Investment, and Contract Hold-Ups in Transition: Evidence from Hungary

Abstract: This paper analyses empirically the effect of "hold-ups" on capital investment in farms using a sample of 318 Hungarian enterprises, surveyed over 1997. A negative relationship arises between capital investment and the incidence of hold-up behaviour. This relationship is affected by farm's wealth and liquidity position, the quality of legal enforcement of contracts, by whether farms have contracted sales to foreign processors, and whether they are established as successors t pre-reform organisations rather than start-up businesses.

Keywords: contracting, hold-ups, firm investment, transition.

1. Introduction

Transition has caused major institutional disruptions with negative effects for output and investment. One of the major transition-related institutional problems is the occurrence of contract breaches, or "hold ups"[1]. "Hold-ups" occur when one party in a contract *ex post* exploits contractual imperfections to extract quasi-rents after the other party has sunk contract-specific investments (Milgrom & Roberts, 1992; Klein, 1996; Gow & Swinnen, 1998; Gow *et al.*, 2000).

One common form of such behaviour in transition is delays in payments for delivered products. In high inflation environments, these imply major rent extractions. For instance, in the Slovak Republic, the average payment delays caused by food processors at the expense of farms that supply raw materials was around 100 days, in 1994 and 1995 (Gow & Swinnen 1998). A 1998 survey among food processors concluded that late payments were considered the single most important obstacle to company growth in the Czech Republic and Slovenia, while this factor was ranked number 3 out of 12 possible causes in Hungary (Gorton *et al*., 2000).

While there is much ad hoc evidence on the occurrence of contractual breaches and hold-ups, there is little consistent and representative evidence, especially on hold-ups' impact on firm investment and growth. In general, empirical work on contracting has been dominated by case studies. This is mainly due to the difficulty of consistently measuring across firms and sectors variables such as contracting cost, asset specificity, transaction complexity etc. (Shelanski & Klein, 1995). Moreover, most of the existing studies have focused on the determinants of contract choice rather than on factors explaining contractual breaching and the effect of the latter on economic activity (see for instance, Allen & Lueck, 1999; 1995; 1992; Johnson *et al.*, 1999; Joskow, 1987; Leffler & Rucker, 1991; McMillan & Woodruff, 1998).

The objective of this paper is, first, to empirically estimate the impact of hold-ups on firm investment, and, second, to identify conditions under which firms are more susceptible to hold-up problems. The empirical analysis is based on a 1997 survey of more than 300 agricultural enterprises that contracted sales to food processing companies, in Hungary.

2. Transition, Hold-Ups, and Investment: The Conceptual Framework[2]

Under the Communist regime, production and processing were centrally planned and vertically integrated through the central command system. Many industries were composed of state-owned firms, which were large and, in certain cases, operating on both sides of the market. This allowed production and resource allocation decisions as well as target prices to be centrally

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[1] Williamson (1975) and Klein *et al*., (1978) were the first scholars to emphasise and elaborate the importance of the hold-up problem for the analysis of business institutions and practices. Subsequently, growing interest in the subject was marked with important contributions to the theoretical literature by Williamson (1983, 1985), Milgrom & Roberts (1992), Shelanski & Klein (1995), Klein (1996), etc.

[2] See Gow *et al*., (2000) for a formal model.

set while enabling the central authority to provide effective contract enforcement with transacting parties facing a low (or zero) probability of being held-up.

Transition reforms, however, caused several institutional changes leading to widespread breaches of commercial contracts. First, economic reforms split the vertically integrated chains into autonomous enterprises. The subsequent privatisation and restructuring process created many independent enterprises. Second, the previous legal system (or the central planning authority) was no longer able to enforce contracts while a new legal enforcement mechanism was absent or ineffective. Third, since the transacting parties had no previous experience with hold-ups, private enforcement levels were left unchanged and producers continued making relationship-specific investments. Fourth, macro-economic reforms including price and trade liberalisation caused dramatic changes in both nominal and relative prices. During the beginning of the 1990s, after many years of near price stability, inflation jumped to several hundreds of percent while in agriculture, for instance, terms of trade declined dramatically.

It is not difficult to imagine the emergence of infringements on private contracts following these reform-related shocks. For example, in the post reform, one observes widespread hold-up behaviour on the part of the food processors at the expense of primary agricultural producers under the form of long (up to several months) delays in payments for products delivered on contract. The payment delays effectively provided processors with interest free loans from supplying farms. With high inflation, the rent extraction was significant.

The incidence of hold-ups was reinforced by two factors. First, the combination of macro-economic reforms, the simultaneous institutional reform of the banking system, both raising the cost of capital, and the cut in government subsidies caused severe financial distress for all companies. This effectively reduced the capital costs of breaching the contract. Second, once a contract breach had occurred, the reputation of the evading processor was already undermined driving down the costs of contract breach in the future.

Impact on investment

The overall impact of hold-ups is thought to have been important. Payment delays caused additional financial strain and worsened farms' already severe cash flow and profitability problems. However, not only did the farms suffer but so did the processors. As farmers expected continued hold-ups they no longer wanted to invest in production involving high asset-specificity (or company-specificity). As a result the supplies to the processing firms declined both in quantity and in quality, with obvious negative effects on the processors.

