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Financial determinants of private investment in Turkey
An Euler Equation Approach to Time Series

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Abstract: This paper employs a dynamic investment model derived from maximising the intertemporal discounted cash flow of a representative firm subject to capital market imperfections, borrowing constraints, and capital adjustment costs. The model is used to test the role of capital market imperfections before and after financial liberalisation undertaken in Turkey. The model is tested on aggregate data. The results demonstrate that the important role of credit constraints in the determination of private investment expenditure and show that financial reforms in the early 1980s have not relaxed these constraints significantly.

Resumen: Este trabajo emplea un modelo dinámico de inversión derivado de maximizar el valor presente del flujo de efectivo intertemporal de una empresa representativa sujeta a imperfecciones de mercado, restricciones de préstamos de capital, y ajustes de costos de capital. El modelo es usado para probar el rol de las imperfecciones del mercado de capital antes y después de la liberalización financiera llevada a cabo en Turquía. Los resultados demuestran el importante rol de restricciones crediticias en la determinación del gasto en inversión privada y muestran que las reformas financieras de principios de la década de 1980 no han relajado estas restricciones de manera significativa.

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1. INTRODUCTION

In recent years an increasingly popular strategy for modelling investment has been the so-called "Euler equation approach" in which an investment equation is derived from the first-order condition for the capital stock. This approach is appealing because the estimated equation is based on explicit microeconomic foundations for investment behaviour (Fazzari et al., 1988; Bond and Meghir, 1994). Empirically, it has been applied mainly to panel data for individual firms (Whited, 1992; Hubbard and Kashyap, 1992; Blundell et al., 1992; Galeotti at al., 1994, and Hubbard et al., 1995; Oliner *et al*., 1996), but there is no reason in principle why it cannot be used for pure time series data (e.g. Abel, 1980 and Schiantarelli and Geogoutsos, 1990 for the US and the UK respectively). Particularly in the Turkish case, the lack of insufficient firm level data covering both before and after financial liberalisation leaves us no option other than employing time series data.

One of the major issues in this research has been to test whether investment is significantly constrained by the availability of finance. Two approaches have been used. One approach consists of assuming rational expectations. If investment is not constrained by finance, the error term in the estimated investment equation should reflect pure expectational error and (under the assumption of rational expectations) should be uncorrelated with observed information from the previous period. This approach has the obvious disadvantage that it is a joint test of finance constraints and a hypothesis about

expectation formation. It is also unclear how it could be adopted to test for the effects of institutional reform in relaxing or tightening such constraints.

The alternative approach is to assume the Lagrange multiplier for the financial constraint to be a function of other variables, which reflect firms' balance sheets, and to test the significance of the appropriate terms in the estimated investment equation. If these terms are significant, the hypothesis that the financial constraint is never binding can be rejected. This approach has been used by Whited (1992), Ng and Schaller (1996), and Barran and Peeters (1998). A difficulty here is that the Lagrange multiplier on financial constraints is parameterised in an *ad hoc* manner, and therefore test results may depend crucially on the specification chosen for the relevant Lagrange multiplier, a matter on which there is little theoretical guidance.

We applied this latter approach to time series data on aggregate investment in Turkey. Developing countries are particularly opposite for an investigation of borrowing constraints on private investment because of the prevalence of administrative controls on bank borrowing and lending rates combined with the absence of alternative sources of finance. In many countries controls have kept lending rates negative in real terms, creating severe excess demand for credit and rationing of investment funds. In recent years, there has been a movement towards financial liberalisation, emphasising the relaxation of controls and the establishment of positive real interest rates. Structural Adjustment Lending by the World Bank, which began in 1980, has given a significant impetus to this type of reform.

Turkey is a particularly interesting case to study because it undertook a major financial liberalisation in 1982, and is widely regarded as one of the more successful reforming countries. Financial reforms have succeeded in raising real interest rates and in

increasing the efficiency of the banking sector (Zaim, 1995), but Turkish companies are still heavily dependent on bank credit for investment finance (Akyuz, 1990; Ersel and Ozturk, 1993). Direct financing options, including issuing equity, still form only a very small component of total finance.[1] The vulnerability of Turkish firms to the implications of any imperfections in financial markets becomes even more evident when the composition of short-term debt is considered. Almost three-quarters of total bank debt are recorded as short-term commitments of the Turkish corporate sector.

