THE DETERMINANTS OF POLISH FARMERS' CREDIT INTEREST RATES

Hedonic price analysis and implications for government policy

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Abstract

Our micro-econometric analysis of agricultural credit market outcomes in Poland sheds new light on the relationship between contractual arrangements and interest rates. An innovative theoretical framework based on a hedonic market model is developed. We interpret the factors that influence interest rates as "quality" components of the credit contract. We use unique data including detailed information about Polish farmers' credit contracts. Both nominal interest rates and bank fees are considered. Results show that banks prefer liquid types of collateral, and care little about the loan's purpose. The effect of government subsidies on interest rates is small compared to the officially declared reduction of the nominal rate.

Keywords

agricultural finance, credit policy, hedonic regression, micro-econometrics, Poland.

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Q 12, Q 14, P 32.

1 Introduction

Credit markets are a prime example for the relevance of complex contractual arrangements. In contrast to spot markets for many agricultural staples, exchange on credit markets happens not simultaneously but involves borrowing now against repayment in a later period. Furthermore, credit transactions are not homogenous but differ with regard to various factors, such as economic return to the investment, time horizon, riskiness, capabilities of the borrower, etc., many of which are difficult to observe (Jaffee and Stiglitz, 1990). The theory of economic institutions has recently paid increasing attention to the contractual hazards that can emerge from such time dependency and unobservable heterogeneity, which include adverse selection, moral hazard, costly state verification, and costly enforcement (for an overview see Freixas and Rochet, 1997: chapter 4). These theoretical insights can explain why observed credit market outcomes are driven by the availability of signalling and screening devices and therefore often depend on elements such as collateral, reputation, or personal characteristics of the borrower.

In agriculture, credit transactions are additionally hampered by small loan sizes, lack of assets that are suitable as collateral, and covariate risks. These factors increase the costs of lending to farm enterprises and may even result in complete unavailability of loans to certain farmers (Barry and Robison, 2001). In many countries governments have therefore intervened in rural credit markets in order to improve farmers' access to credit, for example by granting subsidies or setting up state lending institutions. However, many of these attempts failed. A recent case in point is the transition of agriculture in Central and Eastern Europe, where credit has been regarded as one of the major bottlenecks for development. Many countries in this region uncritically adopted policies that were present in OECD countries, or continued lending practices that were in use prior to transition. As Swinnen and Gow (1999) conclude, these policies frequently neglected the real causes of financing problems but rather tried to cure the symptoms.

Effective policy support to farmers' credit access hence requires a thorough understanding of the factors that influence credit terms for agricultural borrowers *in their specific environment*. Whereas recent theory developments have identified many of the principle problems that influence credit market outcomes, quantitative applications have generally been scarce. This is partly due to the methodological challenges of such an analysis, and partly due to the specific data requirements (Petrick, 2005). Matthews (1986: 917) notes:

"Because economic institutions are complex, they do not lend themselves easily to quantitative measurement. Even in the respects in which they do, the data very often are not routinely collected by national statistical offices. As a result, the statistical approach which has become the bread and butter of applied economics is not straightforwardly applicable."

In this paper, we present a micro-econometric analysis of agricultural credit market outcomes in Poland that attempts to shed new light on the relationship between contractual arrangements and borrowing costs for farmers. In particular, we try to identify and evaluate the factors that influence the cost of agricultural bank loans in Poland, including current government measures. We consider both nominal interest rates and additional transaction costs in the form of bank fees. The empirical results are taken as a basis for discussing alternative policy options aimed at an improvement of farmers' borrowing terms. The previously outlined challenges of such a quantitative analysis are tackled in two ways. First, we develop an innovative theoretical framework based on a hedonic market model, common in consumer research and environmental valuation, from which we derive a reduced-form hedonic equation. We interpret the factors that influence borrowing costs as "quality" components of the credit contract, whose implicit prices are determined by market equilibrium and are not under the control of the individual market participants. Second, we make use of a unique data set that includes detailed information about credit contracts concluded by a sample of Polish farmers in 1999 and 2000. This data set allows us to identify the effect of specific contract and farm characteristics on interest rates.

The plan of the paper is as follows. In Section 2, we present the theoretical framework of the analysis. In Section 3, some background information on agricultural finance in Poland is given. In Section

4, the database is presented. Sections 5 and 6 comprise the estimation approach and its results, and Section 7 concludes.

2 Loan contracts in a hedonic pricing framework

Hedonic prices were initially developed in the empirical literature on quality measurement; recent applications include the analysis of environmental quality and farmland values (Palmquist, 1999). According to Rosen (1974), observed prices of differentiated products are explained by a vector of specific amounts of quality characteristics associated with each good. This hedonic function represents a market equilibrium of prices, since amounts of differentiated commodities offered by sellers are perfectly matched by consumers demanding equal amounts. The hedonic equation results from the market interaction of producers and consumers and thus represents a type of reduced-form equation that is a datum for market participants (Palmquist, 1999).

