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FARM INVESTMENT, CREDIT RATIONING, AND PUBLIC CREDIT POLICY IN POLAND

A microeconometric analysis

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ABSTRACT

The aim of this paper is to empirically analyse the effects of governmentally promoted credit access on the investment behaviour of credit rationed farmers. This is done by specifying an empirical investment equation which is estimated on a cross-sectional sample of Polish farm household data. In contrast to conventional neo-classical investment models, the investment equation contains the financial variable long-term credit access, which plays the central role in this study. The econometric analysis is used to analyse the determinants of credit access and estimate the marginal effect of credit on investment, which in turn provides the key information for policy evaluation.

The results suggest that access to subsidised credit has a significant role in determining investment behaviour of farmers who self-classified as being exogenously credit constrained. This classification applies to 45 percent of all respondents. Major determinants of credit rationing are the reputation of the borrower and the demographic household composition. In various specifications of the credit-investment relationship, including a cubic Tobit model, the average marginal effect of credit on investment was smaller than one. This implies that credit is partly used for other purposes than productive investment. Every second borrower invests less in productive assets than borrowed. However, over a commonly observed range, the marginal effect increases with an increasing credit volume. Even so, the investment volume is negatively related to farm size. A government policy aiming at the promotion of productive investment should hence emphasise lending in larger amounts without discriminating small farms.

JEL: Q 12, Q 14, P 32
Keywords: farm investment, credit policy, Poland, microeconometrics

ZUSAMMENFASSUNG

Zielsetzung dieses Beitrags ist die empirische Analyse der Effekte von staatlich geförderten Krediten auf die Investitionstätigkeit von kreditrationierten Landwirten. Die Analyse erfolgt mittels einer empirischen Investitionsfunktion, die auf der Basis von Querschnittsdaten landwirtschaftlicher Haushalte aus Polen geschätzt wird. Im Gegensatz zu herkömmlichen, neoklassischen Investitionsmodellen berücksichtigt die hier verwendete Investitionsgleichung auch den Zugang zu langfristigen Krediten, der die zentrale Rolle in dieser Studie spielt. Die vorgestellte ökonometrische Analyse untersucht die Bestimmungsgründe der Kreditrationierung und schätzt den marginalen Effekt des Kreditzugangs auf das Investitionsvolumen, welcher seinerseits zur Beurteilung der Wirksamkeit des staatlichen Investitionsprogramms herangezogen wird.

Die Ergebnisse zeigen, dass Zugang zu subventionierten Krediten einen signifikanten Einfluss auf das Investitionsverhalten derjenigen Landwirte ausübt, die sich selbst als exogen kreditrationiert einstufen. Diese Einschätzung trifft auf 45 Prozent der Befragten zu. Wesentliche Bestimmungsgründe der Kreditrationierung sind die Reputation des Kreditnehmers sowie die demografische Zusammensetzung des Haushaltes. In verschiedenen Spezifikationen der Kredit-Investitions-Beziehung, die auch ein kubisches Tobit-Modell beinhalten, war der geschätzte marginale Krediteffekt kleiner als eins. Daraus folgt, dass die Kredite teilweise für nicht-produktive Zwecke eingesetzt wurden. Tatsächlich investiert jeder zweite Kreditnehmer weniger als er an Krediten erhält. Der marginale Effekt nimmt

allerdings über einen Bereich häufig anzutreffender Kreditvolumina zu. Trotzdem besteht ein negatives Verhältnis zwischen Investitionsvolumen und Betriebsgröße. Eine auf die Förderung von produktiven Investitionen abgestellte Politik sollte daher vor allem die Vergabe von größeren Kreditvolumen unterstützen, ohne dabei kleinere Betriebe zu diskriminieren.