The behaviour of private investment in Turkey has been investigated in a number of previous econometric studies based on time series data (Anand et al, 1990; Chhibber and van Wijnbergen, 1992; Rittenberg, 1991; Uygur, 1993; and Guncavdi et al, 1998 and 1999), in most of which the availability of credit emerges as an important factor. The impact of Turkish financial liberalisation on investment, and econometric performance more generally, has also been much discussed (Rittenberg, 1991; Atiyas and Ersel, 1995; and Guncavdi et al, 1998 and 1999). No previous study, however, has used an Euler Equation approach to estimate the impact of financial liberalisation on borrowing constraints.

The remainder of the paper is organised as follows. The next section introduces the theoretical model, which focuses on the intertemporal investment decisions of a representative firm borrowing from an imperfect credit market subject to a borrowing constraint. The empirical specification is derived in Section 3, and the econometrical results are reported in Section 4. Finally Section 5 concludes.

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[1] The share of direct finance options, such as bonds, financial bills, are quite negligible, and is around 3 per cent in total liabilities over the 1984 – 1989 period. However, the share of bank credit in total was recorded nearly 42 per cent over the same period (Ersel and Ozturk, 1993).

2.   THE INVESTMENT MODEL

Consider a representative firm maximising the present discounted value of cash flows subject to imperfect financial markets.

Definition and Assumptions

The model is discrete time analysis in which the firm is assumed to maximise the present value of equity for each time *t* recursively. We make the following standard assumptions, in part for reasons of empirical tractability.

- *Assumption 1*: The firm uses two inputs of production, namely capital (K) and labour (L), in production.

- *Assumption 2*: The capital input is regarded as quasi-fixed, but labour is perfectly variable.

- *Assumption 3*: Capital depreciates at a constant proportionate rate δ.

- *Assumption 4*: The firm's manager is risk-neutral, but lenders are risk-averse.

- *Assumption 5*: The nominal discount rates, β, is constant.

- *Assumption 6*: There are no taxation and investment incentives.

The purpose of these assumptions is to avoid a highly non-linear structure for the investment equation. The procedure for deriving an investment equation follows standard principles. In order to find the optimum levels of labour, investment, dividends, capital and debt-stock, the firm is assumed to solve the following discrete problem:

$$(1) \qquad V_0 = E_0\left[\sum_{t=0}^{\infty} \beta^t D_t\right]$$

subject to several economic constraints give drawn from the balance sheet of the firm and financial constraint imposed by capital market imperfections. The first economic constraint is quite standard in this type of research, and shows the development of the capital stock over time as follows:

$$(2) \qquad \Delta K_t = I_t - \delta K_{t-1}$$

Equation (2) indicates that the capital assets are increased by investment and reduced by depreciation of the capital stock. The second economic constraint involves the motion of the book value of equity, E_t, over time, which follows the standard balance sheet relationship as follows:

$$(3) \qquad \Delta E_t = \left[\Pi(K_t, L_t) - q_t \delta K_{t-1} - q_t \Psi(I_t, K_t) - i_{t-1} B_{t-1} - \Lambda(B_t, K_t)\right] - D_t$$

According to equation (3), the profit, which is defined as equivalent to the turnover minus labour costs, depreciation of the capital stock cost of adjustment and interest payment, is used for paying out dividends and/or accumulating the stock of equity. The economic constraint drawn from the balance sheet relationship can be written as follows:

$$(4) \qquad q_t K_t = E_t + B_t$$

In equation (4), the firm possesses two sources of funds to finance the capital assets, namely equity and debt. In addition to default risk premium required over the risk-free interest rate, we assume that capital market imperfections impose an exogenous upper constraint on the level of the outstanding debt stock of the firm. It is assumed that this exogenous upper limit is determined as a constant proportion of the existing book value of the firm's equity as follows:

$$(5) \qquad B_t \leq \bar{b} E_t$$

where $\bar{b}$ is constant.