Baltensperger (1976) transferred this concept to loan markets with a two-characteristic (interest) price function, including size and risk of loans. However, risk is still a rather general indicator, and loans differ in more than two dimensions. In particular, it cannot be taken for granted that lenders know how risky a loan is. An asymmetric distribution of information between borrower and lender usually leads to costly signalling and screening processes. Lenders need to actively sort out borrowers to avoid adverse selection, whereas borrowers have an incentive to signal their quality (Freixas and Rochet, 1997). The bank is interested in devices that limit moral hazard as well as costly state verification and enforcement. Major mechanisms to overcome these problems are collateral provision or abilities and reputation signalled by the borrower (Dowd, 1992). However, also the quality of lenders, such as the efficiency of the bank's management, the abilities of bank officers, as well as the access to funds for refinancing, can be important implicit elements of a contract. Finally, it matters how government intervention affects credit transactions, for example in the form of subsidies offered for certain types of loans.

In the following, we analyse how a specified set of loan attributes affects the equilibrium price of credit in the framework of a hedonic credit market model, by expanding Baltensperger's (1976) approach. This model depicts how interaction between banks and farmers leads to a price equilibrium for credit contracts as a differentiated good. Banks are assumed to control the following components of a credit contract they offer, in response to market information: the credit volume, L, the repayment period, T, and a vector of components, C, that measures the likelihood of default of the specific loan.[1] These are conveniently captured by the "five *C*s of credit": collateral ($C1$), equity capital ($C2$), character of the borrower ($C3$), economic conditions of the borrower ($C4$), and borrowing capacity ($C5$).[2] There are two further loan contract characteristics that assumedly cannot be changed by the bank. First, it is the efficiency of bank management, B, which is unobserved by borrowers. Second, it is the level of government support, G, which is assumed to be a part of the loan contract once the farm complies with official eligibility criteria, such as carrying out certain governmentally sponsored investment projects or starting up a new farm. Eligibility for government support is assumed to be an exogenously given attribute of the farm. The farms also have available a given technology that can process loans of size L and repayment period T, and possess an individually given vector of characteristics C. For the moment, it is assumed that all of the men-

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[1] The use of the term "control" should not be misinterpreted. It means that the bank can change the value of a specific attribute of the loan contract, should the implicit price that can be achieved on the market for this particular attribute change. For example, the bank can control the relative importance that is attached to the likelihood of default in their loan contracts, but they of course cannot, in a substantial way, control the actions of the borrower that might lead to a certain default probability.

[2] A detailed discussion of these five *C*s that links them to the recent theoretical literature on credit markets is given in Greenbaum and Thakor (1995: 214-239).

tioned variables are expressed in positive, real terms. Together they constitute the vector of loan contract characteristics, which determines the price of credit *r* by a hedonic equation,

$$r = r(L, T, C, B, G). \tag{1}$$

On *theoretical* grounds, nothing can be said about the functional form of (1), which may be non-linear (Palmquist, 1999). It is, however, clear that it should be monotonically increasing in *L* and *T*, as far as they make the loan riskier, and decreasing in *C*, *B* and *G*.

Equilibrium formation on a competitive loan market can be modelled as follows.[3] A bank seeks to maximise profits from a single loan by altering the loan characteristics under its control,

$$\max_{L,T,C} \pi^S = r(L,T,C,G,B) - K(L,T,C,G,B,\rho) \text{ subject to } \pi^S \geq 0, \tag{2}$$

where π^S is bank profit on a single loan, *r*(.) is the loan price schedule from equation (1), $K(.)$ is a joint cost function with the usual properties, ρ is a vector of bank-relevant input prices, such as deposit rates and wages of bank officers. Equation (2) yields first-order conditions requiring that the marginal cost of the loan characteristics under the control of the bank be equal to the marginal characteristics prices in the market.

The equilibrium loan price schedule results from credit offers of banks and credit bids of farmers. The bank's offer function ϕ, representing the prices at which the bank would make loan contracts available to farmers, will depend on the characteristics of the loan, the desired profit level $\pi^{S'}$, and the bank-relevant prices,

$$\phi(L,T,C,G,B,\pi^{S'},\rho) = \pi^{S'} + K(L,T,C,G,B,\rho). \tag{3}$$

The partial derivative of the offer function with respect to an endogenous characteristic represents the marginal cost of that characteristic and is assumed to be non-negative for *L* and *T* and non-positive for *C*, because increasing levels in *C* decrease the default risk for the bank. The second partial derivative is also non-negative for *L* and *T* and non-positive for *C*, since it is equal to the slope of the marginal cost function at a profit-maximising equilibrium. An increase in profits increases the offer price by the same amount.

The bank maximises profits by equating the marginal offer prices for the loan characteristics under its control to the marginal prices for these characteristics in the market. The offer price for the exogenous characteristics is equal to the market price, because at a lower offer price, the bank would forego profits, and at a higher offer price, the offer would not be accepted by farmers (see Palmquist, 1989: 25).