JEL: Q 12, Q 14, P 32
Schlüsselwörter: landwirtschaftliche Investitionen, Kreditpolitik, Polen, Mikroökonometrie

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1 INTRODUCTION[1]

Among the Central and Eastern European Countries in the EU accession process, Poland is believed to be the one where the agricultural sector poses the most difficult adjustment problems. Not only do serious structural deficiencies call the sector's international competitiveness into question (PETRICK et al. 2002). Also the gap in living standards between urban and rural groups of the Polish population gives rise to worries. This already brought about an increasingly negative attitude among rural citizens towards the accession process, which may well endanger social peace in the entire country. The results of the most recent parliamentary elections which strengthened parties with a largely rural clientele supporting extreme anti-EU positions bear lively testimony to this.

Development of the Polish farm sector is thus of urgent necessity. Right from the beginning of market reforms, the Polish government introduced a number of policy measures to achieve this goal. Besides trade policy and output price support measures, interest subsidies figured prominently over recent years. In 1999, the last year under investigation in this study, interest subsidies accounted for about 38 percent of the agricultural budget (not regarding expenses for the farmers' social insurance fund; see MRIRW 2000 and OECD 2000). These subsidies are granted both on operational and investment loans extended by commercial banks. Intervention on credit markets can thus be regarded as a major instrument of the Polish government to achieve its political objectives.

The aim of this paper is to empirically analyse the *effects of governmentally promoted credit access on the investment behaviour of credit rationed farmers*. The central policy question is to what extent subsidised credit fosters investment in productive assets on credit rationed farms. The methodological approach is to specify an empirical investment equation which is estimated on a cross-sectional sample of farm household data. In contrast to conventional neo-classical investment models, the investment equation contains a 'financial' variable long-term credit access, which plays the central role in this study. The econometric analysis is used to estimate the *marginal effect of credit on investment*, which in turn provides the key information for policy evaluation. A marginal effect of credit on investment larger than one implies that additional funds are completely used for productive investment. This describes a situation where subsidised credit is fully used for investment and even triggers the additional mobilisation of other (particularly own) financial sources, which is clearly desirable from the point of view of the government. On the other hand, a marginal effect smaller than one implies that the marginal unit of credit is only partly used for the supposed investment purpose. The estimation is only carried out for farms whose managers self-classified as being credit rationed. This allows a consistent estimation of the investment equation and has the further advantage of providing an analysis of the determinants of credit rationing.

The paper proceeds in several steps. Section 2 outlines the theoretical background of the study. Section 3 explains the data base used for the estimation. Section 4 describes the empirical approach in more detail and discusses the major methodological problems of the analysis. Section 5 contains the econometric results, and Section 6 summarises the findings and concludes with some policy implications.

[1] The author is grateful to Stephan BROSIG, Catrin SCHREIBER, and Peter WEINGARTEN for helpful comments and fruitful discussions on an earlier version of this paper. The usual disclaimer applies.

2 THEORETICAL BACKGROUND

One of the major difficulties of the neo-classical understanding of economic behaviour is that investment activities cannot be explained accurately. The problem has its roots in the assumption of a frictionless equilibrium world in which production factors can immediately adjust to a changing economic environment. This renders any long-term formation of fixed capital stocks unnecessary and cannot provide a rationale for their sluggish adjustment. However, lagged adjustment processes *are* observed in the real world, which is why alternative explanations were incorporated into the neo-classical theory of the firm. A quite commonly used approach is to assume the existence of *convex adjustment costs* that yield a finite demand for investment (see MACCINI 1991 for an overview). However, more in line with the policy motivation of this paper is the assumption that *financial constraints* limit the capital accumulation of farms. A dynamic theory of the financially constrained (farm) household has been elaborated formally by STEIGUM (1983) and CHAMBERS and LOPEZ (1984). It is taken as an implicit theoretical background for the present paper. These dynamic farm household models have the following implications: (a) limited access to credit causes a lagged adjustment of capital stocks to the steady state equilibrium, (b) optimal investment is dependent on equity formation of the household in terms of profit retention or savings, or, more general, the availability of collateral, and (c) investment is thus neither separable from consumption decisions nor independent of the equity position of the farm. More recent work on stochastic investment models arrives at similar implications (HUBBARD and KASHYAP 1992). It should be added that providing equity or collateral is not the only way to improve credit access. Similar effects can result from reputation acquisition (DIAMOND 1989).

