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Farm credit rationing and government intervention in Poland

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May 2002

Working Paper 02-03

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Acknowledgements

The authors strongly thank Sofia Davidova and Chantal Le Mouël for their comments. The authors also benefited from helpful suggestions received when an earlier draft of the paper was presented in seminar in Imperial College at Wye.

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Abstract

It is widely acknowledged that the farming sector in Poland faces slow restructuring and credit constraints. The paper develops a theoretical model of a rural credit market under uncertainty with a view to explaining farm credit rationing in Poland and its possible consequences on farm restructuring. The optimal behaviour of both parties, farmers and lenders, is developed theoretically in a baseline model. The Poland specificity model incorporates into this baseline model some specificity features of credit market and support policy in Poland: insufficient loanable funds, land's opportunity cost and transaction costs. In a third stage, government intervention is introduced in the form of additional loanable funds, credit subsidies and loan guarantees, and the cost-effectiveness of these policies is analysed. Because of the complexity of the theoretical findings, a numerical application is used to illustrate the findings.

Keywords: Poland, farmers, credit rationing, collateral, land's opportunity cost, transaction costs, credit subsidies, loan guarantees

JEL classification: G2, Q14

Résumé

Grâce à un modèle théorique d'un marché de crédit rural en environnement incertain, le rationnement du crédit auquel font face les exploitants agricoles polonais est expliqué, ainsi que les effets possibles sur la structure des exploitations. Des caractéristiques spécifiques à la Pologne, l'insuffisance de fonds de la part des banquiers, le coût d'opportunité de la terre non nul pour les exploitants et les coûts de transaction positifs sur le marché du crédit, limitent l'accès au crédit des petits exploitants polonais pour un achat de terre ou de nouvelle technologie. Ceci peut en partie expliquer la lente restructuration du secteur agricole polonais. Trois politiques publiques de réduction du rationnement du crédit sont examinées en terme de coût-efficacité : subvention au crédit, garantie de prêt et intervention directe pour augmenter l'offre de prêts. Toutefois aucune préférence ne peut être attribuée à l'une ou l'autre intervention, sans étude préalable sur l'origine du rationnement et sur les caractéristiques des exploitants.

Mots clé: exploitants agricoles, Pologne, rationnement du crédit, collatéral, coût d'opportunité de la terre, coûts de transaction, subventions au crédit, garanties de prêt

Classification JEL: G2, Q14

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1. Introduction

Polish farming is characterised by slow farm restructuring. The main features of the sector are in particular a persistence of small-scale farming and a slow technical change. Contrary to most of the centrally planned countries, Polish agriculture was not fully collectivised under communism. Private farms accounted for the largest part of agricultural area and they were mainly small-scale. When transition started, it was expected that the small-scale farms would start disappearing to the benefit of the emergence of middle-sized farms as it is the case in market economies (Kydd *et al.*, 1997). However this pattern did not occur. Small farms still accounted for the major part in 1996. Between 1988 and 1996, the number of farms increased in both small and large farms groups, while the share of middle-sized farms actually decreased, thus maintaining a polarised farming structure (Davidova *et al.*, 2002). Several studies about productivity of Polish farms agree on the conclusion that small farms are the least productive (Davidova *et al.*, 2002).

Like in the other transition countries, capital is the scarcest production factor and Polish farms face credit constraints (OECD, 1998). Farms use little credit and rely mostly on personal savings (World Bank, 2001). Besides, a persistent credit rationing can be observed, and it concerns mostly small farms (Petrick *et al.*, 2000). Credit rationing is not specific to Poland, but occurs in all transition economies. The main reason put forward to explain credit rationing in former communist countries is that the land market is not well developed yet (OECD, 1998; Swinnen and Gow, 1999). Banks require collateral to secure their loan and land is most frequently used in agricultural credit. If the land market is under-developed, banks cannot value the land or sell it, and therefore they prefer not to lend. Moreover land rights are still often unclear and farmers cannot prove their land ownership. However in Poland, because of the prevalence of private farming under communism, a land market is functioning better than in other transition economies. Therefore, some other explanations for credit rationing should be investigated.