On the demand side, we make the simplifying assumption that there are profit maximising farmers who have available a technology that transforms an amount of credit *L*, after a given gestation period *T* and together with other inputs, into outputs. The amount of credit that can be productively used as well as the gestation period are assumed to be exogenous to the farmer, who can only decide about the level of other inputs. The multiple-output, multiple-input technology can be described implicitly as

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[3] The model is inspired by a hedonic land market model due to Palmquist (1989). The standard model of a competitive banking sector that "produces" loan services is described in Freixas and Rochet (1997: 51-57). Due to the widespread use of standardised debt contracts in Poland, there is little scope for bargaining, which supports the assumption of a competitive market.

$$g(x, L, T, \alpha) = 0, \tag{4}$$

where *x* represents the vector of net outputs (if positive, x_i is an output, if negative, it is an input) exclusive of credit, and α denotes a vector of farmer characteristics that influence the production process, such as specific skills.

To study the farmer's behaviour on the credit market, we concentrate on his/her willingness to pay for a single loan contract. We therefore first consider the profit the farmer makes on a given loan, which we call his/her variable profit π^{DV} (analogous to Palmquist, 1989: 24). Variable profit is the difference between the value of output and the value of non-credit inputs. Maximising these profits on a given loan contract yields the following problem,

$$\max_x \pi^{DV} = \sum_i p_i x_i \text{ subject to } g(x, L, T, \alpha) = 0 \text{ and } \pi^{DV} \geq 0. \tag{5}$$

This optimisation problem can be solved for output supply and non-credit input demand functions. These depend on the net output price vector and the technology, but also on the price of credit and therefore on all elements that determine this price according to equation (1), hence $x = x(p, \alpha, L, T, C, G, B)$.[4] Substitution of these functions into equation (5) yields the variable profit function,

$$\pi^{*DV} = \pi^{*DV}(p, \alpha, L, T, C, G, B) = \sum_i p_i x_i(p, \alpha, L, T, C, G, B). \tag{6}$$

By subtracting the farmer's credit costs from these variable profits, the actual profit, π^{*D}, is obtained.[5] A farmer's bid for a particular credit contract will depend on the characteristics of the contract, the prices of outputs and other inputs, the desired profit level, π^D, and the farmer's skills. The bid function can thus be written as

$$\theta(L, T, C, G, B, p, \alpha, \pi^D) = \pi^{*DV}(p, \alpha, L, T, C, G, B) - \pi^D. \tag{7}$$

The loan characteristics enter the bid function in the same manner as fixed factors. The partial derivative of the bid function with respect to the characteristics is hence non-negative for *L* and *T* and non-positive for *C*, *G* and *B*, for example $\partial\theta/\partial L = \partial\pi^{*DV}/\partial L \geq 0$. The second partial derivative of the bid function with respect to a characteristic is non-positive for *L* and *T* and non-negative for *C*, *G* and *B*. The partial derivative of θ with respect to p_j is equal to x_j by the envelope theorem, therefore it is positive for outputs and negative for inputs. The partial derivative of θ with respect to desired profits is –1, since higher profits require a *ceteris paribus* offsetting reduction in the bid (Palmquist, 1989: 25).

The bid function denotes the willingness to pay of the farmer for a credit with specific contractual arrangements, given his/her desired profit level. In equilibrium, the increase of a farmer's bid due to a

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[4] One major difference of the present model with the one offered by Palmquist (1989) is that, apart from the different kind of good considered, only some of its characteristics directly enter the production technology of the farmer. By contrast, all land characteristics considered by Palmquist are directly relevant for production outcomes.

[5] The actual level of credit costs depends on the specific repayment conditions of the credit contract and the level of bank fees. See Section 4.

marginal increase in one of the contract characteristics must equal the increase in the market price for credit contracts as a result of an increase in this particular characteristic. Both banks and farmers take the market price schedule as parametric, but the schedule is determined by the interactions of the two groups. In equilibrium, supplier and demander are perfectly matched when their respective offer and bid functions touch each other, with the common gradient at that point equal to the gradient of the market clearing implicit price function, as given by the hedonic equation (1) (Rosen, 1974: 44). Observations on the hedonic function represent a joint envelope of a family of offer functions and another family of bid functions.[6] This reduced-form hedonic equation relates credit contract characteristics to credit prices. First derivatives of the equation can be interpreted as implicit prices of loan attributes. The subsequent econometric analysis attempts to quantify the importance of the contract characteristics by estimating this equation.

3 Agricultural finance in Poland

In Poland there are two types of lending organizations which specialize in agriculture, namely the Bank for Food Economy (Bank Gospodarki Żywnościowej, BGŻ), and the system of cooperative banks (for an overview see Danilowska, 2004). The BGŻ was the primary channel for financing state-managed agriculture during the socialist period. There were several attempts to comprehensively restructure or liquidate the BGŻ during the 1990s. However, this was successfully blocked, *inter alia* by agricultural lobby groups. Local cooperative banks had often been founded prior to World War II, and existed under the umbrella of the BGŻ during socialism. In 1990, most of them left the BGŻ in order to form regionally-oriented cooperative banking structures. Even so, their reconsolidation remained incomplete. Saturation of urban financial markets and the increasing demand for banking services in rural areas, for example due to the inflow of direct payments under the European Union's (EU) Common Agricultural Policy (CAP), has induced several commercial banks in Poland to compete with the traditional lenders for rural clients.