3 DATA BASE

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 mainly data related to the economic outcomes of the year 1999. Investment and credit data is available for 1997-1999.

The survey is based on a random sample of farms in the record of the official extension service. The record consists only of farms that show at least some degree of commercialisation and market integration and that account for the bulk of the traded agricultural produce in the research area. The sample consists of 464 farms; 120 from Szczecin, 108 from Tarnów, and 236 from Rzeszów. Within the given geographic boundaries of the three voivodships, the sample is stratified in one stage. The strata are identical with administrative districts (powiat). Further details on sampling issues, organisation of data collection and a reprint of the questionnaire can be found in PETRICK (2001).

4 METHODOLOGICAL APPROACH

The subsequent empirical analysis is based on a *potentially non-linear, reduced-form investment equation* of the following type:

$$I = I(K, Z, ?) + e \qquad (1)$$

In this equation, I denotes the investment volume, K is the amount of long-term credit, Z denotes the existing capital stock or, more generally the initial farm size, $?$ is a vector of dummies capturing regional and farm specific effects, and e is a random error term. There are two important peculiarities

compared with conventional neo-classical investment equations (ELHORST 1993, p. 170). First, the equation contains a *financial variable*, *K*. Second, there are *neither user costs of capital nor prices* included in the equation. The first peculiarity is due to the assumed relevance of the financial constraint, as explained earlier. The second is due to the fact that the investment equation is estimated on a cross-sectional data set, so that prices are assumed to be equal for all farms and hence excluded (similar to FEDER et al. 1992).

I expect the following signs of the parameters to be estimated. The relation between credit access and investment is unambiguously positive. The effect of *Z* on *I* depends on the size of the desired capital stock or farm size. A negative sign implies that farm sizes converge over time, whereas a positive sign implies diverging farm sizes. *?* includes a dummy indicating whether the farm has permanent book-keeping, which might be taken as a measure of management skills of the farmer. It is likely that more skilled farmers invest more. A second dummy has the value of one if the farm is located in the northern of the three regions under investigation. Since this region is structurally more advanced, the effect on investment is also likely to be positive.

Equation (1) can be used to determine the marginal effect of credit on farm investment, which is given as the first-order partial derivative with regard to *K*. There are three methodological problems related to the estimation of (1) which shall be discussed subsequently. The first is the potential *endogeneity of regressors*, which might compromise the consistent estimation of (1). Endogeneity is likely to be a particular problem for the credit access variable *K*. Second, approximately 20 percent of households considered in the estimation report a zero investment volume. This implies that the dependent variable is *censored* to some extent, which should be reflected in a possibly non-linear formulation of the model. In addition, non-linearity is also addressed more explicitly as a result of the third problem, which is related to the choice of the *functional form*. As noted earlier, the potential effect of new borrowing on investment is of key interest due to its policy implications. However, the marginal effect is unlikely to be constant over the entire range of observations, as would be imposed by a linear model. It is of interest whether there are any size effects of credit use, i.e. whether more credit implies a higher marginal investment effect. The *change* in the marginal credit effect can be investigated by evaluating the second-order derivative of the investment function with regard to credit. Therefore, the latter effect should not unduly be constrained by the choice of functional form.

The problem of endogeneity was addressed by using specific qualitative information on credit access provided by the survey results. Credit applicants were asked whether they would have liked to borrow more at the same interest rate. If so, this was taken as evidence for an excess demand and the respondents were classified as being partially credit rationed. Applicants who did not obtain a loan at all were classified as completely rejected. Non-applicants were asked whether they had the intention of applying for credit at a particular place in the past but did not do so because the application might have been turned down. Respondents who answered positively were classified as discouraged non-borrowers (JAPPELLI 1990). All these groups of respondents were regarded as being credit constrained, which implies that their access to credit was exogenously determined and hence not under the control of the decision maker. The investment equation is *only estimated on the constrained subsample* of respondents. The cost of this sample splitting procedure is that selectivity might introduce a bias into the estimates. This was tested by a two-stage procedure due to HECKMAN (1979). The estimating equation hence becomes:

$$I = I(K, Z, ?) + e \text{ iff } \boldsymbol{?}' \boldsymbol{z} + u > 0 \qquad (2)$$

$\mathbf{z}$ represents a vector of variables (such as household and production characteristics) determining whether the household is credit rationed (yes/no). $\boldsymbol{?}$ is a vector of parameters, while u is a random error term. In this system, e and u are supposed to have a bivariate normal distribution with zero means and a given correlation.