Credit rationing occurs if some farmers have limited access to credit. It can affect the number of individuals who receive a loan. Another form of rationing occurs when all individuals get a loan but some are restricted in the amount they can borrow. When farmers are able to apply for a loan but do not receive it, it is a case of external rationing. This is due to constraints on the supply side of the market, such as insufficient loanable funds. Internal rationing is linked with the demand side and implies that farmers do not apply for a loan although they wish to. Reasons can be that they are not able to meet the terms of the loan or they are discouraged because of high costs they would face during the application process or subsequently. The government can intervene in improving credit access to the rationed farmers. Indirect intervention involves taking measures to reduce transaction costs or increase the supply of funds. Direct intervention mainly takes the form of two schemes, credit subsidies and loan guarantees (Swinnen and Gow, 1999). Credit subsidies are subsidised interest rates. Loan guarantees reduce the amount of collateral provided by a farmer, as the collateral requirement is provided by both the government and the farmer.

The objective of this paper is to explain farm credit rationing in Poland and explore its possible consequences on the farming sector. Section 2 develops the model. In a first stage, a baseline model representing a rural credit market under uncertainty and information asymmetry is described. It has been developed by Latruffe and Fraser (2002) and is only summarised in this paper. A base case numerical illustration is also given in this section. Then in Section 3 the Poland specificity model incorporates into the baseline model insufficient loanable funds, land's opportunity cost and transaction costs. The effects on farmers' access to credit are investigated using the numerical framework of Section 2. Also in this section government intervention is introduced in the form of additional loanable funds, credit subsidies and loan guarantees, and the cost-effectiveness of these policies is analysed. The paper ends with a brief conclusion.

2. The baseline model

2.1. Framework

Farmers apply for a loan to undertake a project giving an uncertain return at the end of the period considered. For simplicity two types of projects are assumed. A safer project might be land purchase in order to extend the farm. A riskier project might be a new technology purchased in order to modernise the farm and is called business project in what follows.[1] The difference between the two projects types lies not only in their riskiness but also in their expected return. Although business projects are riskier, they have a greater expected return.

The farmers can be separated into two size classes: small farmers and large farmers, where the land owned by small farmers is less than by the large farmers, although within each group there is a distribution of actual land owned around some average level. All farmers are risk averse, and they can be separated into two risk aversion classes: low risk aversion farmers and high risk aversion farmers. All farmers have some reservation level $U_0>0$, which represents the opportunity cost of taking out a loan and below which they do not apply. On this basis, smaller farmers have lower reservation levels than larger farmers.

The rural credit market is assumed to be competitive[2], therefore it will be analysed in terms of a representative lender, who is assumed to be risk neutral. She offers loan contracts defined as {r,C}, where r is the interest rate charged and C the collateral required. For simplicity the loan amount L is fixed and the same for all borrowers. The credit transaction takes place over a single period. At the end of the period, if the project's return is sufficient, the farmer repays the loan with the interest, (1+r)L. In case the return is not sufficient, the lender becomes the owner of the farmer's collateral. As it is mostly the case for farm credit, the collateral is land. Its pledging solves the enforcement problem. The lender offers credit for both types of projects. She charges a higher interest rate for business credit than for land credit because of the greater riskiness (and therefore greater probability of default). Both the interest rate and the collateral would be specific to each borrower in the case of full information. However credit markets are typically affected by asymmetric information, where the lender does not know all the characteristics of the borrower. The screening problem arises from adverse selection, when the lender is unable to identify *ex ante* the borrower's type, defined in particular by the size of collateral she can put up. A common screening device is to offer several contracts differing in the collateral requirement and let the

1 Credit is commonly separated this way. In the literature, both types of credit are respectively called residential or housing credit (safe credit), and non-residential or corporate credit (risky credit). See for example Hendershott and Hu (1983).

2 After restructuring of the bank sector, the rural credit market can be assumed to be competitive in Poland (Swinnen and Gow, 1997; World Bank, 2001).

borrowers choose. Therefore, in what follows, in order to induce borrowers to separate according to the collateral requirement, contracts feature interest rates that are inversely related to the collateral requirement. For simplification, only two (low and high) collateral contracts are specified here, and the collateral requirements do not differ from land credit to business credit[3]. Thus the lender offers in total four possible loan contracts, depending on the project type and on the collateral required.

Further assumptions include no transaction costs for the farmers. There is no moral hazard, that is to say the lender is not uninformed about the farmers' behaviour once they get the loan. Therefore there are no monitoring costs for the lender. The opportunity cost of land is zero and the land market is perfectly functioning. It is also assumed that all applicants get a loan (*i.e.* no external rationing).