The occurrence of hold-ups can affect farm investment in two ways: (a) directly, via the effect of a hold-up on firm's cash flow and (b) indirectly, via the recognition of a hold-up potential. Concerns on the above may lead to sub-optimal investment as risk-averse farms, fearing that their investments will leave them vulnerable, refuse to make the efficient investment. Such concerns are especially due in transition countries where "a combination of high litigation costs, ineffective contract law, poor third party verifiability, and the potential loss of the only suitable trading partner make the use of legal dispute mechanisms not viable (Gow *et al.*, 2000)".

Even with risk-neutral transactors, however, the presence of possible hold-up behaviour, following unanticipated changes in market conditions, will entail costs as real resources are devoted to the attempt to improve post-transaction bargaining positions in the event of such a contingency occurring. In general, less specific investment will be made to avoid being "locked in" (Klein *et al.*, 1978). Agents might move real resources to sectors with lower asset specificity requirements. These reallocations are, however, inefficient because they reflect market imperfections and institutional failures rather than real costs of alternative resource use[3]. For

[3] Examples of such failures might include incomplete contracts, scarce legal enforcement due to weak formal institutions or transaction costs that are too high to justify court enforcement.

instance, a particular investment in farming could result profitable under a regime whereby contracts are fully enforceable. Only enforceable contracts can lead to efficient (optimal) investment levels (Edlin & Reichelstein, 1995).
Almost all investments are liable, to some extent, to sunken costs due to a loss in the value of the assets when used outside the specific setting or relationship. The sorts of assets that are most problematic, however, are specific assets, i.e., "durable investments that are undertaken in support of particular transactions, the opportunity cost of which investments is much lower in best alternative uses or by alternative users should the original transaction be prematurely terminated (Williamson, 1985)". The real problem with asset specificity is that it creates quasi rents to be appropriated. For instance, there may be many potential suppliers of a particular asset to a particular user but once the investment in the asset is made, even with free competition for entry to the market, the asset is so specialised to the particular user (or more accurately the costs of making it available to others are so high) that quasi rents are created (Klein *et al.*, 1978).

Finally, given the incomplete nature of contracts, it is because, in the real world, there is uncertainty over what the future conditions will be and how transactors will behave that contractual non-performance, including the hold-up, occurs. Moreover, uncertainty as a source of transaction costs, reflected as both incentives and enforcement costs, could also give rise to specificity. For instance, the higher the fixed transaction costs associated with an asset (investment) including costs for searching, negotiating, screening and supervising of business partners, the higher its specificity. In some cases, fixed transaction costs associated with an investment might be prohibitively high giving rise to the potential for a hold-up to occur.

One would expect that factors affecting the specificity of investment to a particular contract (or exchange), such as the nature of the activities the investor is involved in, contract complexity, and characteristics of the trading partner, will have some bearing on when the investing firm considers hold-ups probable as well as on how it will adjust resources and investment in presence of hold-ups. In the rest of this paper we will test these hypothesised effects empirically. We estimate the relationship between investment and hold-ups, measured as delayed payments for products delivered on contracts, using data from a survey of Hungarian agricultural enterprises delivering to food companies. In addition, we estimate how a variety of factors affect this relationship, including the financial position of the farms, indicators of asset specificity, uncertainty and the effectiveness of the legal enforcement of private contracts, market imperfections reflected in high search costs, and the origin/ type of the trading partners such as the locally operating foreign processors.

3. The Empirical Model

The empirical specification relies on an augmented liquidity-based model of investment demand. The main equation is of the following form[4]:

$$\begin{aligned} &Y_{1i}^{*} = Y_{2i}\psi_1 + X_{1i}^{'}\beta_1 + u_{1i} \qquad u_{1i} \approx NID(0,\sigma_u^2) \\ &Y_{1i} = Y_{1i}^{*} \quad if\ Y_{1i}^{*} > 0 \\ &Y_{1i} = 0 \quad if\ Y_{1i}^{*} \leq 0 \end{aligned} \tag{1.1}$$

for $i = 1, ..., H$.

where Y_{1i} represents the observed level of investment in farm *i* (see section 4, for definition). Y_{1i} is censored at zero and defined on the basis of the continuous latent Y_{1i}^{*}[5]. $X_{1i}^{'}$ is a *1xM* vector of

[4] The formal derivation of the model and details on its underpinnings in the empirical literature are presented in an extended version of the paper, which the authors can provide on request.

weakly exogenous variables explaining investment, or $X_{1i}^{'} = (1, x_{1i1}, x_{1i2}, ..., x_{1im})$ using vector notation. Y_{2i} is the hold-up variable of unknown exogeneity properties[6]. u_{1i} is an i.i.d. standard normal error term with zero mean and constant variance and, ψ_1 and the vector $\beta_1 = (\beta_{10}, \beta_{11}, \beta_{12}, ..., \beta_{1m})^{'}$ are estimable coefficients.

If Y_{2i} is endogenous, the usual tobit estimator for equation (1.1) is inconsistent. A more appropriate estimation technique is the Two Stage Conditional Maximum Likelihood (TSCML). Smith & Blundell (1986) show this method to yield consistent estimators for the simultaneous tobit model[7]. Rivers & Vuong (1988) demonstrate similar properties for the simultaneous probit model. Vella (1993) considered the case of a simultaneous equation model with a primary equation for an uncensored dependent variable on censored endogenous regressors.