The two-stage approach has the further merit of providing information about the *determinants of being credit rationing*, since it implies to estimate a *Probit equation* prior to the investment equation. This can be used to test the theoretical propositions of the financial constraints model outlined above. The dependent variable indicates by one all farm households which self-classified as credit rationed according to the previous definition. The following explanatory variables were chosen (expected signs are given in parentheses). Land owned (+) was taken as an indicator of the volume of collateralisable wealth, which is expected to play a key role in the presence of loan market imperfections. For land owned, I used the nominal value of land owned by the farm in the beginning of the investment period expressed in thousand zloty (zl), which was calculated by subtracting land investment carried out in the period 1997-1999 from the stated value of owned land in 1999. Land quality is hence captured as well, at least as long it is reflected in monetary land values. A dummy indicating a previously rescheduled loan (+) illustrates the credit history of the borrower, and a dummy indicating the expressed habit to regularly engage in conversation with neighbours (?) is used as a measure of village-internal information flow. The rescheduled loan variable was taken from the interviews where respondents were asked whether they did reschedule the repayment of a loan in the past. This is regarded as evidence for a relatively poor reputation of the borrower. Conversation with neighbours might reduce the probability of being credit rationed due to improved information availability for the local bank. However, it may also identify the borrower as little diligent in his own business, with the result of an increased likelihood of being credit constrained. Liquidity shortages may also be due to consumption behaviour of the farm household. The number of adult males (?) and females (?) were therefore taken to reflect household characteristics. The effect of the number of adults in the household is indeterminate since a higher number of household members may both increase (via increased consumption) and decrease (via generation of unearned income) the liquidity shortage. In addition, the number of males or females may take on a signalling function for the bank. For example, a higher share of men in the households' labour force may indicate that more resources are devoted to actual farm production as opposed to household work, and hence may imply a higher creditworthiness. Finally, two dummies indicating the year in which the loan was approved by the bank were added to the model. All explanatory variables are assumed to be exogenous or predetermined at the time of loan application.

To address the censoring problem, I considered a *Tobit model* (GREENE 2000, pp. 905-926) in the estimation of the investment equation. Conventional marginal effects in the Tobit model vary with different values for the regressors. They give the total effect of a change in explanatories on the observed, censored investment volume. In an imaginary way, the latter effect can be decomposed into an effect on the conditional mean (and thus the size) of investment *plus* an effect on the probability that the farm invests at all (MCDONALD and MOFFIT 1980). The implicit assumption of the Tobit model is that the given regressors explain *both* effects. In the present study, the *uncensored* part of the model is the relationship of interest, whereas the qualitative choice whether to invest or not is not analysed more deeply. Regarding the zeros as implying unobserved disinvestment might provide a rationale for this approach. In this case, the marginal effects are given by the *coefficients* of the Tobit model (JOHNSTON and DINARDO 1997, pp. 436-439).

In the standard Tobit formulation, the level of investment is still explained by a model that is linear in parameters. However, by including *higher-order polynomials* into the equation, the model can be made much more flexible. The aim of introducing more flexibility is to trace more closely the true functional relationship between credit and investment. I hence augmented the Tobit equation by a quadratic and a cubic term for the credit variable. This is assumed to contribute little to improve the explanatory power of the model with regard to the decision to invest at all (i.e. the qualitative choice part of the Tobit model). The virtue of this procedure is that a cubic function for the uncensored part of the investment equation obtains, which can be used for the further analysis of the credit-investment relationship.