Now, assume for simplicity from equation (4) that net investment in current price of capital goods is financed by changes in equity plus borrowing (or changes in outstanding debt stock); that is, $\Delta q_t K_t + q_t \Delta K_t = \Delta E_t + \Delta B_t$.[2] Having substituted (2) and (3) in this identity, the following definition of dividends can then be derived:

$$(6) \qquad D_t = \Pi(K_t, L_t) + \Delta B_t - i_{t-1} B_{t-1} - \Lambda(B_t, K_t) - q_t I_t - q_t \Psi(I_t, K_t)$$

Additionally, on substitution of E_t from (4) into (5), we get

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[2] Firms in Turkey have been operating in a high inflationary environment for almost thirty years, and are allowed for correcting the adverse effects of inflation on their balance sheet by revaluing the book value of their capital assets basing on the inflation rate. The first term on the left-hand side can be considered to be the term showing the change in the book value of the capital assets as a result of an inflation in the price of capital goods.

(7) $$\frac{B_t}{q_t K_t} \le \overline{B}$$

where $\overline{B} = \left[\overline{b}/(1-\overline{b})\right]$ is constant. With this specification of the borrowing constraint, the model becomes quite similar to that of Jaramillo *et al.* (1996).

The aim of the firm therefore becomes to maximise the objective function (1) subject to constraints (2), (6), (7) and the dividend constraint. The resources available to the firm for achieving this aim –the control variables- are investment, labour demand and dividend payments. The first-order condition of this value optimising firm with respect to capital, investment and borrowing at time *t* respectively can be obtained as follows:

(8) $$\left(1+\lambda_t^D\right)\left[\Pi_K(K_t,L_t) - \Lambda_K(B_t,K_t) - q_t\Psi_K(I_t,K_t)\right] - \lambda_t^K$$

$$+ \beta(1-\delta)E_t\left(\lambda_{t+1}^K\right) + \lambda_t^B\,\frac{B_t}{q_t K_t^2} = 0$$

(9) $$-\left(1+\lambda_t^D\right)\left(q_t + q_t\Psi_I(I_t,K_t)\right) + \lambda_t^K = 0$$

(10) $$\left(1+\lambda_t^D\right)\left(1-\Lambda_B(B_t,K_t)\right) - \lambda_t^B\,\frac{1}{q_t K_t} - \beta E_t\left[\left(1+\lambda_{t+1}^D\right)\left(1+i_t\right)\right] = 0$$

(11) $$\lim_{T\to\infty}\left(\beta^T K_T\right) = 0, \qquad \lim_{T\to\infty}\left(\beta^T B_T\right) = 0$$

where subscripts indicate time. The first-order condition (8)-(10), along with the transversality conditions (11), may be simultaneously solved for the capital stock, the

outstanding stock of debt, dividends, investment and three Lagrange multipliers. In the presence of a binding credit constraint ($\lambda_t^B > 0$), the shadow price of capital will be augmented by λ_t^B in (10); ie. the presence of λ_t^B increases the expected marginal benefits from an additional unit of capital. In order to provide an economic interpretation for the first-order conditions for the capital stock and investment equations (8)-(9), the following substitution may be convenient. Upon substituting λ_t^K and λ_{t+1}^K from condition (8) and λ_t^B from (10), the following Euler equation for the capital stock can be obtained.

$$(12) \qquad \Pi_K(K_t, L_t) - \Lambda_K(B_t, K_t) - q_t \Psi_K(I_t, K_t) - q_t(1 + \Psi_I(I_t, K_t))$$

$$+ \beta(1 - \delta) E_t \left[\frac{(1 + \lambda_{t+1}^D)}{(1 + \lambda_t^D)} q_{t+1}(1 + \Psi_I(I_{t+1}, K_{t+1})) \right]$$

$$+ (1 - \Lambda_B(B_t, K_t)) \frac{B_t}{K_t} - \beta E_t \left[\frac{(1 + \lambda_{t+1}^D)}{(1 + \lambda_t^D)} (1 + i_t) \right] \frac{B_t}{K_t} = 0$$

The equation has to be understood in terms of the choice between investing today and investing tomorrow. This is the most general specification of the Euler equation including the effects of a binding borrowing and non-zero dividend constraints. In the unconstrained case, the last two terms naturally disappear. However, λ_t^D still remains unobservable. We assume that the firm generates net positive revenue and distributes positive dividends. This indicates that $\lambda_t^D = \lambda_{t+1}^D = 0$, and helps us to derive empirically tractable investment equations.