Following TSCML, an auxiliary reduced-form equation for Y_{2i} is also estimated, in addition to the investment equation given in (1.1). This takes the following form:

$$\begin{aligned} &Y_{2i}^{*} = X_{i}^{'}\mu_2 + v_{2i}, \qquad v_{2i} \approx NID(0, \sigma_v^2) \\ &Y_{2i} = 1 \quad if \quad Y_{2i}^{*} \leq \gamma_1 \\ &Y_{2i} = 2 \quad if \quad \gamma_1 < Y_{2i}^{*} < \gamma_2 \\ &Y_{2i} = 3 \quad if \quad Y_{2i}^{*} > \gamma_2 \\ &\text{for } i = 1, ..., H. \end{aligned} \qquad (1.2)$$

where Y_{2i} is a polychotomous observable whose values follow a logical ordering (i.e., 1, 2, 3) representing farms' responses on whether hold-ups are important, somehow important, or unimportant constraints to expanding profits[8]. Y_{2i}^{*} is an underlying latent variable, mapped into its observed counterpart Y_{2i} through some censoring function *G*, $Y_{2i} = G(Y_{2i}^{*})$, driving the choice between alternatives in Y_{2i}. $X_{i}^{'}$ is a *1xK* vector of observations on variables maintained as weakly exogenous, such that $X_{i}^{'} = (X_{1i}^{'}, X_{2i}^{'})$, with $X_{2i}^{'}$ containing exogenous regressors pertinent to equation (1.2) only so as to allow the system's identification. v_{2i} is an i.i.d. standard normal error term, and the γ-s are unknown "threshold" parameters characterising the boundary values defining the range of the observable Y_{2i}. Finally, $\mu_2 = (\mu_{20}, \mu_{21}, \mu_{22}, ..., \mu_{2k})^{'}$ is a vector of estimable coefficients.

The empirical model (1.1) – (1.2) includes both a censored dependent variable in (1.1) and an endogenous regressor, which is itself ordered categorical. This is a combination of the models of Smith & Blundell and Vella. Following Smith-Blundell-Vella, first, the conditional model for (1.1) – (1.2) is derived below. Then, estimates of the unobserved heterogeneity, responsible for the endogeneity bias, are included as an additional explanatory regressor in the primary equation. These are obtained as the "generalised residuals", in the Cox & Snell (1968) sense, from the

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[5] One can loosely interpret Y_{1i}^{*} as the desired level of investment for farm *i*.

[6] In the survey, the indicator variable for hold-ups represents the responses from enterprise managers to the question of whether delayed payments for delivered products are important, somewhat important, or unimportant constraints to profitability. Obviously, there is a potential endogeneity problem as the importance of the constraint may partially reflect the amount of investment by the farms.

[7] In the Smith-Blundell model, the structural equation regresses a censored dependent variable on explanators including a continuous (uncensored) endogenous regressor, for which a reduced form equation is provided.

[8] The variable distribution is determined by the way the relevant information/question was structured in the survey.

reduced form equation (1.2). Finally, a test on the significance of the additional residual term appearing as explanatory is a test for Y_{2i}'s exogeneity in the investment equation (1.1).

Consider the above two-equation simultaneous model again:

$$\begin{aligned} Y_{1i}^* &= Y_{2i}\psi_1 + X_{1i}^{'}\beta_1 + u_{1i}, \\ Y_{2i}^* &= X_i^{'}\mu_2 + v_{2i}, \\ for \quad i &= 1,\dots,H. \end{aligned} \tag{1.3}$$

Assume u_{1i} and v_{2i} have a joint normal distribution with zero mean and finite positive definite covariance matrix:

$$\begin{bmatrix} u_{1i} \\ v_{2i} \end{bmatrix} \approx NID\left(0, \begin{pmatrix} \sigma_{uu} & \sigma_{uv} \\ \sigma_{vu} & \sigma_{vv} \end{pmatrix}\right) \tag{1.4}$$

Further, assume $X_i^{'}$, u_{1i}, v_{2i} are i.i.d and the parameters of the model are identified up to some normalisation. System (1.3) is written in its conditional form, by taking expectations conditional on Y_{2i}, as:

$$\begin{aligned} E\left(Y_{1i}^*\middle|Y_{2i}\right) &= \psi_1 E\left(Y_{2i}\middle|Y_{2i}\right) + \beta_1 E\left(X_{1i}^{'}\middle|Y_{2i}\right) + E\left(u_{1i}\middle|Y_{2i}\right), \\ E\left(Y_{2i}^*\middle|Y_{2i}\right) &= \mu_2 E\left(X_i^{'}\middle|Y_{2i}\right) + E\left(v_{2i}\middle|Y_{2i}\right) \end{aligned} \tag{1.5}$$

The conditional error terms $E\left[u_{1i}\middle|Y_{2i}\right]$ and $E\left[v_{2i}\middle|Y_{2i}\right]$ (i.e., best predictions of u_{1i} and v_{2i} given Y_{2i}), are the generalised errors in the Cox & Snell (1968) sense. Denote those as $\tilde{u}_{1i}(.)$ and $\tilde{v}_{2i}(.)$. Rewriting $\tilde{u}_{1i}(.)$ in terms of $\tilde{v}_{2i}(.)$, the following expression can be obtained[9]:

$$E\left(u_{1i}\middle|Y_{2i}\right) = E\left(E\left(u_{1i}\middle|v_{2i}\right)\middle|Y_{2i}\right) = E\left(\alpha v_{2i}\middle|Y_{21}\right) = \alpha E\left(v_{2i}\middle|Y_{2i}\right) = \sigma_{uv}\sigma_{vv}^{-1}\,\tilde{v}_{2i}(.) \tag{1.6}$$

where $\alpha = \sigma_{uv} / \sigma_{vv}$.