2.2. Borrowers' optimisation behaviour

Farmers may choose one of the four contracts offered, depending on the characteristics of the contracts, and those of the farmer. The choice of the contract for farmers is influenced by two constraints. They apply for a type of credit (land or business) only if the expected utility is greater than their reservation level, and the type of collateral contract (low collateral or high collateral) chosen depends on the level of collateral they own. To do this they maximise their expected utility (EU), based on the mean-variance form:

$$\text{Max } EU = U\{EY\} + \frac{1}{2}U''\{EY\}\text{VarY}$$

where

U is the increasing and concave utility function including the farmers' relative risk aversion index;

EY and VarY are respectively the farmers' expected income and the variance of the income Y. They are functions of the project's return and riskiness, the interest rate and the collateral requirement. The mathematical expressions can be found in Latruffe and Fraser (2002).

All farmers prefer the contracts with a lower interest rate. What separates the farmers is the constraint of their collateral. Small farmers are forced to consider only the low collateral contract, while large farmers can apply for the high collateral contract.

[3] This assumption is made to keep the model simple. In reality banks require higher collateral for business credit.

Farmers are also segmented for the choice of type of projects, in this case according to their risk aversion. The risk aversion index determines if the expected utility for each contract is greater than the farmer's reservation level. High risk aversion farmers prefer credit for land purchase, while low risk aversion farmers prefer credit for business purchase. The consequent segmentation of farmers is summarised in Table 1.

(Table 1)

For each contract, the number of farmers applying is a decreasing function of the collateral required and of the interest rate:

$$N_{ij} = g(r_{ij},C_j) \text{ with } g'(r_{ij})<0 \text{ and } g'(C_j)<0$$

where

i = land or business, j = low or high collateral.

It reflects the distribution of farmers within each size category, and the fact that a farmer's expected utility relative to the reservation utility is a decreasing function of the interest rate charged.

2.3. Lender's optimisation behaviour

When designing the four contracts, the lender sets the collateral requirements and interest rates that maximise her total expected profit from all the loans, $E\pi_{TOT}$. Her optimisation problem is:

$$\text{Max } E\pi_{TOT} = \sum_{i,j} N_{ij}\, E\pi_{ij}$$

where

N_{ij} is the number of farmers applying for the contract $\{r_{ij},C_j\}$;

$E\pi_{ij} = (1-p_{ij})(1+r_{ij})L + p_{ij}C_j$ is the lender's expected profit for the contract $\{r_{ij},C_j\}$,

where p_{ij} is the borrower's probability of default in repaying the loan.

$E\pi_{ij}$ is expected to be positively influenced by the interest rate and the collateral requirement, but N_{ij} is negatively influenced by both of them. $E\pi_{ij}$ is positively related to the project's expected return, but negatively related to the project's riskiness.

The shape of the total expected profit is given by its derivatives with respect to the collateral requirements and the interest rates. There exist optimal collateral requirements and interest rates that maximise the total expected profit. Increasing the collateral requirement firstly increases the lender's total expected profit since it increases her compensation in case of default ($E\pi_{ij}$ increases). But at some point, a large number of borrowers have dropped out of the market because they have limit to their collateral (N_{ij} decreases). Similarly, increasing the interest rate firstly increases the lender's total expected profit because it increases the repayment ($E\pi_{ij}$ increases). But at some point, a large number of borrowers have dropped out of the market because their expected utility is lower than their reservation level (N_{ij} decreases). The optimal collateral requirements C_j* and the optimal interest rates r_{ij}* are given by the first order conditions of the lender's optimisation problem.

The lender ranks the four loan contracts according to her expected profit per contract $E\pi_{ij}$. The expected profit per high collateral contract is greater than the one per low collateral contract. This is an intuitive result and is based on the wish of the lender to separate the borrowers into the collateral contracts. But the theoretical model does not give an unambiguous conclusion about the ranking by project type. It actually depends on the relative values of each project type's riskiness and expected return. However it is more likely that in reality the expected profit per loan is greater for business credit than for land credit. Such a situation has been for example reported in a Euroconsult and Centre for World Food Studies study (1995) and in a World Bank study (2001), where it is indicated that most Polish banks prefer to lend for a machinery purchase rather than for a land purchase.

2.4. Base case numerical illustration

In order to undertake a numerical analysis of the model it is necessary to specify the functional forms and the parameter values of the model. The functional form of the project's uncertain return and the function representing the impact of changes in the interest rate and collateral requirement on the number of loan applicants are given in the Appendix. Table 10 in the Appendix gives the numerical values of all parameters of the model. Land projects have a coefficient of variation of 10% while it is of 23% for business projects[4]. In addition, business projects have a 20% greater expected return.