3. EMPIRICAL SPECIFICATIONS

In order to obtain an empirical model of investment, we must specify the functional forms for the risk premium and the costs of capital stock adjustment functions. In the preceding section the costs of borrowing for the firm were assumed to comprise two elements. The first part represents the risk less cost of the outstanding debt stock, $i_t B_{t-1}$, and is not affected by the firm's financial structure, in particular by the debt-capital ratio (i.e. leverage ratio). The second part is, however, assumed to represent the default risk premium (or agency cost) over the risk less interest rate. Following the current investment literature, this risk premium element of interest payment can be represented by a quadratic, convex function of the ratio of debt to capital as follows (e.g. see Galeotti *et al.*, 1994 and Chirinko, 1987).

$$(13) \qquad \Lambda(B_t, K_t) = \frac{a}{2} \left(\frac{B_t}{q_t K_t} \right) B_t$$

where the term in the parenthesis is the debt-capital ratio. The convexity of the function with respect to debt stock, B_t, provides the increasing risk premium in the margin. Also, agency costs are a decreasing function of the capital stock. Thus, the marginal default risks of the firm with respect to debt stock and the capital stock respectively are

$$(14) \qquad \Lambda_B(B_t, K_t) = a \left(\frac{B_t}{q_t K_t} \right) > 0, \qquad \Lambda_K(B_t, K_t) = -\frac{a}{2} q_t \left(\frac{B_t}{q_t K_t} \right)^2 < 0$$

The parameterisation is carried out for the function capturing the costs of adjustment, $\Psi(.)$. Our specification of a convex adjustment cost function in equation (15) is standard in the *q*-theory literature due to its simplicity. Since this is an aggregate

equation, a cost function of this kind can be though of as reflecting a rising supply curve of capital goods. The following function form is assumed to hold for the adjustment cost of capital:

$$(15) \qquad \Psi(I_t, K_t) = \frac{b}{2} \left(\frac{I_t}{K_t} - c \right) K_t, \qquad b, c > 0$$

where c is the required minimum level of investment (see Summer, 1981). The partial derivatives of the function with respect to investment and capital respectively are

$$(16) \qquad \Psi_I(I_t, K_t) = b \left(\frac{I_t}{K_t} \right) - bc, \qquad \Psi_K(I_t, K_t) = -\frac{b}{2} \left(\frac{I_t}{K_t} \right)^2 + \frac{bc^2}{2}.$$

The marginal productivity of capital must also be parameterised for the purpose of estimation. This may be specified either by assuming a particular form of the production function (see Abel, 1980), or alternatively by relying on a constant returns to scale assumption and homogeneity of the production function (see Bond and Meghir, 1994). We assume that the production function is Cobb-Douglas with constant return to scale (ie. $Q_t = K_t^\theta L_t^{1-\theta}$), so that the marginal productivity of capital can be written as follows:

$$(17) \qquad \Pi_K(K_t, L_t) = \theta \left(\frac{p_t Q_t}{K_t} \right)$$

where θ is the share of capital in the production of Q.

3.1 The Derivation of Estimable Euler Equation

Using (14), (15) and (16), two empirical equations are derived, depending on whether λ_t^B is greater than or equal to zero. In the second case, in which the credit constraint is assumed to be not binding (i.e. $\lambda_t^B = 0$), it is possible to test the significance of the risk premium term. The unconstrained equation, however, is merely a special case of the equation with a binding credit constraint (i.e. $\lambda_t^B > 0$), and our principal purpose is to test the significance of these constraints. Before deriving the estimable investment equations, one must note that the performance of the estimation results will be closely related to the functional specifications chosen in this section. The empirical results in the following sections may also provide support in favour of or against those specifications.

(a)   An Euler Equation with a Non-Binding Credit Constraint ($\lambda_t^B = 0$)

The borrowing constraint is assumed not to constraint the firm's behaviour; $\lambda_t^B = \lambda_{t+1}^B = 0$. The Euler equation (12) for capital thus becomes

$$(18) \qquad \Pi_K(K_t, L_t) - \Lambda_K(B_t, K_t) - q_t \Psi_K(I_t, K_t) - q_t(1 + \Psi_I(I_t, K_t))$$
$$+ \beta(1 - \delta)E_t\left[q_{t+1}(1 + \Psi_I(I_{t+1}, K_{t+1}))\right] = 0 \qquad)$$

