their relation to variability in farm income weighs heavily into credit choices. Farmers facing higher production risks, balance this business risk by reducing financial risk with lower credit demand. Although our measures of risk aversion were inconclusive, the strength of risk balancing suggests that risk aversion is indeed at play. From an agricultural policy point of view economic efficiency gains can be had with prudential use of credit. If credit use is sub-optimal then policy should be directed towards various forms of risk-reducing programs including, but not limited to crop insurance, weather insurance or price insurance.

Notes

1. The general criticism of a linear model with a 1-0 dependant variable is that unlike LOGIT and PROBIT models the predicted values are not entirely confined to the 0-1 interval. Predicted values can be negative or greater than 1.0. This would be problematic if we were defining, for example, a credit scoring model where the probability of default was being predictive and so defined as a probability was required to be between 0 and 1. But as indicated in the text our task here is not predictive but explanatory in which predicted values in the neighborhood of 0.0 or 1.0 are quite acceptable. See, Turvey (1991) for an illustration of the relationship between the linear probability model, LOGIT and PROBIT.

2. As is often the case with survey data coefficients by endogeneity or other means may be highly collinear. We do not believe that multicollinearity as an explanation for our results. Although we elected to retain non-significant variables in our model so that we could maintain consistency with the theory, a variety of models were actually examined in which variables were removed. There was no indication in the varied models to suggest that removal of one variable over another had caused huge swings in the value of coefficients or a statistical improvement over the models we have presented and discussed.

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Further reading

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About the authors

Calum G. Turvey finished his BSc(agr) and MSc in University of Guelph Canada; PhD in Purdue University USA. He is the W.I. Myers Professor of Agricultural Finance at Cornell University, USA, where he teaches and researches issues in agricultural finance and risk management and is an Editor of *Agricultural Finance Review*. Calum G. Turvey is the corresponding author and can be contacted at: cgt6@cornell.edu

Rong Kong finished his BA, MA and PhD in Northwest Agriculture and Forestry University, People's Republic of China. She is an Associate Professor at College of Economics and Management, Northwest Agriculture and Forestry University, People's Republic of China, where she teaches financial management and accounting and conducts research into the economics of rural enterprise and agriculture.