[4] The coefficient of variation measures the relative dispersion around the mean. It is defined by the return's standard deviation over its mean. A greater coefficient of variation means a riskier project. High riskiness is characterised by a coefficient of variation between 20% and 30%. See for example Hazell *et al.* (1990).

For the parameters in the applicant function, the numerical values are chosen such that the optimal interest rates and collateral requirements calculated in the baseline case reflect the rural credit market in Poland[5]. These are given in Table 2. The collateral is given as a percentage of the principle L.

(Table 2)

The lender's expected profits for each contract are presented in Table 3. Details of the calculation of the borrower's probability of default are given in the Appendix. As explained earlier, the greatest expected profit is for high collateral and business credit.

(Table 3)

Given the optimal values of interest rates and collateral requirements, the numbers of applicants for each contract in the base case are given in Table 4.

(Table 4)

3. Poland specificity model

3.1. Insufficient loanable funds

Polish banks face a limit in their availability of loanable funds (European Commission, 1998). The main reason, common to other transition countries, is that people's savings in banks are small (World Bank, 2001). Another reason, which is more specific to Poland, is that there were and still are obstacles to foreign direct investment (FDI), often more than in other transition countries (Hyclak and King, 1994; Davidova and Buckwell, 2000).

If the lender faces limited loanable funds, she lends to the most profitable contracts and thus starts rationing the least profitable one. By the ranking of the loan contracts in the baseline model, it has been indicated that the least profitable contract is the one with low collateral requirement and for land credit. Through the borrowers' segmentation in the baseline model (Table 1), it has been shown that this contract is chosen by the small and high risk aversion farmers. Therefore small high risk aversion farmers are rationed.

[5] In 2000, the National Bank of Poland reported average rates charged by the commercial banks from 15.9% to 25.5% (NBP, 2000). A World Bank study of 2001 reports averages of loan-to-value ratios from 80% to 110% (World Bank, 2001: Table 3.6). They are the inverse are the collateral requirements. Even if the true loan terms that exist in rural credit market in Poland are different than the numerical values chosen here, it does not change the general findings of the model. The important point are the relative values.

As they do not get credit for land although they apply for it, this is a case of external credit rationing.

In the base case, the total amount lent is S = N*L. With N=276 and L=10, it follows that S=2760. Therefore, if the lender faces a shortage of 10% in her loanable funds, the amount available is reduced by 276, and therefore the number of applicants satisfied is reduced by 27. As indicated previously, this rationing occurs for the small, high risk aversion farmers, who choose the low collateral contract for land credit, as summarised in Table 5.

(Table 5)

3.2. Opportunity cost of land

There exists a non-zero opportunity cost of land for Polish small farmers due to the specific farm support policy. The agricultural pension, KRUS, is highly subsidised. Individuals' required contributions to KRUS are almost six times as low as contributions to the regular pension system ZUS, for an equal pension size from KRUS and ZUS (World Bank, 2000). This makes the KRUS system more attractive, and since the eligibility requires owning at least one hectare of land during a minimum of 25 years[6], there is a high opportunity cost for the last hectare of land.

Small farmers have an incentive to keep one hectare of land in order to be eligible for the KRUS pension scheme. The pension received does not depend on the farm size or the farmers' income, but is based on the number of contributory years (World Bank, 2000). Therefore the opportunity cost per hectare of land is not a function of the amount of land owned. For simplicity it is called λ, with $\lambda > 0$. This opportunity cost means that for small farmers the value placed on the required collateral, $(C_{low}+\lambda)$, is greater than the one placed by the lender, C_{low}.

Graph 1 depicts the expected utility of a farmer for a reduction in the collateral required with the same interest rate. Since there is no compensation in terms of interest rate decrease, the expected utility is a decreasing function of the collateral requirement. The graph clearly shows that, because of the greater value of the collateral placed by the farmers, $(C_{low}+\lambda)$, the expected utility from applying for a loan might be lower than the

[6] Farmers can receive a KRUS pension at the age of 60 for women and 65 for men if they were eligible for KRUS for a duration of 25 years, or at the age of 55 and 60 respectively if the duration was 30 years (World Bank, 2000).

reservation level U_0, meaning that some small farmers would not apply. As they are discouraged from applying, this is a case of internal credit rationing.

(Graph 1)

Table 6 presents the change in the numbers of applicants in comparison with the base case. The opportunity cost of land is taken as λ=1.43. This value is calculated assuming that small-medium and large farmers can expect to receive respectively a pension of 18.1% and 8.6% of their total income (World Bank, 2001: Table 2)[7].