Accordingly, one can rewrite the main equation in (1.5) as:

$$\begin{aligned} E\left(Y_{1i}^*\middle|Y_{2i}\right) &= \psi_1 Y_{2i} + X_{1i}^{'}\beta_1 + \alpha E(v_{2i}|Y_{2i}) + \varepsilon_{1i} \\ E\left(Y_{1i}^*\middle|Y_{2i}\right) &= \psi_1 Y_{2i} + X_{1i}^{'}\beta_1 + \alpha\tilde{v}_{2i}(.) + \varepsilon_{1i}, \\ Y_{1i} &= Y_{1i}^* \qquad if\ Y_{1i}^* > 0 \\ Y_{1i} &= 0 \qquad otherwise \end{aligned} \tag{1.7}$$

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[9] Such expression is arrived at by using the assumption of joint normality between u_{1i} and v_{2i} and the law of iterated expectations. Note that the law of the iterated expectations $E\left(u_{1i}\middle|Y_{2i}\right) = E\left(E\left(u_{1i}\middle|v_{2i}\right)\middle|Y_{2i}\right)$ is applicable since v_{2i} provides as much information about the stochastic nature of u_{1i} as the continuous latent Y_{2i}^*, while the latter tells more than its ordered counterpart, Y_{2i}. The observations in the vector of exogenous variables are fixed in repeated samples and μ_2 is a vector of constants.

where ε_{1i} is a zero mean error, which is uncorrelated with the regressors by construction. An additional assumption on the distribution of ε_{1i} is required in order to proceed with estimating the structural equation in (1.7). This paper proceeds with a tobit estimation of (1.7) making use of the usual normality conditions though, in general, ε_{1i}'s distribution will be unknown (Vella, 1993). This is admittedly an *ad hoc* assumption. However, a test for the normality of the error term ε_{1i}, based on the method of the scores shows the errors to be roughly normal[10].

The TSCML is then computed in two steps. Initially, the vector μ_2 of coefficients in the reduced-form equation (1.2) is estimated as an ordered probit model by Maximum Likelihood (ML). Then, the $\hat{\mu}_2$ estimates are used to calculate estimates of the generalised residuals $\hat{\tilde{v}}_{2i}(.)$ [11]. Second, the tobit estimation of the equation for Y_{1i} with $\hat{\tilde{v}}_{2i}(.)$ appearing as explanatory, in addition to Y_{2i} and $X_{1i}^{'}$, provides consistent estimates for the coefficients in equation (1.7).

Moreover, the additional regressor $\hat{\tilde{v}}_{2i}(.)$ captures the dependence between the error term in equation (1.1) and that from the reduced form equation (1.2). As a result, a sufficient condition for Y_{2i} being weakly exogenous is $\sigma_{uv} = 0$ [12]. Thus the tobit estimator for α in the estimated conditional model provides the required test of $H_0 : \alpha = 0$. If $\alpha = 0$, then TSCML is consistent and asymptotically efficient since Y_{2i} and u_{1i} are independent so that Y_{2i} may be treated as exogenous. In this case, we can use the unadjusted standard errors (SEs) from the original output since $\alpha = 0$ implies no endogeneity bias is present (Vella, 1993)[13].

4. Variables and Data[14]

The empirical analysis uses data from a 1997 survey of Hungarian agricultural enterprises implemented by the Central Statistical Office of Hungary (CSO) in collaboration with the Department of Agricultural Economics at the Budapest University of Economic Sciences and the Department of Agricultural Economics at the Catholic University of Leuven, in Belgium[15].

The survey randomly selected a sample of 367 agricultural enterprises, which were surveyed as representative for the country. The enterprises are all large farms and include a variety of organizational forms such as cooperatives, partnerships, limited liability and shareholding companies. From this original sample, a sub-sample of 318 farms involved in contracts with food processing companies was drawn. The analysis in this paper is based on this sub-sample.

The full empirical specification of the system in (1.1) - (1.2) is as follows:

$INV = f(LIQ, WLTH, EXP, DPAY, ORG, SPEC, SUC, MATR, INTR, INVSUB, INTSUB, GUAR)$ and

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[10] This tests for the absence of skewness and excess kurtosis by specifying a general distribution for ε_{1i} and then testing the restrictions of no skewness and kurtosis, which reduce the general distribution to the normal one. For a detailed discussion of the test, see Verbeek (2000) p. 206-207, and Johnston & DiNardo (1997) p. 149.

[11] The generalised residuals can be estimated by making use of results in Gourieroux *et al*., (1987) which show that the best prediction for the error term is the score with respect to the intercept.

[12] Since, $X_i^{'}$ is exogenous to Y_{1i}, by assumption, then the source of any potential endogeneity of Y_{2i} is the unobserved heterogeneity embodied in $\tilde{v}_{2i}(.)$.

[13] The need for correcting the SEs results from extra heterogeneity in the main equation resulting from the inclusion of generalised residual from the reduced form equation (1.2) as an additional explanator.