Investment volume in thousand zl is the aggregate of all productive investment, including land, all types of agricultural machinery, farm buildings, livestock, permanent crops, to name the most important. Only gross investment is considered here, to avoid the difficult choice of a depreciation rate. Credit access was measured as the total volume of credit with a repayment term of more than 12 months taken by the farmer in the period 1997-1999. There were 81 single loan contracts reported for the group of farmers under investigation. 78 percent of borrowers obtained at least one loan under the government program. The capital stock Z at the outset of the investment period was difficult to measure, since detailed statements on farm assets were only available for 1999. I used the nominal value of land owned by the farm in the beginning of the investment period, as in the Probit model. The advantage of using land as compared to other assets is that the problem of depreciation can reasonably be ignored.

5 RESULTS

An evaluation of the qualitative information on credit access showed that 45.2 percent of all farmers must be regarded as being exogenously constrained. The pool of constrained respondents is used for the estimation of the investment equation. Note however that only 79.5 percent of these respondents reported positive investment, and only 44.1 percent took long-term loans. Subsequently I present the results of the Probit analysis and the empirical investment equation.

5.1 Probability of being credit rationed

The variables used in the Probit model are described in Table 1, net of drop outs due to data cleaning and missing values.

Table 1: Description of variables used in the Probit model

	Mean	*Std. Dev.*	*Minimum*	*Maximum*	*Valid observations*
Credit rationed (dummy)	0.5	0.5	0.0	1.0	345
Total land owned beginning of 1997 (ths. zl)	65.2	88.6	0.0	600.0	345
Adult males in household (no.)	1.7	0.9	0.0	5.0	345
Adult females in household (no.)	1.7	0.9	0.0	5.0	345
Previous loan rescheduled (dummy)	0.7	0.5	0.0	1.0	345
Conversation with neighbour (dummy)	0.1	0.3	0.0	1.0	345
Year of loan approval = 1997 (dummy)	0.3	0.5	0.0	1.0	345
Year of loan approval = 1998 (dummy)	0.2	0.4	0.0	1.0	345

Notes: 4.227 zl = 1 € in 1999.
Source: Own calculations.

The regression results are shown in Table 2. Somewhat surprisingly, the coefficient of Total land owned beginning of 1997 is not significant. To the extent that the volume of *available collateral* is appropriately measured it can hence be concluded that it is of *less importance* in the general observation of credit rationing. On the other hand, the *reputation effect* as measured by the Previous loan rescheduled dummy is *quite significant*, with a *t*-value of almost three.

The positive sign of the dummy on village internal information flow supports the above mentioned

Table 2: Probit estimates of the probability of being credit rationed

	Coefficient	t-*value*	*Marginal effect*
Constant	-.272	-1.163	–
Total land owned beginning of 1997 (ths. zl)	<-.001	-.300	-.010
Adult males in household (no.)	-.217	-2.652	-8.581
Adult females in household (no.)	.149	1.813	5.894
Previous loan rescheduled (dummy)	.737	2.998	29.151
Conversation with neighbour (dummy)	.448	2.850	17.711
Applied in 1997 (dummy)	-.258	-1.691	-10.199
Applied in 1998 (dummy)	-.086	-.453	-3.402
Chi-squared (significance)		26.985 (<.001)	
Percent correctly predicted		60.3	
Observations		345	

Notes: Marginal effects in percentage points, calculated at sample means.
Source: Own calculations.

view concerning reduced diligence of the borrower. A second explanation is that better information about farming activities of a given borrower led the bank to the impression that this borrower is in fact *not* creditworthy. He may thus have obtained less credit than expected and consequently be classified as credit constrained.

Regarding the *household characteristics*, the coefficient of the number of males is significant at less than one percent. Apparently, more men in the farm household tend to relax the credit constraint, which may be explained by different consumption habits of men. Alternatively, more men in the household could make the farm more creditworthy due to a higher share of labour devoted to farm production as opposed to household work. The reverse holds for women, however less significant.

The regression also reveals that applying in 1997 significantly reduced the probability of being credit rationed. This finding is quite in line with the fact that governmentally subsidised credit expansion in the farm sector showed a clear peak in this year. In subsequent years, governmental credit programs were cut down, which arguably resulted in a relative deterioration of credit access of farmers (see CZERWINSKA-KAYZER 2000).