(Table 6)

3.3. Transaction costs on the rural credit market

The rural credit market in Poland is characterised by non-zero transaction costs faced by the banks in terms of monitoring costs, or faced by farmers mainly in terms of extra fees, paperwork and travel to the banks, especially by the small ones (World Bank, 2001). In Poland, banks face particularly high monitoring costs for small farmers, since the latter are numerous and scattered, and highly fragmented (Directorate for Agriculture, 1998). This makes on-site visits costly for the lender. In return, banks try to discourage small farmers from applying by requiring more paperwork and fees, which increases small farmers' transaction costs. As reasoning about lender's or small farmers' transaction costs gives the same result, here the consequences of the lender's monitoring costs only are analysed.

The lender faces transaction costs when small farmers apply in terms of monitoring costs. It is assumed that the smaller the farmer, that is to say the smaller the collateral, the greater the transaction costs[8].

Thus the transaction costs, TC, are a decreasing function of the low collateral requirement:

$$TC = \varphi(C_{low}) \quad \text{with} \quad \varphi'(C_{low}) < 0.$$

[7] Polish farms, particularly small farms, mostly involve families with several generations. Therefore typical total incomes in farms are derived from different sources such as farm incomes, off-farm incomes and pensions (World Bank, 2000).

[8] This is purely intuitive. Although it is suggested by Miller and Ladman (1983), no studies are available about the relationship between collateral and transaction costs. However several surveys conducted in developing countries report that the lender's transaction costs are a decreasing function of the loan amount (e.g. Adams and Nehman, 1979). With their limit in the collateral they can provide, it is clear that small farmers would apply for a smaller loan than large farmers would, which supports the intuition.

The lender's total expected profit with transaction costs is the total expected profit from the baseline case minus the transaction costs:

$$E\pi_{TOT,TC} = E\pi_{TOT} - \varphi(C_{low}).$$

The first order condition of maximisation of $E\pi_{TOT,TC}$ gives the optimal low collateral requirement $C_{low,TC}$*, which is greater than the one of the baseline case with no transaction costs C_{low}*. This is shown on Graph 2. The lender requires greater collateral for the low collateral contract, in comparison to the case with no transaction costs. As a result, some small farmers cannot apply although they wish to. This is again a case of internal rationing.

(Graph 2)

Table 7 presents the change in the numbers of applicants in comparison with the base case. The transaction costs are taken as a decreasing function of the collateral, with a value of zero for the high collateral requirement and a value of 40% of the loan amount L for the low collateral requirement. Such a figure is reported for developing countries by Adams and Nehman (1979). No studies are available for Poland.

(Table 7)

3.4. Implications

Because of insufficient loanable funds, small farmers may not be able to get credit for land purchase, only large farmers can. This gives an additional insight into the change in the distribution of farms, mainly the increase of the number of large farms, and the decrease of small and medium farms[9]. It should be noted that the increase in the very small farm group mentioned in the introduction incorporates the effects of the highly subsidised agricultural pension scheme, which creates incentives to hold on to small units of land. Insufficient loanable funds may thus be an important reason for the persistence of small-scale farming in Poland, and the creation of a polarised farming structure.

Both land's opportunity cost and transaction costs have the consequence that small farmers do not apply for credit at all. One implication of this is that they do not have

[9] Large farms can buy land from the medium farms fragmenting into small plots, but they mainly do it from the state reserves (World Bank, 2001).

credit for a new technique purchase, although banks are willing to lend for this purpose. Therefore, because of this credit rationing, Polish small farmers have difficulties in modernising their production technology. This might explain the slow technical change, and maybe the low productivity, of small farms in comparison to large farms that have access to both types of credit.

3.5. Credit rationing and government intervention

The Polish government intervenes directly in order to improve access to credit for rationed farmers. The Agency of Restructuring and Modernisation of Agriculture (ARMA) provides credit subsidies and loan guarantees (Swinnen and Gow, 1997). Both may act for farmers to remove a constraint that was previously binding. Credit subsidies may raise a farmer's expected utility above her reservation level so that more high risk aversion farmers are able to apply for land and more low aversion farmers are able to apply for business credit. Loan guarantees mean that more small farmers satisfy the requirement for low collateral contracts, and that more large farmers satisfy the requirement for high collateral contracts. These intervention measures can be included in the function representing the number of applicants:

$$N_{ij} = g(\mu_r r_{ij}, \mu_C C_j) \quad \text{with } 0 \leq \mu_r ,\ \mu_C \leq 1$$

where the impact of μ_r is to reduce the interest rate paid by the farmer, and the impact of μ_C is to share with the farmer the collateral requirement.