[14] More detailed descriptions of the variables used in here, their specifications and summary statistics are provided in the extended version of the paper.

[15] The survey was carried out in the framework of a joint research project sponsored by the European Union's ACE 1996 Programme.

$$DPAY = g(LIQ, WLTH, EXP, ORG, SPEC, SUC, MATR, BUY, CAP, FDI, PREF, CGUAR, PRCINF, LEG)$$

Where INV (=Y_1), is the flow of *gross capital investment* during 1997 normalised by the stock of the gross capital assets at the beginning of the period, CAP. This normalisation controls for the effects of size, as well as reduces the problem of remaining outliers and the severity of heteroskedasticity and sample heterogeneity[16,17]. Other financial variables are also scaled by the stock of fixed capital at the beginning of the period[18].

$DPAY$ (=Y_2) is a categorical variable taking the values 1,2 or 3 whenever farms responded that delayed payments for delivered products are unimportant, somehow important, or important constraints to profitability, respectively. The other (control) variables in the INV equation are:

LIQ, the *quick liquidity position* of the farm measured by the stock of working capital at the beginning of the period, normalised by gross capital lagged one period[19].

$WLTH$, the value of the farm's stock of own wealth used as a proxy for farm's *net worth position*. Due to lack of comprehensive information on beginning-of-period own wealth, a measure of the level of collaterised real estate assets (both agricultural and other) deflated by the stock of capital (lagged one period) is used. The exogeneity of this variable is difficult to prove formally given the cross-sectional nature of the data. The assumption here is that the investment process takes place after credit applications have been filed, thus, after collateral has been committed.

Following Gertler & Rose (1991), a measure of farm's *net worth position* expressed as the sum of $WLTH$ and LIQ normalised by the gross capital assets was also constructed (see Gertler & Rose, 1991; Hubbard & Kashyap, 1991)[20]. Regressions using net worth and owned wealth interchangeably yield identical results with the only difference being in the coefficients and *z*-values of the liquidity variable appearing slightly smaller whenever the net worth is used. Liquidity itself remains significant, nevertheless. In fact, the net worth variable, as measured additively ($WLTH + LIQ$) only exhibits a correlation of -.03 with liquidity while it is almost perfectly correlated with $WLTH$, as shown by a .98 correlation coefficient. Any results observed for the net worth variable will therefore, almost exclusively, be due to wealth. Only results from regressions with the wealth variable have been reported in here.

EXP, a measure of farm's *expectations* of future output conditions is used in addition to the liquidity variable to make sure that the later does not proxy for the former (Hoshi *et al.,* 1991; Hubbard & Kashyap, 1991)[21]. Assuming that expectations are extrapolations from previous periods, EXP is based on the rental value of total agricultural land cultivated in 1996 (including arable land, orchards, vineyards, pastures, forests, etc.) deflated by the stock of fixed capital for the same period. It should be noted that the land variable is an imperfect proxy for output as 27 percent of the farms in our sample are mainly livestock oriented. The reader is, therefore, cautioned against the structural interpretation of the coefficient on this variable. Finally, note that EXP only marginally overlaps with $WLTH$ because 94 percent of cultivated land was leased.

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[16] This is a standard normalisation rule in the literature (see, Kaplan & Zingales, 1997; Lamont, 1997; Chirinko & Schaller, 1995; Fazzari & Petersen, 1993; Whited, 1992; Hoshi *et al.,* 1991; Fazzari *et al.,* 1988).

[17] Information on replacement investment is unavailable. However, as usually done, this paper assumes that replacement investment is proportional to capital stock implying a geometric mortality distribution for investment goods (see, Chirinko, 1993; Jorgenson, 1967). As such, given the normalisation rule and the cross-sectional nature of the data, the effect of replacement capital is just a scaling constant that can be assumed away.

[18] A discussion of the rationale for such deflation rule and implications for the statistical validity of the results is provided in the extensive version of the paper.

[19] Information on the level of cash flows and sales, at the beginning of 1997, is not available but the liquidity variable in here is highly correlated with these. The correlation coefficients are .92 and .95, respectively.

[20] Hubbard & Kashyap (1991) use the value of farmland (or its prices) and the ratio of farm's equity to capital, as proxies for net worth. Gertler & Rose (1991) measure net worth by the sum of liquid assets and collateral.

[21] See, Hoshi *et al.* (1991) for a discussion of the rationale for including a proxy for output in addition to a variable for financial constraints.

Three variables capturing exogenous farm characteristics, which might explain cross-farm variations in investment behaviour, have also been included. These include *organisation* (ORG), experience or *maturity* ($MATR$), *specialisation* ($SPEC$), and information on whether the farm was established as a successor to previous organisations or a start-up business (SUC). ORG is specified as 1 if the farm is a cooperative and 2 if it is organised as limited partnerships, limited liability and joint-stock companies. $MATR$ is the natural logarithm of the number of years that the farm has been operating in the business since its establishment plus one. SUC is 1 if the farm is a start-up and 2 if it is a successor organisation. Finally, based on the share of crop to total sales, $SPEC$ categorises the farms between crop farms (crop sales 70 - 100 percent of total sales), mixed (30 - 70 percent) and livestock (0 - 30 percent). Besides controlling for additional heterogeneity, the specialisation index is intended to capture possible industry/activity-specific differences in capital-intensity requirements within the farming sector. It could be argued that the specialisation index is endogenous, since it is based on the total volume of realised sales, as reported at the end of 1997. Nevertheless, regressions run with and without this variable yielded identical results. Only results including the specialisation index have been reported in here as more instructive.