The null hypothesis that all slopes of the model are zero as represented by the chi-squared statistic is clearly rejected. The percentage of correctly predicted outcomes reveals a fairly satisfactorily fit of the model.

The marginal effects display the slope of the probability function at sample means. For the interpretation of the marginal effects of the two explanatory dummies it is useful to imagine a division of the sample into two subgroups, one for which the dummy takes the value of zero, and one for the other. In this case, the marginal effects of the dummy variables are the difference of the probability of being credit rationed between the two subgroups at the means of all other independent variables. At sample means, the subgroup of respondents who rescheduled a loan in the past had a 30 percentage points higher probability of being credit rationed than the subgroup with a better reputation. Reputation thus plays a key role in determining credit access of farm households.

5.2 Investment equation

I now turn to the investment analysis. The characteristics of the subsample used for estimation are illustrated by a number of descriptive statistics in Table 3. I display values separately for all constrained respondents and for constrained non-zero investors.

Table 3: Description of variables used in the investment model (constrained subsample)

	Mean	*Std. Dev.*	*Minimum*	*Maximum*	*Valid observations*
All constrained respondents					
Investment volume 1997-1999 (ths. zl)	24.8	42.4	0.0	322.5	156
Credit volume 1997-1999 (ths. zl)	20.6	43.2	0.0	400.0	156
Land owned beginning of 1997 (ths. zl)	65.7	97.3	0.0	600.0	156
Farm has permanent book-keeping (dummy)	0.4	0.5	0.0	1.0	156
Farm is located in northern region (dummy)	0.3	0.5	0.0	1.0	156
Respondents with positive investment					
Investment volume 1997-1999 (ths. zl)	31.2	45.5	0.0	322.5	124
Credit volume 1997-1999 (ths. zl)	24.8	47.4	0.0	400.0	124
Land owned beginning of 1997 (ths. zl)	60.2	88.4	0.0	520.0	124
Farm has permanent book-keeping (dummy)	0.5	0.5	0.0	1.0	124
Farm is located in northern region (dummy)	0.3	0.5	0.0	1.0	124

Source: Own calculations.

The results of the estimations are presented in Table 4. I report the results for three specifications. Mainly for purposes of exploration and comparison, I estimated a linear investment equation by Ordinary Least Squares (OLS) (I). This equation is also used for testing selectivity, it is therefore estimated in a two-stage procedure together with the above Probit equation (HECKMAN 1979; JOHNSTON and DINARDO 1997, pp. 447-450). The second specification is a conventional Tobit model (II), to account for the censoring of the investment variable. Marginal effects at sample means are reported separately. The third specification is the cubic Tobit model (III), which includes the credit variable in quadratic and cubic form. For this model, marginal effects are analysed separately below.

Table 4: Estimated investment equations

	Linear (I)	*Standard Tobit (II)*		*Cubic Tobit (III)*
	Coefficient	*Coeffi-cient*	*Marginal effect*	*Coefficient*
Constant	3.478 (.437)	-.782 (-.229)	–	1.558 (.442)
Credit volume 1997-1999 (ths. zl)	.739 (14.237)	.783 (13.161)	.602	.418 (2.031)
Credit ^ 2	–	–	–	.003 (1.392)
Credit ^ 3	–	–	–	<-.001 (-1.120)
Land owned beginning of 1997 (ths. zl)	-.051 (-2.139)	-.082 (-2.678)	-.063	-.100 (-3.131)
Farm has permanent book-keeping (dummy)	7.868 (1.853)	10.597 (2.087)	8.145	14.195 (2.684)
Farm is located in northern region (dummy)	17.267 (3.393)	20.909 (3.422)	16.070	23.387 (3.813)
Inverse Mills Ratio	1.521 (.162)	–	–	–
Log-Likelihood	-714.319	-610.996		-608.950
Adjusted R^2	.666	–		–
N	156	156		156

Notes: *t*-values in parentheses. *t*-values of the linear model corrected for selectivity. Marginal effects calculated at sample means of selected observations.
Source: Own calculations.

