MEASURING THE QUALITY OF AGRICULTURAL CREDIT CONTRACTS - A HEDONIC REGRESSION ANALYSIS OF EFFECTIVE INTEREST RATES ON POLISH CREDIT MARKETS

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1 Introduction

Among the Central and Eastern European Countries that acceded to the EU in 2004, Poland is believed to face the most difficult adjustment problems in its agricultural sector. Polish farms are suffering from a comparatively low profitability as compared to the "old" EU-member countries, which is primarily due to lower productivity levels and a less protective policy environment (PETRICK et al., 2002). Farms are not efficient in terms of quantity of inputs used, and in particular use labour and capital in excess (LATRUFFE et al., 2005). Indebtedness of farms generally is low, which is believed to be due to *farmers' limited access to finance* (PETRICK, 2004a). It has been a widely held view among economists and politicians that this is one of the major obstacles to a more favourable development of the farm sector in Poland.

The aim of this paper is to present an innovative application of the hedonic pricing approach to the measurement of credit contract quality on agricultural loan markets in Poland. We seek to empirically investigate the determinants of effective interest rates farmers face, whose high level is regarded as a major obstacle to credit access. Effective interest rates encompass both nominal interest rates and additional bank fees on the basis of single loan contracts concluded between individual farmers and formal banks. The analysis is based on the hypothesis that *the individual quality of a credit-financed investment project is reflected in the level of the effective interest rate the borrower faces on the loan market.* This quality – and hence the level of the interest rate – is decisive for his/her access to credit and is therefore regarded as an indicator of the overall development potential of the individual farm. Credit contracts with the 'best' quality involve the lowest interest rate. We use a hedonic regression approach in combination with a unique dataset to analyse the *impact of single loan quality attributes on effective interest rates* which enables us to determine the economic value of these attributes.

Due to the scattered structure of farms and the relatively low degree of commercialisation of farming in Poland, (potentially missing) institutional solutions to problems of asymmetric information and loan enforcement are likely to be of key relevance in determining interest rates. The theoretical literature on credit contracts can therefore be used to inform the empirical analysis. Furthermore, the Polish government massively intervenes on rural credit markets by granting generous subsidies on agricultural loans (PETRICK, 2004b). How this affects farmers' effective interest rates is a further question to be addressed in the following. We therefore employ a *broad definition* of credit contract quality which encompasses all relevant characteristics of the financed investment object: specific attributes of the particular loan contract as well as farm and household characteristics of the borrower.

The paper is structured as follows. Section 2 explains the analytical framework of the study and how a hedonic regression approach is used to measure credit contract quality. Section 3 gives some background information on the data used and the way the effective interest rate

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variable was calculated. Section 4 presents the findings of the quantitative analysis and section 5 summarises the results and concludes with some policy recommendations.

2 Credit Contract Quality in a Hedonic Pricing Framework

The idea behind the concept of hedonic prices is that goods are priced according to their inherent quality attributes (BERNDT, 1991: 102-149). Hedonic prices are defined as the implicit prices of attributes and are revealed from observed prices of differentiated products and the specific amounts of characteristics associated with them (ROSEN, 1974: 34). BALTENSPERGER (1976) was the first to apply this concept to loan markets, where interest rates are the observed prices and credit-financed investment projects of borrowers with differing riskiness are the traded goods. BALTENSPERGER hence introduced a quality component into the loan contract, so that interest rates differ between different contracts. Borrowers are no longer price takers because the price is based on individual loan characteristics determining its quality, which can be influenced by the borrower.

In pursuing an empirical application of this approach, we extend BALTENSPERGER's (1976) basic argument in two directions. First, we regard the total effective interest rate (including nominal interest rate plus bank fees) as the appropriate price variable. Second, we argue that relevant quality attributes are not only the riskiness of the borrower's investment project as such, but also how difficult it is to reveal and under what conditions it is financed. We explicitly wish to investigate the relevant *determinants* of effective interest rates and their varying contribution to empirically observed rates. By having a look at recent developments in the theory of loan markets, it will become clear that this implies a rather broad meaning of quality attributes of loan contracts.