Equation (13) is very similar to Galeotti *et al.* (1994) with the minor difference that our definition of the agency cost function is much simpler. The right-hand side of the equation is the quasi-forward difference in the marginal adjustment cost. The left-hand side is the

incremental profit, obtained as a result of a unit increase in the capital stock, net of its user cost and the expected saving in the marginal cost of borrowing avoided by installing capital today rather than tomorrow (the second and third term on the left-hand side of (18)). Rearranging the Euler equation (18), and making use of (14), (15) and (16), one can easily obtain the following empirical investment equation.

$$(19) \quad \left(\frac{\theta}{b}\right)\left(\frac{p_t Q_t}{q_t K_t}\right) + \left(\frac{a}{2b}\right)\left(\frac{B_t}{q_t K_t}\right)^2 + \left(\frac{1}{2}\right)\left(\frac{I_t}{K_t}\right)^2 - \left(\frac{I_t}{K_t}\right) + E\left[\Phi_{t+1}\left(\frac{I_{t+1}}{K_{t+1}}\right)\right]$$

$$+ \left(\frac{1}{b}\right)E_t(\Phi_{t+1}) - \left(\frac{c^2}{2} + \frac{1}{b} - c\right) = 0$$

where $\Phi_{t+1} = \beta(1-\delta)q_{t+1}/q_t$ is the real discount rate. Let

$$IK_t = I_t/K_t , \quad QK_t = p_t Q_t/q_t K_t , \quad BK_t = B_t/q_t K_t$$

For estimation purposes, (19) can be re-arranged, leaving the expected value of the rate of investment on the left-hand side. Therefore, the first estimable Euler equation can be written as

$$(21) \qquad E_t(\Phi_{t+1} IK_{t+1}) = \alpha_0 + \alpha_1 IK_t + \alpha_2 IK_t^2 + \alpha_3 QK_t + \alpha_4 BK_t^2 + \alpha_5 E_t(\Phi_{t+1}) + \upsilon_{t+1}$$

where

$$\alpha_0 = \left(c^2/2 + 1/b - c\right), \; \alpha_1 = 1, \; \alpha_2 = -1/2, \; \alpha_3 = -\theta/b, \; \alpha_4 = -a/2b, \; \alpha_5 = 1/b$$

The additive error-term in (20) reflects not just normal random variation but also expectational error, which under the hypothesis of rational expectations can be assumed to be non-systematic. The restriction that $\alpha_1 = -2\alpha_2$ enables the recovery of all structural parameters. The signs of the variables in equation (20) are similar to those in previous studies (in particular to those in Galeotti *et al.,* 1994). The presence of the output term captures the accelerator effect in the output market. The debt term appears because of the assumption of an imperfect capital market in which the firm with higher debt are forced to pay a higher premium over the risk less interest rate. We estimate the model both in unrestricted form and with the numerical restrictions $\alpha_1 = 1$ and $\alpha_2 = -0.5$ imposed.

(b)   An Euler Equation with a Binding Credit Constraint ($\lambda_t^B > 0$)

The equation above is correctly specified only if the borrowing constraint is not strictly binding. When the credit constraint becomes binding (i.e. $\lambda_t^B > 0$), an additional variable appears in the shadow value of capital (equation 13) through the unobservable multiplier of dividend (8). Using the first order condition for debt, this multiplier can be defined in terms of observable variables. Using (10'),

$$(21) \qquad E_t\left(\Phi_{t+1}IK_{t+1}\right) = \alpha_0 + \alpha_1 IK_t + \alpha_2 IK_t^2 + \alpha_3 QK_t + \alpha_4 BK_t^2 + \alpha_5 E_t\left(\Phi_{t+1}\right)$$

$$+ \alpha_6 BK_t\left(1 - \beta\left(1 + i_t\right)\right) + v_{t+1}$$

where

$$\alpha_0 = \left(c^2/2 + 1/b - c\right), \qquad \alpha_1 = 1, \qquad \alpha_2 = -1/2, \qquad \alpha_3 = -\theta/b, \qquad \alpha_4 = -1/b, \qquad \alpha_5 = -3a/2b,$$

$$\alpha_6 = -(1 - bc)/b$$

This function is the most general function that is to be estimated below, since it compromises the influence of financial factors on investment. We now turn to estimating equation (21) as suggested by underlying microeconomic principles above.