Previous studies have shown that Polish rural banks generally tend to be quite risk averse, and thereby maintain a low default rate of loans. As reported in Petrick (2004a), banks closely screen farmers and sort out those whose lending history or personal characteristics suggest less than satisfactory loan repayment. Furthermore, credit rationing due to lacking collateral and demographic characteristics is a significant problem in the Polish farm sector (Latruffe, 2004; Petrick, 2004b). It seems therefore useful to investigate to what extent these factors also influence credit costs for farmers who obtain (some) credit.

To foster modernisation and structural change in agriculture,[7] the Polish government launched in 1994 a voluminous farm credit programme, which mainly encompasses interest subsidies granted on operational and investment loans (Petrick, 2004a). Preferential loans are extended through the existing network of banks. In 1999, the year under investigation in this study, subsidies on loans amounted to 1.194 billion złoty (zł) (approximately 288 million USD; OECD, 2000). Excluding expenses for the farmers' social insurance fund, these payments made up 38 percent of the budget of the Ministry of Agriculture and Rural Development (Ministerstwo Rolnictwa i Rozwoju Wsi, MRiRW, 2000; see also Danilowska, 2004).

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[6] The case of quantity rationing can be included as a special case: it means that, for bids involving certain combinations of loan characteristics, in particular large L or T with low levels for C, there is simply no corresponding offer in the market. In line with this argument, Baltensperger (1978: 174) notes that "it is not useful to refer to the fact that a borrower with a given investment project cannot obtain more than a certain amount of credit at the 'market rate of interest,' without increasing his collateral and/or equity, as credit rationing, since it simply means that we are facing a market with heterogeneous goods."

[7] Compared to farms in EU-15 member-states, per capita incomes from Polish agricultural production are quite low (Petrick et al., 2002). A major reason for this is severe structural deficiencies in the farm sector, most notably an unfavorable man/land ratio and low labor productivity levels, which call into question the sector's international competitiveness (Pouliquen, 2001; Latruffe et al., 2004).

Intervention on credit markets can thus be regarded as a major instrument of the Polish government to achieve its political objectives. After accession to the EU, national credit policy has been continued, but is being harmonised with the rural development measures of the CAP.

4 Database

The data source for the analysis in this paper is the "IAMO Poland farm survey 2000", which is a cross-sectional farm survey conducted in the boundaries of the former Szczecin, Tarnów, and Rzeszów voivodships existing prior to the administrative reform of 1. January 1999. The survey was carried out in 2000 and contains data related to the economic outcomes of the years 1997-2000. It is based on a random sample of farms in the database of the official extension service ODR. Further details on sampling issues, organisation of data collection and a reprint of the questionnaire can be found in Petrick (2001).

The specific strength of this database is that it entails detailed information about loans acquired by farmers. In the following econometric analysis we use the information available for the years 1999/2000. This includes relevant data on interest rates, repayment period, lending source, collateral arrangements, etc., but also on bank fees. Fees or provisions are used as instruments in price policy or reflect risk adjustments made by the bank. Bank fees are sometimes charged on a percentage base related to the loan volume (1 per cent p.a. in about 20 per cent of loans taken in 1999/2000, 2 per cent p.a. in about 10 per cent of cases), but fixed amounts not related to the specific loan size are the rule. The particular level of the fee does not depend on the volume or the repayment period of the loan. To obtain a meaningful measure of the price of credit, bank fees have to be combined with nominal interest rates. The problem here is that interest payments are due on a periodical basis (for example annually), whereas fees accrue only once (usually when the loan contract is negotiated). It was however desirable to have a single variable representing the total credit rate in a plausible way. We therefore chose an internal rate of return (IRR) method for computing this variable, following the suggestion in Rojas and Rojas (1997). The idea is to compare the periodical payments of the borrower (consisting of repayment of the principal plus interest) based on the nominal interest rate r^n as given in the loan contract, with the initial amount borrowed, *L*, minus fees, φ. This yields an annual percentage rate denoted *r* that encompasses both the nominal interest rates and fees. For our calculations, we first expressed all fees in Polish złoty.[8] We then computed *r* as the rate at which the discounted value of all periodical payments A_t (based on the nominal interest rate) equals the initial loan volume in złoty minus fixed fees,

$$\sum_{t=1}^{T} A_t (1+r)^{-t} = L - \varphi \,. \tag{8}$$

In this equation, *t* denotes the current period and *T* is the total repayment period of the loan. The relation between the calculated annual percentage rate *r* and the nominal interest rate r^n as negotiated in the loan contract is $r \geq r^n$. Equality is given for $\varphi = 0$ that is to say when there are no fees. It is hence possible to compare the effective interest rates of loans with different repayment periods based on this variable. One important effect of the outlined procedure is that two loans with the same nominal interest rates and the same fixed fee but different repayment periods also differ in their effective interest rate. The loan with the longer repayment period will display a lower effective interest rate – which is a consequence of the fixed cost character of the fee.