As these measures work on the demand side and not the supply side of the credit market, it is clear that they cannot reduce the direct effect on credit rationing of limited loanable funds. However, such indirect intervention is justified if it can be identified that internal rather than external rationing is the problem. The effectiveness of credit subsidies and loan guarantees is thus analysed for the cases of land's opportunity cost and transaction costs, while the expected costs of these policies can also be calculated and compared with the equivalent impact of additional loanable funds on the supply side of the credit market.

The levels of intervention are such that farmers pay 60% of the interest rate in the credit subsidy case, and that they provide 30% of the collateral in the loan guarantee case. Several references report subsidised interest rates from 20% to 50% of the rates charged by the commercial banks in Poland (Swinnen and Gow, 1997; Petrick *et al*., 2000;

World Bank, 2001). Swinnen and Gow (1999) report that loan guarantees from ARMA are up to 80% of the collateral. Table 8 presents the change in the number of applicants for both policy measures.

(Table 8)

The analysis has been done for the case where all farmers benefit from the policy measures. The credit subsidies seem to be more effective in terms of number of additional applicants. But, as pointed out in Latruffe and Fraser (2002), this cannot be treated as a robust finding as the relative effectiveness of the policy measures depends indeed on the population characteristics of borrowers. In particular, the responsiveness of the demand for loans among the population of borrowers was shown to depend both on the distribution of own collateral and on the reservation utility levels among this population. Therefore relative effectiveness cannot be assessed without ambiguity.

However, besides their effectiveness in stimulating new loan applicants, such policies can be assessed in terms of their expected cost. And because only small farmers are affected by the problems of land's opportunity cost and transaction costs, the two policies are treated as targeted specifically at these small farmers. On this basis, the expected total cost of a credit subsidy EB_{μ_r} and of a loan guarantee EB_{μ_C} can be calculated as follows:

$$EB_{\mu_r} = \sum_i N_{i,low}(1 - p_{i,low})(1 - \mu_r) r_{i,low} L$$

$$EB_{\mu_C} = \sum_i N_{i,low} p_{i,low}(1 - \mu_C) C_{low} L$$

where $N_{i,low}$ is the number of small farmer applicants for credit i;

i = land or business.

Once converted to an expected cost per additional applicant (loan) these costs can be compared with each other, as well as with the equivalent expected cost of a direct government intervention to provide additional funds to the lender. This cost is calculated based on the probability of default multiplied by the loan amount L. Table 9 gives the numerical values of the three expected costs per additional loan.

(Table 9)

The results in Table 9 show both a clear cost advantage for the supply-side policy and that, of the two demand-side policies, expected cost per additional loan is substantially lower for the loan guarantee in the case of land's opportunity cost, but only slightly lower in the case of transactions costs. The explanation for this finding lies in the relative effectiveness of the two policies in stimulating for each case new loan applicants as shown in Table 8. But as shown in Latruffe and Fraser (2002) this relative impact can be reversed for different parameters to capture different distributions of the characteristics of the borrower population. It follows that, if the relative effectiveness of the two policies in stimulating new loan applicants was reversed by changes in the characteristics of the population of borrowers, then so would their relative cost-effectiveness.

Moreover, based on this analysis, it is clearly more important to gather additional information to reveal whether credit rationing is primarily originating on the supply-side (internal) or the demand-side (external), and if on the demand-side, then whether this rationing is due to inadequate collateral or loans being too costly. For example, if this information reveals no external rationing, then nothing is achieved by providing additional loan funds as these funds are already sufficient to service all applicants, even though the results in Table 9 suggest this is the least-cost form of intervention. And in the case of internal rationing, this additional information will determine the relative cost-effectiveness of the two demand-side policies and therefore whether intervention should be in the form of a credit subsidy or a loan guarantee.

4. Conclusion

The aim of this paper has been to analyse farm credit rationing in Poland. In Section 2 a framework of a credit market operating under uncertainty was developed, including a modelling of the optimal behaviour of borrowers and lenders. This model was extended in Section 3 to take account of Poland-specific features affecting farmers' access to credit, including the availability of loanable funds as well as the presence of opportunity costs for land as collateral and transactions costs associated with borrowing. This section also examined the operation of three government intervention schemes: a credit subsidy and a loan guarantee to increase demand for credit and direct intervention to increase the supply of funds.