It has become a common understanding in the literature that, even after interest rates have been adjusted for risk, loans still differ in several dimensions (JAFFEE and STIGLITZ, 1990: 867, mention the wealth of the borrower or his/her risk aversion). Although riskier loans are charged higher interest rates, it is stressed that it cannot be taken for granted that lenders *know* how risky a loan is. Central to the argumentation is the notion of an asymmetric distribution of information between borrower and lender, which leads to costly signalling and screening processes (following AKERLOF, 1970). Broadly speaking, lenders need to actively sort out borrowers to avoid adverse selection and moral hazard, whereas borrowers have an incentive to signal their quality because otherwise they may experience excessively high interest rates or may even be denied loans (FREIXAS and ROCHET, 1997: 91-135). Leading candidates among the mechanisms to overcome asymmetric information are collateral provision, third-party-guarantees, joint liability, and the borrower's abilities and reputation. Employing these instruments implies costs, some of which may be included in the nominal interest rate, while others may accrue in addition to that. An important additional cost component is bank fees. The relevant price of the loan therefore consists of nominal interest rates *plus* additional fees.[1]

It is beyond the scope of this paper to develop a full theoretical model of hedonic price equilibrium on the rural credit market. We only outline the basic ingredients of such a model as follows. On the demand (i.e., farmer's) side, the hedonic market model will entail a bid function for credit, denoting interest rates as a function of the loan's quality attributes as well as a desired profit level and other relevant exogenous variables, such as a price vector and technology. The supply (i.e., bank's) side is described by an offer function, representing the interest rates at which the bank would make credit available to the market. Analogously to the bid function, it depends on the loan attributes as well as price and technology variables relevant

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[1] The implicit assumption is that information asymmetries are in fact overcome to some extent by costly signalling/screening activities. The case of pure credit rationing analysed by STIGLITZ and WEISS (1981), where the bank is completely unable to distinguish between borrowers, is therefore ruled out.

for the bank. The observed equilibrium interest rate schedule, which in our case encompasses nominal interest rate plus fees, is the result of the farmers' bids for credit and the offers of the banks.[2]

We assume that effective interest rates (r^{eff}) are ultimately determined by the various quality attributes of the loan contract (z_m, m=1,…,M), in the sense of a hedonic pricing mechanism. The following equation becomes the basis of our analysis:

$$r^{eff} = r^{eff}(z_1, z_2, ..., z_M) \tag{1}$$

The empirical analysis tries to quantify the importance of the quality attributes of loan contracts by estimating equation (1). First derivatives of this equation can be interpreted as implicit prices of these attributes.

It should be noted that the hedonic price function is market-determined and not a behavioral equation. The single decision maker has no influence on how the different loan attributes are priced in the market. For this reason, it can be ruled out on theoretical grounds that latent household characteristics hidden in the error term of the estimated version of (1) lead to an endogeneity bias in the estimates.

Besides repayment period and loan volume we also included explanatory variables indicating whether the loan was contracted under the governmentally-subsidised lending programme and which bank was the lending source. Although these attributes of loan contracts are not a characteristic of the quality of investment projects in the narrow sense, it is most likely that they affect effective interest rates and hence credit access and the development perspectives of individual farms. They might also proxy different information availability to lenders, and hence different screening costs. Furthermore, they are of particular interest for giving policy advice.

In addition, we consider both farm and household characteristics as important attributes. Farm characteristics are relevant because borrowing is often motivated by financing needs for production purposes within the farming business. Furthermore, these attributes are largely responsible for the expected return and riskiness of investment in agriculture. However, due to the close linkages between production and consumption within a farm household, socio-economic and demographic characteristics of the associated farm family are likewise regarded as important. In particular, consumption smoothing and liquidity insurance must be regarded as relevant motives for borrowing (see BESLEY, 1995). These suggestions will be taken up in the empirical application below.