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[8] The monetary equivalence is 3.97 zł = 1 USD (in 1999).

For reasons of simplicity, we assumed that interest and principal repayment was made in the form of constant annuity payments throughout the sample.[9] Although some of the recorded loan contracts divert from this rule (for example because interest payments were made in separation from principal repayment), we regard the possible inexactness in the calculation of the effective interest rate as negligible.

Table 1 displays descriptive statistics of the annual loan rate calculated as explained above, as well as the nominal rate, that is to say without accounting for bank fees. Our sample size is 149, which is the number of loans taken in 1999/2000 by the surveyed farmers. The average annual loan rate of the sample is 9.80 per cent, which is 1.2 points lower than the average nominal rate, suggesting non-negligible bank fees for some farmers.

5 Estimating the hedonic equation

The empirical analysis consists of an econometric estimation of equation (1) based on the previously described data. The variable on the left-hand side of (1), the annual loan rate including bank fees, was calculated as described in Section 4 and enters the regression in per cent. Among the right-hand side variables of (1), the five *C*s of credit are partly measured by several variables, which were then numbered consecutively by a second digit. Collateral is included as total land owned by the borrower ($C11$) plus a set of dummy variables indicating whether a certain type of collateral was specified in the loan contract or not ($C12$-$C17$): land, machinery, crops, regular income, compensating balance or no collateral required. The effect of these dummies is measured against a residual group of other types of collateral, which were used only sparsely, for example jewellery or household assets. Equity capital, or leverage, is measured by the volume of interest payments due to loans taken in earlier periods ($C2$). The farmer's characteristics are captured by the years of farm ownership ($C31$) and a dummy indicating whether the farmer had been a client of the same bank previous to the current loan application ($C32$). The economic conditions of the farm are measured by a dummy indicating whether some members of the household had off-farm income ($C4$). The borrower's future debt servicing capacity is included by a set of dummies indicating the purpose of the loan ($C51$-$C54$), namely input, land or machinery purchase, or renovation/extension of buildings. The residual purposes consist mainly of purchase of household assets. Since we had no detailed data on banks' efficiency, we introduced dummy variables for the most common lending institutions: (a) the co-operative banks, (b) the governmentally-owned agricultural sector bank BGŻ, (c) the savings bank PKO and (d) all other banks (which consisted mainly of other commercial banks). We included separate dummies for the first three types of banks ($B1$-$B3$), thus measuring the effect of borrowing from one of these sources vis-à-vis the fourth type. The overall effect of government intervention G is captured by a dummy indicating whether the loan was taken under the government subsidy programme.

All variables L, T, C, B, G are listed in Table 1, together with descriptive statistics. Loans taken by the sample's farmers in 1999/2000 are relatively small on average, less than 30 thousand złoty, and are repaid over two years on average. Such characteristics suggest that mainly loans for working capital than for investment were taken. This is confirmed by the dummies indicating the purpose of the loan: 77 percent of the loans were for input purchase. The most frequently required collaterals were land and machinery, as well as regularly income. Most of the applicants borrowed from a co-operative bank, where they had already been client, and benefited from a preferential loan. They were strongly established farmers as they had on average owned their farm prior to the start of the transition period in Poland. The average land area owned by the borrowers was approximately 20 hectares, which suggests larger farms in comparison to the Polish population where the average farm size is 7 hectares.

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[9] Note that the number of instalments in a given period does not affect the effective interest rate as long as there are always constant annuity payments.

Table 1. Description of variables

Variable	Mean	Std. Dev.	Mini-mum	Maxi-mum
Annual loan rate incl. fees (per cent) *r*	9.80	5.05	1.0	32.9
Nominal interest rate (per cent) r^n	8.58	4.49	3.9	32.0
Loan volume (thousand zł) *L*	29.61	97.60	0.6	800.0
Repayment period (months) *T*	25.28	26.80	12.0	120.0
Total land owned (ha) *C*11	19.62	34.61	0.4	365.0
Land as collateral (dummy) *C*12	0.14	0.35	0.0	1.0
Machinery as collateral (dummy) *C*13	0.17	0.38	0.0	1.0
Crops as collateral (dummy) *C*14	0.01	0.12	0.0	1.0
Regular income as collateral (dummy) *C*15	0.14	0.35	0.0	1.0
Compensating balance (dummy) *C*16	0.05	0.23	0.0	1.0
No collateral (dummy) *C*17	0.04	0.20	0.0	1.0
Current interest expenses from previous loans (thousand zł) *C*2	1.26	4.53	0.0	52.0
Farm ownership (years) *C*31	15.07	8.06	0.1	45.0
Previous client of the bank (dummy) *C*32	0.89	0.32	0.0	1.0
Household members work off-farm (dummy) *C*4	0.40	0.49	0.0	1.0
Loan purpose: input purchase (dummy) *C*51	0.77	0.43	0.0	1.0
Loan purpose: land purchase (dummy) *C*52	0.05	0.23	0.0	1.0
Loan purpose: machinery purchase (dummy) *C*53	0.09	0.28	0.0	1.0
Loan purpose: renovation or extension of buildings (dummy) *C*54	0.11	0.32	0.0	1.0
Loan from co-operative bank (dummy) *B*1	0.79	0.41	0.0	1.0
Loan from agricultural sector bank (dummy) *B*2	0.11	0.31	0.0	1.0
Loan from savings bank (dummy) *B*3	0.06	0.24	0.0	1.0
Loan under the government programme (dummy) *G*	0.57	0.50	0.0	1.0