A number of important conclusions can already be derived from the linear model. First, in contrast to received neo-classical thinking, the financial variable *does* have an effect on investment outcomes. This is consistent with the self-classification of borrowers as being credit rationed. Credit access is of overwhelming importance in the linear model (as measured by the *t*-value). The coefficients of all other regressors have the expected signs and are significant, at least at the ten-percent level. The coefficient of the land variable is significant at five percent, indicating that *farms with fewer assets at the outset invest more*. The coefficient of the Inverse Mills Ratio which tests the impact of selectivity fails to be significant, it can hence be assumed that there is *no selectivity bias* in the equation. For this reason I ignore selectivity in all other estimations. A further conclusion concerns the marginal effect of credit on investment in the linear model. The effect is smaller than one, which already points at an *underutilisation of credit for investment purposes*. This is in accordance with the farmers' reported use of credit funds for what could be called 'durable consumption goods', for example renovating residential buildings or automobile purchases. Only for 50 percent of borrowers does the amount of productive investment exceed the credit volume. However, the linear model imposes that the marginal effect is constant over the entire range of observations, as noted earlier.

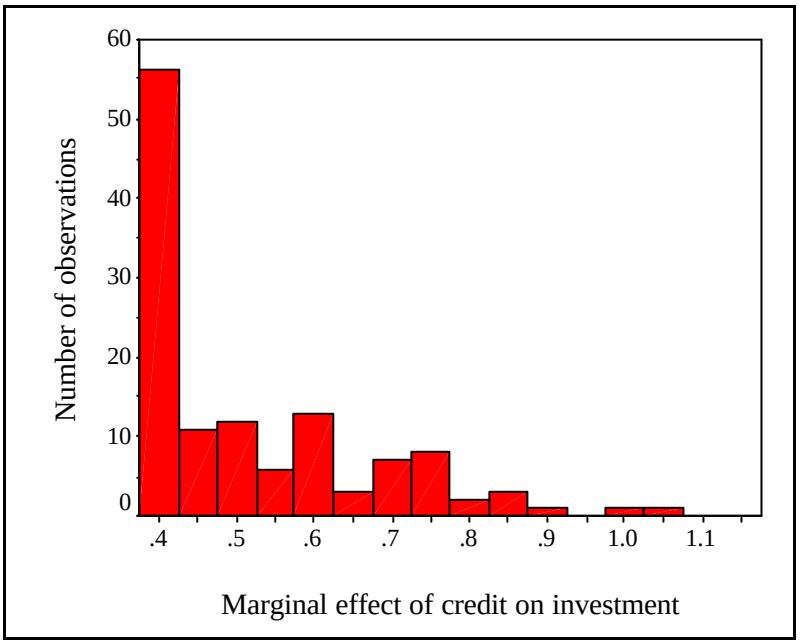
The two other specifications are primarily used to further examine the marginal credit effect. Since they introduce additional flexibility into the specification, they should trace this effect more accurately.

As can be seen from the values of the Log-Likelihood function, the fit of Models II and III continuously improves as compared with the linear model.

The marginal effect given in Table 4 for the standard Tobit model is the partial derivative of expected investment with respect to credit, evaluated at sample means. This marginal effect again is smaller than one, even lower than in the linear model. If the coefficients of the Tobit model are taken as the correct marginal effects, they still indicate a slope smaller than one. The general result of a diversion of the marginal credit funds from investment is hence supported.

The cubic Tobit model achieves the best fit of the data in terms of the Log-Likelihood, although the improvement as compared to the standard Tobit is small. It might be taken as the most flexible and therefore also the most accurate depiction of the true relationship. However, as compared to the two other models, flexibility increases at the cost of less precisely estimated coefficients of regressors, as shown by their *t*-values. To check the precision of the marginal effect, I calculated the latter together with its standard error at sample means of non-zero investors (see GREENE 2000, p. 326). This resulted in a marginal effect of .559 with a *t*-value of 4.502, which is significantly different from zero at the one percent level. Therefore using the coefficients of the cubic Tobit model, I computed marginal effects individually for all investors in the sample (Figure 1). The shown histogram offers two interesting insights: First, almost *all observations fall below the threshold of one* (98.4 percent, to be precise). Second, the mean of these individual marginal effects is substantially *below* the (constant) marginal effects obtained from the coefficients of Models I and II.