3   Database

The data source for the analyses 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 1997-1999. 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 years 1997-1999. This includes relevant data on interest rates, repayment period, and lending source, but also on bank fees. There are 485 contracts in the database, including all types of loans, i.e. working capital, consumption, and investment loans.

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[2]   A general model of hedonic price equilibrium is presented by ROSEN (1974). A formal model of land as a factor of production which is similar to the approach presented in this paper is offered by PALMQUIST (1989).

365 loan contracts were recorded with sufficient detail to calculate an effective interest rate measure, among which almost 70 percent were taken under the government programme.

To obtain a measure of effective interest rates, 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 effective interest 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 as fixed in the loan contract, with the initial amount borrowed *minus* fixed fees. This yields an *effective interest rate* denoted r^{eff} as introduced above. r^{eff} is the rate at which the discounted value of all periodical payments A_t (based on the nominal interest rate) equals the initial loan volume L minus fixed fees:

$$\sum_{t=1}^{T} A_t (1 + r^{eff})^{-t} = L - fee \tag{2}$$

In this equation, t denotes the current period and T is the total repayment period of the loan. The relation between the calculated r^{eff} and the nominal interest rate r as negotiated in the loan contract is as follows:

$$r^{eff} \geq r \tag{3}$$

Equality is given for *fee*=0. 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.

For reasons of simplicity, we assumed that interest and principal repayment was made in the form of constant annuity payments throughout the sample.[3] 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.

4   Empirical Findings on Credit Contract Quality in Rural Poland

The hedonic pricing model (1) was estimated on a sample of 311 loan contracts, for which complete data was available. All loans taken between 1997 and 1999 were included. The repayment period of the loan in months (?) and the loan volume in thousand zł (?) were taken as explanatory loan characteristics measured on a metric scale (expected signs in parentheses). Expected signs of these two variables are not unambiguous. Loans with a long repayment period and a large volume are usually regarded as riskier, which should be reflected in higher interest rates. However, since fees with a potentially fixed character are included, larger loans and loans with a long repayment period might also bear lower effective interest rates. In addition, the relationship might be influenced by the government program if it specifically targets loans with certain repayment periods or loan volumes. The overall effect of government intervention was captured by a dummy indicating whether the loan is taken under the government subsidy programme (?). Again, the sign is indeterminate: interest subsidies clearly reduce

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[3]   In case that the repayment period was equal to or more than 12 months, we assumed constant annual payments; otherwise constant monthly payments were assumed. 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.

nominal interest rates, however, programme application may tend to increase fees. A further dummy takes the value of one if the loan was used for automobile purchases and zero otherwise. Automobile loans are not covered by the subsidy programme and must be regarded as exceptional events. *Ceteris paribus*, taking a loan for automobile purchases is therefore likely to increase the effective interest rate, unless nominal interest subsidies for non-automobile purchases are offset by increased fees.

A further important policy question is whether the choice of the bank affects effective interest rates. We therefore distinguished four types of banks: (a) co-operative banks, the traditional lending source in rural areas, (b) the governmentally-owned agricultural sector bank BGŻ, (c) the savings bank PKO, and (d) all other banks (which consist mainly of other commercial banks). Consequently, we included separate dummies for the first three types of banks, thus measuring the effect of borrowing from one of these sources vis-à-vis the fourth type.

Total land owned (-) was used as a proxy for the volume of collateralisable wealth. The number of years of farming practice (?) was included to represent the experience of the farmer. It might however also indicate the stage of the farmer in his life cycle. The former interpretation suggests a negative sign, whereas the latter might imply the opposite (younger farmers are more dynamic in expanding their farm and therefore face lower interest rates). Three further dummy variables were used to indicate the skills of the farmer and how professional his business is managed: farm has permanent book-keeping (-), farmer previously participated in additional training courses (-), and farmer owns a personal computer (PC) (-). Book-keeping farms are commonly those which have a more commercial orientation. Similarly, training courses are usually attended by farmers who are particularly active in developing their business. Owning a PC was considered as an information means, which reduces interest rates.