Note: 149 observations.

As noted earlier, there are no theoretical restrictions on the functional form of the hedonic equation. We therefore tested the functional form by using a general Box-Cox formulation with a constant transformation parameter for all left- and right-hand side variables as a benchmark (Greene, 2000: 444-453). This encompasses linear and log-linear models as special cases. A maximum likelihood estimation with algorithmic search for the transformation parameter showed that this parameter was not significantly different from zero, implying a log-linear functional form. The regression of the log-linear model was then carried out by ordinary least squares. *t*-values were calculated using a heteroscedasticity-robust covariance matrix.

6 Empirical findings on hedonic pricing of loans in rural Poland

The results of the econometric analysis are given in Table 2, the left columns reporting results using the annual loan rate including fees, as explained above. As a comparison, the right columns display results of a similar econometric estimation, but using as dependent variable the (logarithm of the) nominal interest rate, that is to say the rate charged to borrowers without accounting for additional bank fees.

Table 2. Results of the hedonic regressions

Variable	Annual loan rate incl. fees r			Nominal interest rate r^n		
	Coeff.	*t*-value	Implicit price	Coeff.	*t*-value	Implicit price
Constant	2.147 **	5.136	–	2.178 **	7.559	–
Loan volume (thousand zł)[a] *L*	0.044 **	1.653	<0.1	0.037	1.544	<0.1
Repayment period (months) [a] *T*	-0.156 **	-1.956	-0.1	-0.145 **	-2.246	>-0.1
Total land owned (ha)[a] *C*11	-0.014	-0.382	>-0.1	-0.010	-0.298	>-0.1
Land as collateral (dummy) *C*12	-0.054	-0.533	-0.5	-0.048	-0.529	-0.4
Machinery as collateral (dummy) *C*13	0.240 **	2.659	2.3	0.172 **	2.222	1.5
Crops as collateral (dummy) *C*14	0.475 **	2.817	4.7	0.444 **	3.461	3.8
Regular income as collateral (dummy) *C*15	0.157	1.428	1.5	0.159	1.457	1.4
Compensating balance (dummy) *C*16	-0.377 **	-2.899	-3.7	-0.398 **	-3.530	-3.4
No collateral (dummy) *C*17	-0.163 *	-1.485	-1.6	-0.154	-1.395	-1.3
Current interest expenses from previous loans (thousand zł) [a] *C*2	-0.008	-0.884	-0.1	-0.016 **	-2.055	-0.1
Farm ownership (years) [a] *C*31	0.082 **	2.590	0.1	0.069 **	2.321	<0.1
Previous client of the bank (dummy) *C*32	0.418 **	3.024	4.1	0.343 **	2.706	2.9
Household members work off-farm (dummy) *C*4	0.136 **	2.045	1.3	0.127 **	2.128	1.1
Loan purpose: input purchase (dummy) *C*51	-0.130	-1.098	-1.3	-0.143	-1.157	-1.2
Loan purpose: land purchase (dummy) *C*52	-0.347	-1.142	-3.4	-0.144	-0.729	-1.2
Loan purpose: machinery purchase (dummy) *C*53	-0.034	-0.222	-0.3	-0.024	-0.174	-0.2
Loan purpose: renovation or extension of buildings (dummy) *C*54	0.053	0.364	0.5	0.089	0.618	0.8
Loan from co-operative bank (dummy) *B*1	-0.042	-0.298	-0.4	-0.130	-1.347	-1.1
Loan from agricultural sector bank (dummy) *B*2	-0.092	-0.552	-0.9	-0.133	-0.989	-1.1
Loan from savings bank (dummy) *B*3	0.233 *	1.661	2.3	0.107	1.062	0.9
Loan under the government programme (dummy) *G*	-0.214 **	-3.856	-2.1	-0.224 **	-4.314	-1.9
F-value (P-value)	4.20 (<0.001)			4.49 (<0.001)		
Adjusted R^2	0.312			0.331		
Observations	149			149		

Note: Dependent variables are in logs. Implicit prices in percentage points, calculated at sample means. *t*-values calculated from robust covariance matrix.

[a] Variable enters the regression in log form.