4. EMPIRICAL RESULTS

Data on investment in Turkey are very limited for an extensive time series analysis. Quarterly data on aggregate (or sectoral) private and public capital stock are not available at all. Both model (20) and (21) have, therefore, been applied to annual data over the 1963-93 period, the longest period for which a consistent data series is available. The results are based on the aggregate data on capital stock, investment, and the price index of capital goods, which have been obtained from Maraslioglu and Tiktik (1991). Data on the volume of credit to the private sector have been compiled from various issues of *IMF International Financial Statistics*. Interest rate data have been taken from the various issues of the *Quarterly Bulletin of the Central Bank of Turkey*.

We have started with the estimation of the unrestricted equation (19) and subsequently imposed the restrictions *($\alpha_1=1$)* and *($\alpha_2=-0.5$).* In equation (19) the dependent variable is private investment in period *(t+1)* multiplied by the ratio of capital goods prices in period *(t+1)* to period *t*. In using the realised values, we are imposing the rational expectations assumption that the expected value is equal to the realised value plus a random error which is assumed to be a function of the following variables: investment as a proportion of capital stock, the square of investment as a proportion of capital stock, the ratio of output to capital, the square of the ratio of debt to capital, inflation in capital prices, and an additional variable representing the effects of financial constraints. The last variable

should only appear in the equation, if borrowing constraints are binding. A *t*-test of the hypothesis that the coefficient of this variable is zero, is therefore a test of the significance of borrowing constraints on investment. Theoretically, we expect all coefficients to be negative except in the case of the investment/capital ratio.

In order to test for the impact of financial liberalisation, we use a dummy variable (*DUM*) which takes the value of zero up to 1981 and one from 1982 onwards. Financial liberalisation can influence investment through a number of channels, including changes in interest rates, but the specific hypothesis we wish to test is whether it has relaxed borrowing constraints or not. We therefore test for financial liberalisation effects in the form of shifts in the coefficients of the two variables, which only appear in the equation when borrowing constraints are binding. We also allow for a shift in the intercept (otherwise a change in the slope coefficients implies a change in the level of the dependent variable, and this might distort our estimations of the shift in the slope coefficients).

Table 1

Aggregate Investment under the Rational Expectation Assumption
(Ordinary Least Squares Estimation)

variables	(1)	(2)
constant	-0.039***	-0.037***
	(-3.735)	(-3.444)
ik_t	2.462***	2.232***
	(3.728)	(3.176)
ik_t^2	-17.742**	-15.231*
	(-2.170)	(-1.774)
qk_t	-0.027	-0.017
	(-1.287)	(-0.725)
bk_t^2	1.197*	0.943
	(1.816)	(1.329)
Φ_{t+1}	0.0184***	0.019***
	(4.596)	(4.655)
$bk_t(1-\beta(1+i_t))$	-0.169***	-0.015

	(-3.628)	(-0.091)
DUM* $bk_t(1- \beta(1+i_t))$	---	-0.140
		(-0.971)
R^2-adj.	0.944	0.944
SC	0.004	0.066
FF	1.142	0.939
N	4.26	3.729
H	0.914	1.070
Coefficient restrictions test	2.505	---
	[0.103]	

Notes: Figures in parentheses are t-statistics. ***, ** and * denote significant coefficients at the 1%, 5 % and 10 % levels. *DUM*=0 up to 1981 and =1 from 1982 onwards. *SC* is a Lagrange multiplier test for first-order serial correlation. *FF* is Ramsey's *RESET* test for functional form using the square of the fitted values. *N* is a test for residual normally using skew ness and kurtosis. *H* is a test for heteroscedasticity based on a regression of the squared residuals on the squared fitted values. "Coefficient restrictions" is a test of the theoretical restrictions on the coefficients of *ik* and ik^2.

Results are presented in Table 1. The first column of the table shows the estimated

equation assuming no financial liberalisation effects, but allowing for borrowing

constraints. All variables, except the output variable, appear to be significant and to have

expected signs. The output (or accelerator) variable appears to be insignificant, but we

should not immediately conclude that the accelerator does not matter for explaining the

behaviour of private investment in Turkey. Rather, the model estimated in this paper is

complex and the data used for estimating such a complex model is aggregate time series

data. However previous research based on time series data with simple theoretical model

have consistently showed that the accelerator is important (*see* Günçavdı *et al.*, 1998, 1999

and Günçavdı and McKay, 2003). The coefficient of the cost of capital term, Φ, is

significant, but not of the expected sign. For our concern in the paper the borrowing

constraint variable is very significant. This result postulates that the investment demand of

Turkish firms is constrained by the availability of credit, and increase in the stringency of

the constraint seems to decrease the demand for capital by firms. The Table also includes conventional test statistics for autocorrelation (SC), functional form misspecification (FF), normality of the residuals (N) and heteroscedasticity (H), and these do not reveal anything problematic.