Two variables are added to include factors that might directly affect the investment demand such as investment subsidies, and the opportunity cost of capital proxied by the interest rate for loans. The *interest rate* ($INTR$) refers to farm's average interest charges for loans. This is assumed exogenous since farms can hardly influence lender- or government- determined rates. A dummy for *investment subsidies*, ($INVSUB$), was set to 1 when farms had received such subsidies.

A dummy variable for *interest subsidies* ($INTSUB$) and one for *credit guarantees* ($CGUAR$) set to 1 for farms receiving preferential access to credit during 1997, have been added to represent factors that directly affect the credit function (both demand and supply) and could be thought of as augmenting the interest rates on loans to reflect the real cost of borrowing/lending.

Finally, in addition to firm’s financial position (*LIQ*) and characteristics (*ORG, SPEC, SUC* and *MATR*), variables in the hold-ups equation (1.2) are intended to capture the effect of asset specificity, transaction complexity (type of contract, origin of parties), and contractor uncertainties. Specifically, the following measures are intended to reflect:

(i) specificity: a variable for whether farms find it *easier to locate a buyer* compared to 1993 (BUY) to capture market frictions and search costs; own wealth ($WLTH$), the stock of *gross capital assets* (CAP), and the land value (EXP). Admittedly, those are imperfect proxies for the specificity of assets held by the farm. Unfortunately, more adequate measures were not possible to construct given the information available.

(ii) transaction complexity: a dummy for whether the farms have contracted any sales to foreign *firms* (FDI), a dummy for whether *preferences* were included in the contracts ($PREF$), and one for whether any *guarantees* were foreseen ($CGUAR$).

(iii) contractor uncertainties: an indicator of whether the farms report the *lack of price information* as an important constraint ($PRCINF$), and an indicator of whether the farms report the ineffective court enforcement of contracts as an important constraint to their activity (LEG).

All variables contained in the vector X_i' and appearing as exogenous to the DPAY equation in the simultaneous system are maintained as weakly exogenous to investment as well. Variables for farm's internal liquidity, the level of gross capital assets, and total land cultivated in 1996, are exogenous because of reflecting beginning-of-period information. Further, assuming that contracting precedes investment, the variables for whether farms sell to downstream businesses with foreign involvement, and the dummies for contract preferences and guarantees, are exogenous to investment[22,23]. Those are also exogenous in relation to the hold-up's variable following the argument that contracting precedes any possible hold-up behaviour.

Variables reflecting farm characteristics or their perception of the effect that market imperfections have on their activity, are also exogenous in both equations because of representing past decisions and/or factors outside the farm's control. These variables are: the dummy for organisation, the dummy for whether farms are successor organisations as opposed to start-up businesses, the experience of the enterprise, the variable reflecting the effectiveness of the court system in enforcing private contracts, whether the farms report lack of market information, and whether it was easier to find a buyer in 1997 than in 1993.

5. Results

Table 1 reports results from the ML estimation of (1.1) assuming *DPAY* is exogenous. The findings provide support for the Gow & Swinnen (1998) arguments discussed in section 2. Regressions (1) – (3) show that DPAY has a significantly negative effect on investment This confirms theoretical expectations that fear of being held-up *ex post* causes farms to *ex ante* depress new invest in an effort to reduce potential costs. This result is robust to changes in the set of control variables such as *SUC*, *FDI*, *CGUAR*, and *INTSUB*. Nevertheless, our result would be biased and inconsistent were *DPAY* endogenous in the investment regression. Following the TSCML approach described in section 3, a reduced form equation for the hold-ups' variable is estimated by ordered probit. Generalised residuals, i.e., the scores with respect to the intercept, are then calculated. Results are reported in table 2, regression (5), (6) and (7).

The findings suggest that contracting with FDI processors, the poor court enforcement of contracts, the wealth and liquidity position of the farm, and the dummy for successor organisations, appear to be significant determinant of whether hold-ups are important for farms.

The likelihood for hold-ups being reported as important constraints to farm's profitability:

(i) is lower for farms that have contracted sales to FDI firms, and the stronger the own wealth and internal liquidity position of the farm though the liquidity variable only becomes significant when the highly insignificant variables for output expectations and level of capital stocks, at the beginning of the period, are excluded (see, regression (7));

(ii) increases when legal enforcement is considered as poor, and when farms are established as successors to pre-reform organisations. The significance of *SUC* increases with the exclusion of the dummy for organisation (see, regression (6)).

First, the result that farms contracting foreign partners seem to be less fearful of hold-ups than the rest of their counterparts might be explained by foreign processors being less prone to cash flow shocks that often affect buyer's ability to timely meet financial obligations towards primary producers. Also, FDI firms might be better connected and possess higher levels of private enforcement capital, especially in the form of reputation. This is also consistent with the finding that FDI involvement at a processing level has a significantly positive effect on agricultural firm's credit receipts (regression (4)). However, the direct effect of FDI is insignificant for investment (regression (1)). If the involvement of foreign firms at the processing level affects the primary producers' capital investment, the effect works via the variable for hold-ups and possibly credit.