** Significant at the 0.05 level. * Significant at the 0.10 level.

While the loan volume (*L*) has no impact on the nominal interest rate, it increases the total annual rate that includes bank fees. This can be explained by the fixed character of the fees. It also indicates that banks are more concerned about defaulting when large loans are at stake than small loans, and hence have a stricter screening and monitoring behaviour towards large loan borrowers, thus charging them higher additional fees. Regarding the repayment period (*T*), again the fixed cost character of fees leads to a lower annual loan rate for long-term loans, as explained in Section 4. The fact that this effect is also present when the nominal interest rate is used is counter-intuitive. It can be rationalised by the fact that long-term loans were more heavily subsidised than short-term loans (Poganietz and Wildermuth, 1999: 537).

The collateral variables' parameters reveal that the most favoured collateral by banks is a compensating balance (*C*16), as it strongly reduces the total and nominal loan rates. Machinery (*C*13) and crops (*C*14) are the least preferred collateral, as using them, all other things equal, increases the loan rates by 2.3 and 4.7 percentage point, respectively. Machinery on Polish farms is often obsolete (Latruffe et al., 2005) and has a low resale value whereas the enforcement of crops as collateral involves high costs for the bank, which explains this result. Bringing up land (*C*11 and *C*12) and regular income (*C*15) as collateral does not increase the rate charged, suggesting that banks treat these as "average" types of collateral. It also shows that there is no systematic interest rate discrimination against small farms. The finding that land is not a particular high-valued type of collateral in Poland is recurrent in the literature (Latruffe, 2005; Petrick, 2004a). It can be explained by low land prices due to lacking demand and banks' reluctance to enforce claims on land because it is regarded as an "essential" asset, in particular for the poorer segments of the rural population. The rare case of bringing up no collateral (*C*17) has no effect on the nominal rate but decreases the total costs of the loan. This difference between nominal and total rate is plausible as fixed fees also comprise costs of collateral appraisal. However, that the absence of collateral does not generally drive up the interest rate is surprising. A closer examination of the survey data showed that the share of non-traditional commercial banks in collateral-free lending was particularly high and that these loans were primarily extended during the end of the surveyed period. Most of these were working capital loans with 12 months repayment period. We interpret this as an attempt to acquire new customers by an attractive loan offer that does not involve pledging collateral, which was pursued particularly by commercial banks newly entering the agricultural credit market.

The parameter of the indebtedness variable (*C*2) is not significantly different from zero in the annual loan rate regression. At first sight, this finding seems counter-intuitive because highly indebted farmers are assumed to have a lower repayment capacity and are thus usually considered as risky borrowers. However, debt levels of Polish farmers have in general been low (SAEPR/FAPA, 2000). Together with the surprising fact that being a new client of the bank decreases the interest rate by 4.1 percentage point (*C*32), we interpret this finding as a sign that rural banks attempted to become attractive for new customers from the agricultural sector. Indeed, Polish banks started to regard farmers as an increasingly relevant market segment at the time when accession to the EU and payments under the CAP promised additional liquidity for farmers (Danilowska, 2004).

The borrowers' character and economic situation have a strong influence on the price of credit. The number of years of owning the farm (*C*31) has a positive influence on the total and nominal rates, indicating that young farmers seem to be preferred clients by banks. Off-farm work by some of the household members (*C*4) raises the price of loans by 1.3 percentage point on average. This suggests that banks prefer households with a major attention on their farming activities, whereas part-time farmers pay more. This supports the above view that banks display a strong sectoral focus on agriculture.

All loan purpose dummies (*C*5) are non-significant in both regressions, indicating that the loan type does not influence the price of credit. This interesting finding implies that, overall, farmers' likelihood of default is not considered by banks to be dependent on how they intend to use the loan. Whereas many Polish farmers eventually use part or all of their production loans for consumption purposes (see the evidence provided by Petrick, 2004a), there is no sign that this results in increasing default rates.

Regarding the sources of credit, the left columns of Table 2 indicate a significant positive sign for the parameter attached to the PKO savings bank dummy (*B*3), implying that this bank charges on average 2.3 percentage point higher interest rates including fees than the other banks. Since the two other bank dummies are not significantly different from zero, this finding shows that the classic rural banking sector (BGZ and co-operative banks) does not systematically demand higher prices than the other banks, despite the absence of restructuring in this sector. The finding is supported by case study results which demonstrate that traditional agricultural banks usually do not charge additional fees for appraising agricultural collateral, and that they regard farmers as particularly reliable customers (Latruffe, 2005).