It was shown that because of both the opportunity cost of land and the transactions costs of making loans small farmers have limited access to credit for land purchase as well as for new technique purchase. This gives an additional insight into the slow farm restructuring in Poland. It was also shown that no unambiguous preference between the three schemes for decreasing the number of rationed farmers can be determined on a least-cost basis without additional information regarding both whether the primary source of rationing is on the supply-side or the demand-side of the loans market, and in the case of the demand-side, whether the characteristics of the population of borrowers favours a credit subsidy or a loan guarantee in terms of cost-effectiveness.

It follows that the gathering of such additional information should be a prerequisite to the taking of any specific government action to alleviate credit rationing in Poland.

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Appendix

The project's uncertain return is assumed to have a normal distribution. The specification is as follows:

$$R_i = \theta\gamma L^z$$

where

z>1;

i = land or business;

$Var\theta_{business} > Var\theta_{land} > 0$ and $\gamma_{business} > \gamma_{land} > 0$.

The borrower defaults in repaying the loan when her income is strictly negative, that is to say when the project's return is smaller than the repayment due: $R_i < (1 + r_{ij})L$. In this case the income is –C. Thus there is a threshold $R_{ij}^* = (1 + r_{ij})L$ under which the income is not anymore random as a function of the variable return R_i, but is equal to the fixed value –C. The probability of default in repaying the loan p_{ij} is equal to $F\{R_i < (1 + r_{ij})L\} = F\{R_i < R_{ij}^*\}$. F is the cumulative density function of R_i. Calculating the borrowers' probability of default in repaying the loan involves the Winsorisation of the distribution of the return R_i. It is described in greater detail in Latruffe and Fraser (2002).

The function representing the number of applicants with respect to the interest rate and the collateral requirement is specified as follows:

$$N_{ij} = 150 - 10^{a_r}\left(\mu_r r_{ij}\right)^{x_r} - 10^{a_C}\left(\mu_C C_j\right)^{x_C}$$

where

the parameters a and x characterise the function's "slope" and "curvature", that is to say, the responsiveness of the applicant population to changes in the interest rates and in the collateral requirements;

$\mu_r = \mu_C = 1$ in the case of no intervention;

$\mu_r = 0.6$ and $\mu_C = 1$ in the case of a credit subsidy only;

$\mu_r = 1$ and $\mu_C = 0.3$ in the case of a loan guarantee only.

This function is designed to capture how changes in the interest rates and collateral requirements affect the extent to which the reservation utility and own collateral constraints are binding across the population of borrowers. This impact depends on the population characteristics embodied in the assumed values of the parameters a and x. The numerical values of all parameters of the model are presented in Table 10.

(Table 10)

Table 1: Segmentation of farmers between the four loan contracts

	Small farmers	Large farmers
High risk averse farmers	*Low* collateral *Land* credit	*High* collateral *Land* credit
Low risk averse farmers	*Low* collateral *Business* credit	*High* collateral *Business* credit

Table 2: Optimal interest rates and collateral requirements

	Low collateral	High collateral
Land credit	r = 14.2%	r = 13.0%
Business credit	r = 28.2%	r = 24.7%
	C = 90%	C = 121%

Table 3: Lender's expected profits for each loan contract

$E\pi_{ij}$ for:	Low collateral	High collateral
Land credit	11.32	11.33
Business credit	12.20	12.41

Table 4: Number of applicants per loan contract – Base case

N_{ij} for:	Low collateral	High collateral
Land credit	80	80
Business credit	55	61
Total N	276	

Table 5: Change in the number of applicants satisfied per loan contract in case of insufficient loanable funds

Change for:	Low collateral	High collateral
Land credit	–27	
Business credit		
Change in the total	–27	

Table 6: Change in the number of applicants per loan contract in case of land's opportunity cost

Change in N_{ij} for:	Low collateral	High collateral
Land credit	–28	
Business credit	–27	
Change in total N	–55	

Table 7: Change in the number of applicants per loan contract in case of transaction costs

Change in N_{ij} for:	Low collateral	High collateral
Land credit	–14	
Business credit	–13	
Change in the total N	–27	

Table 8: Change in the numbers of applicants with government intervention

	Credit subsidy		Loan guarantee	
Case of land's opportunity cost				
Change in N_{ij} for:	Low C	High C	Low C	High C
Land	*+7*	*+6*	*+34*	*+8*
Business	*+20*	*+16*	*+34*	*+8*
Change in total N	*+49*		*+84*	
Case of transaction costs				
Change in N_{ij} for:	Low C	High C	Low C	High C
Land	*+7*	*+6*	*+20*	*+8*
Business	*+20*	*+16*	*+20*	*+8*
Change in total N	*+49*		*+56*	