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[22] 92 percent of the investing farms answered positively when asked whether their investment was linked to some marketing contract, indicating that contracting is driving investment rather than the other way around.

[23] In addition, the variable for contracting with FDI firms might be exogenous if reflecting a relationship dating before 1997, that is, if farms rely essentially on the same business partners as they did in earlier periods.

Table 1. Estimation of the Tobit Model for Capital Investment[a]

Sample Size: 318 farms

Dependent:	*Capital Investment*						*Credit*	
Regress. No[b]	(1)		(2)		(3)		(4)	
	coeff.	*z-value*	*Coeff.*	*z-value*	*coeff.*	*z-value*	*coeff.*	*z-value*
Constant	65.64	(.50)	57.66	(.47)	60.51	(.48)	-16.46	(.26)
INV Fitted[c]	---	---	---	---	---	---	.41***	(3.31)
WLTH (_)	-.08	(1.03)	-.08	(1.01)	-.07	(.92)	.06	(.68)
DPAY	-12.44**	(2.43)	-12.70**	(2.45)	-12.7**	(2.39)	-1.75	(.33)
EXP (_)	.11***	(2.98)	.11***	(3.02)	.11***	(2.98)	---	---
LIQ (_)	1.57*	(1.73)	1.62*	(1.80)	1.59*	(1.74)	-7.35	(1.36)
INVSUB	106.8***	(4.15)	105.9***	(4.41)	107.2***	(4.40)	---	---
INTR	-.06	(1.00)	-.07	(1.30)	-.03	(.84)	-.11	(1.53)
ORG	-1.87	(.21)	.43	(.05)	.41	(.05)	-9.12	(1.39)
MATR	-80.78	(1.06)	-82.05	(1.05)	-82.25	(1.04)	-31.86	(.94)
MATR (Sqr)	11.43	(1.07)	11.62	(1.06)	11.73	(1.05)	5.93	(.94)
SPEC	3.29	(.61)	3.59	(.63)	3.42	(.61)	10.03*	(1.75)
CGUAR	2.36	(.26)	2.52	(.27)	---	---	6.86	(1.46)
INTSUB	6.12	(.55)	7.18	(.70)	---	---	67.04***	(2.97)
SUC[d]	-10.59	(.33)	---	---	---	---	-17.20	(.79)
FDI	3.48	(.46)	---	---	---	---	19.19***	(2.56)
Wald chi2	144.53		68.53		64.60		308.59	
Prob > chi2	.00000		.00000		.00000		.00000	

[a] All regressions are reported with Huber/White/sandwich robust SEs adjusted for clustering on a county dummy.
[b] *** ,** and * denote significance at 1%, 5% and 10%, respectively.
[c] The fitted values for capital investment were calculated from regression (1).
[d] Though the dummy for successor organisations and the one for organisational types are highly collinear, the former remains insignificant even if the *ORG* is excluded from the regressions.

Second, as expected, the weak court enforcement is positively correlated with the incidence of hold-ups being an important constraint. This finding contrasts those in Bigsten *et al.*, (1999) who argue that "good legal institutions incite the farms to take more chances, thereby encouraging trade and leading to more cases of breach and more recourse to the courts".

Third, the negative and significant association between *WLTH* and *DPAY* suggests that, in here, the former actually reflects risk aversion rather than the specificity of the assets, i.e., the higher the level of wealth in a farm the less the farm reports hold-ups as a major problem. Other variables included to capture asset specificity are insignificant. This result, however, should not be interpreted as indicating that specific investment does not affect the incidence of hold-ups. Rather the proxies used to capture these effects perform disappointedly, in here. The same applies to the variable for the lack of market information available to producers.

Finally, the negative sign for the liquidity position is not surprising. It is to be expected that the more liquid the farm the less of a problem the occurrence of delayed payments will be since hold-ups put a strain on the farm's cash flows.

Table 2. Estimation of the Ordered Probit Model for the Hold-Ups' Variable[a]

Sample Size: 318 farms

Dependent:	*Delayed Payments are Important Impediments*					
Regression No.[b]	(5)		(6)		(7)	
	coeff.	*z-values*	*coeff.*	*z-values*	*Coeff.*	*z-values*
WLTH (_)	-.002*	(1.91)	-.002*	(1.77)	-.002**	(1.93)
CAP (_)	-.00001	(.67)	-.00001	(.78)	---	---
EXP (_)	-.00004	(.18)	-.0001	(.25)	---	---
LIQ (_)	-.02	(1.11)	-.02	(.99)	-.03*	(1.62)
ORG	-.11	(.71)	---	---	-.13	(.85)
MATR	-.28	(.47)	-.25	(.43)	-.25	(.41)
MATR (Squared)	.02	(.20)	.02	(.19)	.02	(.17)
SPEC	.05	(.63)	.05	(.61)	.06	(.88)
SUC	.63*	(1.80)	.74**	(2.49)	.56	(1.43)
LEG	.30**	(2.48)	.31***	(2.55)	.30***	(2.50)
FDI	-.27**	(1.90)	-.28**	(1.89)	-.27**	(1.91)
PREF	.04	(.33)	.04	(.32)	.05	(.38)
CGUAR	.003	(.02)	.002	(.01)	-.01	(.05)
PRCINF	.17	(1.32)	.16	(1.30)	.17	(1.33)
BUY	-.08	(.93)	-.08	(.93)	-.08	(1.01)
Wald chi2	138.17		82.55		77.86	
Prob > chi2	.0000		.0000		.0000	

[a] All regressions are reported with Huber/White/sandwich robust SEs adjusted for clustering on a county dummy.