Borrowing under the public loan programme reduced the annual loan rate. Switching from a non-programme to a programme loan was worth 1.9 percentage point in nominal interest rates, and 2.1 percentage point if fees are included. In general, the reduction was quite small in light of the difference between subsidised and non-subsidised loans, which ranged between 17 and 25 percentage points (Petrick, 2004a). It is assumed that the programme drew into the credit market borrowers who induced higher risk premia and more costly screening procedures, so that the subsidy effect was severely diluted.[10]

A comparison of the nominal rate model with the annual loan rate model including fees shows that several effects only become visible once the fees are taken into account (concerning loan size, *L*, the effect of no collateral, *C*17, and the savings bank, *B*3). In general, in case that loan components induce higher nominal rates, this effect is reinforced. If they induce lower nominal rates, this is also strengthened. This is evidence against the view that fees are systematically used as instruments of active price policy to lower the nominal interest rate visible for the customer. They may be simply regarded as an additional price component that is subject to the same determinants as the nominal interest rate.

7 Conclusions

Our paper demonstrates that the hedonic price approach is a useful framework for investigating the relationship between lenders and borrowers, and for measuring the importance of specific institutional arrangements in a credit market. As suggested by the theoretical model that we developed in this paper, such arrangements are reflected in the price of credit via various quality components. Our empirical application to the agricultural credit market in Poland accommodates a broad range of institutional determinants relevant for credit market outcomes, and allows drawing significant conclusions with regards to the factors that might matter in the case of a former communist country at the time of preparation for EU accession.

Firstly, borrowers' quality was found to be important, in the sense that specific farmers' characteristics can influence the cost of credit. Collateral, lending history, age and farming attitude are among such components. This underlines the problem of asymmetric information in the Polish agricultural credit market, as lenders need to sort risky and less risky borrowers and use such characteristics as screening devices. However, there is no evidence that small farmers pay higher interest rates than large farmers. Furthermore, lenders' quality matters, as the level of screening and monitoring costs depends on lenders' ability to perform these activities. The econometric results illustrate this, as the PKO savings bank was found to charge higher fees than the other banks to cover such costs.

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[10] This interpretation would imply that the regression model does not capture all factors that are relevant for the determination of the interest rate. Indeed, the R^2 of the model is not so high that this can be ruled out. The spread between nominal subsidies and actual effect of programme participation as revealed by the regression can then be explained by unobserved factors that lead to higher risk premia for borrowers under the programme. If really *all* relevant borrower characteristics were included in the hedonic equation, there is no reason why the reduction due to programme participation should be smaller than the nominally applied subsidy.

Hence, the previous analysis confirms other studies' findings (Latruffe, 2004; Petrick, 2004b) that, after almost a decade of transition, to tackle information asymmetries is still a major problem in the Polish agricultural credit market. However, the analysis also reveals several peculiarities of actual practice that cannot be explained by theoretical reasoning alone. For example, rural banks dislike certain common forms of collateral, such as land, machinery or crops, because they are of little value or difficult to enforce in the Polish context.

The results support the view that banks are quite risk-averse, strongly oriented towards agricultural producers, and prefer what Von Pischke (1991) calls "asset based" as opposed to "cash-flow based" lending: the most liquid and secure forms of collateral (bank deposits) are preferred most, and it does hardly matter for what purpose loans are actually used. Screening procedures are based on very traditional methods and the entrepreneurial opportunities of a particular farmer appear to play a very small role. This may be due to continued or inherited banking practices stemming from socialism, where an assessment of credited firms did not take place, and which was characterised by a structural absence of decision-making capacities within banks (Feakins, 2004).

Only few signs indicate that increasing competition and the additional liquidity expected to become available in rural areas due to payments under the EU's CAP force banks to increase their competitiveness and customer orientation. Mainly newly entering commercial banks started to offer inexpensive collateral-free loans. However, commercial banks have not been able to secure a price advantage over the traditional sector banks, which implies that the latter have been able to adjust to increasing competitive pressure.

High interest rates had prompted the Polish government to intervene in order to increase the number of farmers that could afford loans. As mentioned earlier, the main intervention is in the form of subsidised credit, which is aimed at reducing the price of loans. Our analysis confirms that this form of intervention is effective in decreasing the total interest rate. However, the impact of the government programme on the reduction of the price of loan was not found to be large, for example in comparison to the effects of the variables related to the form of collateral. Moreover, all other contract attributes equal, taking a loan under the public lending programme reduced the annual loan rate by 2.1 percentage point on average, which is much less than the nominal reduction in the range of 17 to 25 percentage points. On the other hand, there is no empirical support to the view that the interest-lowering effect of the subsidies is compensated by higher bank fees, because in the case where additional fees are taken into account the effect of programme participation is also higher. Nominal loan support was not completely eaten up or even turned to the opposite by additional bureaucracy. Nevertheless, the results pinpoint the important issue whether the outcome of this subsidisation policy is worth the huge financing spent on it.

The structure of the rural banking sector, where the government is an important stakeholder, was shown to have some effect on farmers' credit terms. Future policies aiming at a further restructuring or consolidation of the banking sector should take into account the relative performance of the competing banks. However, the privatisation of banks seems not generally recommendable, because the terms offered by traditional agricultural sector banks were shown to be not worse than those of private commercial banks. An increasing demand for financial services as a result of EU accession will make rural areas more attractive for banks and will likely continue to induce less conservative lending practices.

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