Table 9: Expected costs per additional loan of government intervention to reduce credit rationing

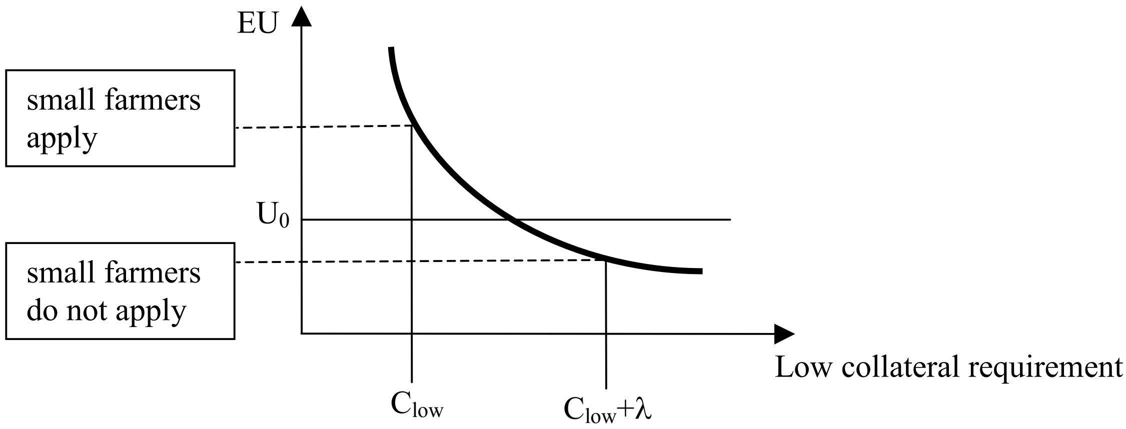
Insufficient funds	Land's opportunity cost		Transaction costs	
	Credit subsidy	Loan guarantee	Credit subsidy	Loan guarantee
0.08	0.76	0.31	0.73	0.64

Table 10: Numerical values of parameters used in the model

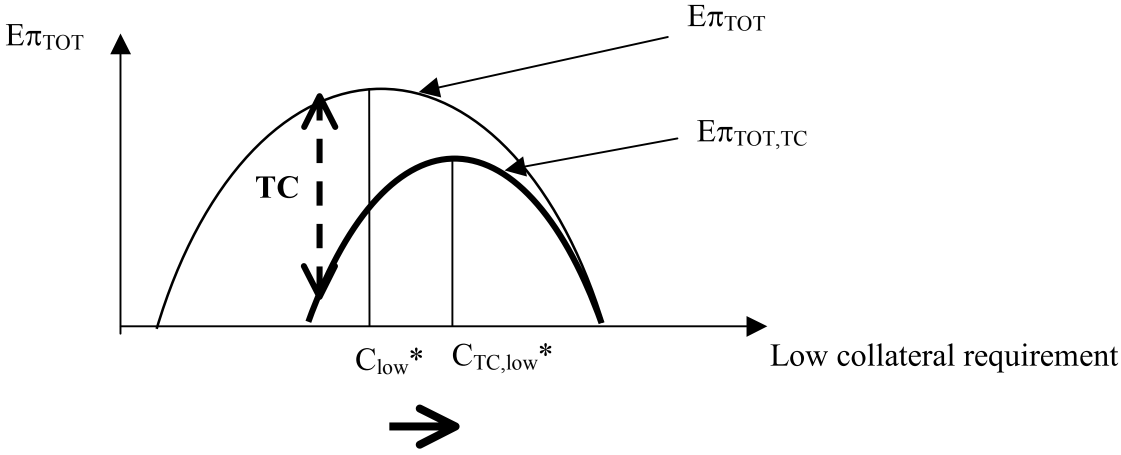
Projects' parameters		Other parameters
$Var\theta_{land} = 0.01$	$Var\theta_{business} = 0.055$	loan amount $L = 10$
$\gamma_{land} = 0.88$	$\gamma_{business} = 1.1$	multiplicative coefficient $z = 1.2$

Applicant function parameters	
$x_r = 1.5$	$a_r = +2.4$
$x_C = 11$	$a_C = –9.7$ for low collateral and $–11$ for high collateral

Graph 1: Opportunity cost of land and small farmers' application for credit



Graph 2: Lender's total expected profit with respect to the low collateral requirement in case of zero and non-zero transaction costs



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