A dummy taking the value of one if the household head is a registered member of a co-operative bank and zero otherwise (-) was regarded as indicating a general interest in borrowing and a closer social proximity to the bank, which reduces effective interest rates. Two 'emergency dummies' among the household characteristics (experienced harvest failure and loss of employment) (+) can be interpreted as indicating a sudden demand for credit, which usually increases costs. Furthermore, households in an emergency situation might be regarded as riskier borrowers for the bank, because their liquidity cushion is likely to be small. Off-farm employment of household members (-) might be regarded as increasing this cushion, which should reduce effective interest rates.

The results of the estimation are presented in Table 1. We used a double-log model, which is commonly used in hedonic regression analysis. The coefficients of the OLS regression therefore display the relative changes of the dependent variable in the sense of an elasticity. It should be stressed that these relative changes refer to an explained variable which is already a relative magnitude (effective interest rate in annual percent). We are particularly interested in the loan attributes' implicit prices, which are most usefully expressed in *marginal changes in percentage points* of the dependent variable. This information is given in the most right column of Table 5. Since the double-log model implies marginal effects that vary with the size of the explanatory variables, marginal effects are given at sample means.[4]

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[4] The regression was preceded by a first-step Probit analysis of whether the respondent was a borrower or not, to avoid selectivity bias. Based on these estimates, an Inverse Mill's Ratio was included in the hedonic regression model, which, however, turned out being insignificant (for detailed results see PETRICK and LATRUFFE, 2003).

Table 1: **Results of the effective interest rate hedonic regression model**

Variable	Coefficient	t-value	P-value	Implicit price in percentage points (marginal effect)
Constant	2.790	12.980	<0.001	−
Loan characteristics				
Repayment period (months)[a]	-0.231	-6.452	<0.001	-0.046
Loan volume (ths. zł)[a]	0.064	2.562	0.011	0.017
Loan under the government programme (dummy)	-0.177	-3.329	0.001	-1.648
Loan for automobile purchase (dummy)	0.639	6.147	<0.001	5.941
Loan from co-operative bank (dummy)	-0.022	-0.324	0.746	-0.209
Loan from BGŻ (dummy)	-0.098	-1.160	0.247	-0.908
Loan from PKO (dummy)	0.021	0.241	0.810	0.195
Farm characteristics				
Total land owned (ha)[a]	-0.073	-2.536	0.012	-0.043
Farming practice (years)[a]	0.048	1.065	0.288	0.022
Permanent book-keeping (dummy)	-0.144	-2.318	0.021	-1.336
Previous participation in training courses (dummy)	0.099	1.107	0.269	0.923
Farmer owns personal computer (dummy)	0.056	0.897	0.370	0.519
Household characteristics				
Member of co-op bank (dummy)	0.009	0.132	0.895	0.086
Experienced harvest failure (dummy)	0.028	0.584	0.560	0.260
Experienced loss of employment (dummy)	0.014	0.169	0.866	0.130
Household members work off-farm (dummy)	0.086	1.752	0.081	0.798
F-value (*P*-value)	15.6 (<0.001)			
Adjusted R²	0.444			
Observations	311			

Notes: Dependent variable: log effective interest rate. Equation also included Inverse Mill's Ratio from a first-step Probit equation. [a] Variable enters the regression in log form. Implicit prices calculated at sample means.

Source: Authors' calculations based on IAMO Poland farm survey 2000.

Table 1 shows that several coefficients are significantly different from zero at least at the five percent level. The adjusted R² has an order of magnitude that is quite acceptable for micro data.

Long-term loans are significantly less costly than short-term loans. This is plausible because single fee expenses become less relevant for the effective interest rate the longer the repayment period is, whereas nominal interest rates are charged on a periodical basis. There is hence no apparent risk premium for long-term loans. Furthermore, long-term investment credit is particularly heavily subsidised (POGANIETZ and WILDERMUTH, 1999: 537). All other things equal, prolonging the repayment period of the loan for one month reduces effective interest rates by approximately 0.05 percentage point at the margin.