[b] *** ,** and * denote significance at 1%, 5% and 10%, respectively.

The robustness of the results in table 1 is revisited to reflect the TSCML procedure. Results are reported in table 3. First, regressions (8) and (9) report consistent estimates for the investment equation, by virtue of the TSCML procedure. Second, those results are asymptotically efficient since the significance test on the generalised residual accepts the null hypothesis of a zero α.

However, the empirical findings in table 3 are not identical to those obtained earlier using ML to estimate the standard tobit model for investment (see table 1). Here, the *DPAY* is insignificant. This result is attributable to much larger SEs for this variable than those observed in regressions (1) - (3) while the coefficients have remained very high. The reason for the above is multicollinearity. *DPAY* is extremely correlated with the generalised residual as shown by a correlation coefficient of .96. This is not surprising given the few significant explanatory variables in the hold-ups' regression where the scores were calculated. Nevertheless, the fact that the coefficient for the generalised residual is not significantly different from zero indicates that the *DPAY* is exogenous to investment. As such, the results reported in table 1 remain valid.

Finally, some additional results regarding the other variables in the investment regression are discussed, though those are not of primary interest in this paper.

Table 3. TSCML Results[a]

Sample Size: 318 farms

Dependent:	*Capital Investment*			
Regression No.[b]	(8)		(9)	
	coeff.	*z-values*	*coeff.*	*z-values*
Constant	46.56	(.42)	55.01	(.48)
WLTH (_)	-.07	(.96)	-.06	(.86)
DPAY	-7.96	(.47)	-10.33	(.63)
EXP (_)	.11***	(3.03)	.11***	(2.99)
LIQ (_)	1.66*	(1.83)	1.61*	(1.77)
INVSUB	105.75***	(4.44)	107.23***	(4.40)
Generalised Residual[c]	-4.05	(.25)	-2.03	(.14)
INTR	-.08	(1.29)	-.03	(86)
ORG	1.18	(.13)	.78	(.08)
MATR	-81.45	(1.05)	-81.93	(1.05)
MATR (Squared)	11.59	(1.06)	11.71	(1.06)
SPEC	3.46	(.58)	3.34	(.57)
CGUAR	2.56	(.27)	---	---
INTSUB	7.79	(.73)	---	---
Wald chi2	103.74		80.99	
Prob > chi2	.0000		.0000	

[a] All regressions are reported with Huber/White/sandwich robust SEs adjusted for clustering on a county dummy.
[b] *** ,** and * denote significance at 1%, 5% and 10%, respectively.
[c] Scores with respect to the intercept, i.e., the generalised residuals, were calculated from regression (5), table 2.

The variable for own wealth, *WLTH*, shows insignificant results what remains unchanged even when the generalised residuals are used as reported in table 3. This result is in contrast with the strong positive association of wealth with investment which one finds in the original sample of Hungarian farms. One explanation for the result in here might be that contracting farms are relatively well integrated into the commercial system and, as such, their investment behaviour is less sensitive to how much of their assets is owned as opposed to leased than in farms that are less commercially viable.

To learn a bit more about the effect of *WLTH* in the sample of the contracting farms, regression (4) tests some relationships for credit. The results show the wealth variable to be insignificant for credit suggesting that, once other effects are controlled for, the wealth position of the contracting farm does not matter for its credit receipts. This is also in sharp contrast with the results for the entire sample. The obvious interpretation is that contracting matters to lending organisation. This is consistent with the dummy for contracting with foreign firms being highly positively correlated with credit (see regression (4)).

Finally, *EXP*, *LIQ* and *INVSUB* have the expected signs and are significant. Variables capturing farm characteristics including *ORG*, *MATR*, *SUC*, and *SPEC* are all insignificant.

6. Conclusions and Implications

Following the marketisation reforms in the former socialist countries, the collapse of the centrally-planned vertically-integrated systems of supply and delivery has given rise to enormous difficulties in the commercialisation of farm produce.

Case study evidence by Gow, Streeter and Swinnen, indicates that imperfect commitment and contractual breach in the agri-food sector, in particular, the occurrence of hold-up problems between processors and farmers, is a potentially important source of underinvestment in agriculture (Gow *et al.*, 2000).

Using a sample of 318 Hungarian contracting farms, surveyed in 1997, this paper finds results, which are consistent with the Gow-Swinnen argument. Indeed, a statistically significant and negative relationship exists between capital investment and hold-ups being important constraints to farm profitability.

Moreover, the importance of hold-ups for farm profitability appears to be significantly affected by whether the farm is contracting sales to locally operating foreign businesses, by the legal enforcement of contracts being an important constraint, by whether the farm is created as a successor organisation as opposed to a start-up business, and by its position in owned assets and liquidity, at the beginning of the period.

These findings have important implications. First and foremost, the results suggest that policy agenda's for the agri-food sectors in transition make a priority of tackling the issue of contract resolution and the related hold-up problems. To this end, governments would be advised to focus more on promoting competition in the food sector, facilitating agricultural producers' access to market information, implementing policies that stimulate FDI and similar forms of investments, and establishing an effective legal system and regulatory framework which adequately tackles contracting, private sanctions and business practices, in general.

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