Figure 1: Distribution of marginal credit effects



Notes: Mean = .526; Std. Dev. = .144; N = 124.
Source: Own calculations based on cubic Tobit model.

A further analysis of the functional relationship between credit and investment based on the cubic Tobit coefficients reveals that, over the range of commonly observed credit volumes, the *marginal effect increases with increasing credit volume.* The function is hence convex, i.e. the second derivative is positive. Only at a credit volume of 200 ths. zl, there is an inflection point, indicating a decreasing marginal effect for larger credit volumes. In the range between 150 and 275 ths. zl credit volume, the slope is almost stable at about one or even slightly higher. In terms of additional mobili-

sation of funds, this could thus be called an optimal credit volume range. However, only 1.6 percent of actual observations fall in this range. More than 95 percent of the observed credit volumes fall below 100 ths. zl and hence in a range of the function where its slope is clearly below one.

If the land variable is taken to measure farm size, the following relationships can be traced empirically. There is a significant positive correlation of .22 between farm size and credit volume, i.e. large farms seem to invest more. The correlation between credit volume and land owned is .30. Accordingly, particularly if non-borrowers are neglected, high farm-individual marginal credit effects are found in the group of relatively larger farms. However, net of the credit effect, *large farms invest less*, as can be seen from the regression results. The implication is that, out of a group of farms with equal credit volume, smaller farms devote a higher amount of money for investment. There are hence two opposing effects with regard to investment: larger credit volumes imply more, but larger farm sizes as such (i.e. controlling for credit volume) imply less investment. Overall, it is therefore incorrect to say that large farms invest more, but if they use credit for investment, they obtain larger credit volumes and hence divert less to non-productive activities.

6 CONCLUSIONS

The major results of this empirical study of farm investment in Poland can be summarised as follows. First, access to subsidised credit plays a significant role in determining investment behaviour of farmers who self-classified as being exogenously credit constrained. This classification applies to 45 percent of all respondents. Major determinants of being credit rationed are the reputation of the loan applicant as well as demographic household characteristics. Respondents with a good credit history have a 30 percentage points lower probability of being rationed than borrowers who rescheduled a loan in the past. In addition, more adult males in the household decrease the probability of being credit rationed, while more females increase it. This is assumed to be an effect of higher liquidity demand for consumption purposes by women or a signalling effect due to the higher share of male labour force. On the other hand, an effect of collateralisable wealth could not be detected.

Second, in various specifications of the credit-investment relationship, the marginal effect of credit on investment was clearly smaller than one, implying that credit is partly used for other purposes than productive investment. Based on a cubic Tobit estimate of the investment function, the mean of the farm-individual marginal effects was at .53 on average. Other, less flexible models presented as well principally support this result. Every second borrower invests less in productive assets than borrowed. Only 1.6 percent of the selected respondents with positive investment displayed farm-individual credit effects larger than one. Over the observed range of credit volumes, the marginal effect increases with an increasing credit volume.

The results are consistent with the following *policy implications*. Although farmers make their investment decisions conditional on the availability of subsidised credit, funds are only partly used for productive investment. The diversion of funds is the more substantial the smaller the loan amount is. This might be taken as evidence for a band-wagon effect, i.e. small loan amounts are taken on favourable terms to finance consumption activities, whereas there is no actual investment project available. If diversion is regarded as undesirable, one solution could be to concentrate future lending on large loan amounts, up to a size of 275 ths. zl. In contrast, lending in small amounts below 150 ths. zl contributes less to foster productive investment. However, the results provide evidence against the view that investment is positively related to farm size. If high investment levels are the aspired policy goal, a discrimination of small farms should be avoided.

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