In contrast, the loan volume had a positive effect on the effective interest rate. Although loans are commonly charged a fee in percentage of the loan volume (one or two percent are frequently reported in the sample), the increased risk associated with big loan volumes apparently outweighs this effect and leads to higher interest rates.

Borrowing under the public loan programme *reduces* the effective interest rate. Switching from a non-programme to a programme loan is worth 1.6 percentage point in effective interest

rate. However, the reduction is quite small in light of the difference between subsidised and non-subsidised loans in terms of nominal interest rate, which is in the range of 20 percentage points. A first possible explanation is that the programme application procedure as such implies so heavily increased fees that the overall subsidy effect is only barely positive. However, a more plausible interpretation is that the programme draws borrowers into the credit market who induce higher risk premia and more costly screening procedures, so that the subsidy effect is severely diluted.

Taking an automobile loan increases the effective interest rate by almost 6 percentage points on average. However, its importance should not be overstated, since automobile loans are very rare events. In any case, contrary to what one is used to in former EU 15-economies, automobile loans are relatively expensive in rural Poland.

The coefficients of the three dummies indicating the bank where the loan was taken reveal some differences. Conditional on all other variables, although loans from the BGŻ seem to be the least expensive, followed by loans from co-operative banks and the savings bank PKO, there is no significant difference between the credit sources.

The signs of the coefficients of farm and household characteristics generally support the above expectations. More land owned clearly reduces effective interest rates. Since the loan volume is considered separately, this is strong evidence for a collateral effect. Furthermore, farms with permanent book-keeping have lower effective interest rates. Years of farming practice, participation in training courses and ownership of a PC do not significantly affect the effective interest rate. The latter also applies for membership in a co-operative bank, job loss, and experiencing a harvest failure. The coefficient of off-farm employment has an unexpected positive sign. The interpretation that off-farm employment indicates a liquidity cushion and thus lowers the effective interest rate is thus rejected by the data. The positive sign could be due to the fact that households with off-farm employment are commonly part-time farmers with less experience and less emphasis on their farming business, which leads to higher interest rates of 0.8 percentage point at the margin.

5   Conclusions

This paper hypothesised that the quality of loan contracts as reflected in the effective interest rate is a useful indicator of farmers' credit access and the development potential of their farm. Drawing on the recent theoretical literature on credit markets, we argued that relevant quality attributes are not only the riskiness of the borrower's investment project as such, but also how difficult it is to reveal and under what conditions it is financed.

The results consistently suggest that the presence of devices to *screen and signal the characteristics of the borrower* in terms of available collateral and commercial attitude of the farmer reduces the effective interest rate. This finding hence underpins the theoretically stipulated relevance of asymmetric information on loan markets. The widely held view that formal lenders tend to *discriminate against smaller farms* is supported by our analysis because farms with fewer assets and managed by farmers with a less commercial attitude, often on a part-time basis, face higher interest rates. All other contract attributes equal, taking a loan under the public lending programme *reduced total effective interest rates* by 1.6 percentage point at the margin. Compared to the nominal reduction of interest rates in the range of 17 to 25 percentage points, this is a small effect. The *choice of the bank* had no significant effect on the effective interest rate. This implies that neither the traditional lending sources nor private banks which entered the rural loan market more recently could establish a price advantage, and face similar screening problems and costs.

Based on these considerations, a number of policy recommendations can be derived from the study. First, the government should check whether the small effect on effective interest rates justifies the substantial resources spent on the entire programme. In particular, it is in question

whether the lending procedures are sufficiently streamlined and whether the loans are effectively targeted. 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, based on the findings of this study, the privatisation of banks seems not generally recommendable, since there are no visible price differences between state-controlled and private banks. Other policy measures could address the demand side of the credit market. In general, farmers with a commercially-oriented attitude have relatively better access to credit, which makes sense in an economic view. Promoting book-keeping could improve the quality of credit contracts and hence access to finance.

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