The estimation of equation (20) was repeated by imposing the theoretical restrictions on the coefficients of current investment and its square (i.e. α_1=1 and α_2=-0.5. The significance of these constraints was tested by the Wald test, which is shown in the last raw of column 1 together with the p-value of the test. It seems that these constraints imposed on coefficients of current investment and its square are rejected by the data.
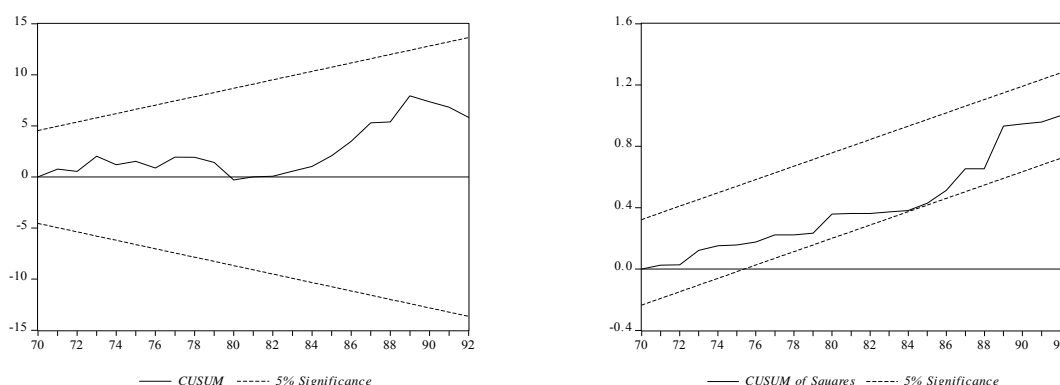

Figure 1 Stability of Estimated Regression

The measures undertaken under the financial liberalisation programme in 1982 are expected to have relaxed the stringency of financial constraints on investment demand. Besides, such economic policies could have caused a structural change in the pattern of

investment in the post-liberalisation period. Column 2 of Table 1 shows the effects of including dummy variables to capture the impact of financial liberalisation. Any significant and positive signs of this variable indicate a decrease in the stringency of borrowing constraints on firms in Turkey. The result shows that the interactive term with the borrowing constraint variable is not significant at any significance level. Additionally, the *CUSUM* test and *CUSUM* Square test, based on the regression in column 1, yield supportive view in which the estimated regression model is stable over the full sample period. Hence the availability of financial funds continues to impose the major constraint on investment in Turkey even after the financial liberalisation in 1982 (Günçavdı *et al.*, 1998 and 1999).

Since the aim of the paper is to investigate the importance of financial constraints in the Turkish economy, we are not able to pay attention to the other factors –such as public invetment, macroeconomic instability and the availability of foreign exchange- that would possibly have significant effects on private investment. Besides the theoretical setting presented in section 2 does not allow us to include such variables in the empirical equation. This is mainly because the model with the present form is highly complex and utilizes limited number of observations to test the significance of these variables. Günçavdı *et al.* (1999), however, show that public investment is only significant in explaining the long run behaviour of Turkish private investment. The results regarding the importance of macroeconomic instability is quite mixed in the Turkish case. Günçavdı and McKay (2003) finds no significant effects of macroeconomic instability[12] wheresas chronic and

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[12] However it should not be concluded that macroeconomic uncertainty is not important in Turkey. Rather it is difficult to measure uncertainty satisfactorily, and annula data used in Günçavdı and McKay (2003) may not be enough to capture the high short-term volatility in macroeconomic environment.

increasing macroeconomic instability of the Turkish economy has seriously affected her capital formation and growth (İsmihan *et al*., 2005).

5. CONCLUSION

This paper has examined the role of financial constraints in the investment process, and evaluated the impact of financial liberalisation programme undertaken in 1982 in Turkey. It was particularly considered whether financial liberalisation programme has caused any structural changes in the pattern of investment behaviour. For this purpose, the paper present a theoretical model in which the estimable investment demand function is derived from the first order condition with respect to capital stock. Unlike other empirical studies in the literature on Turkey, an important feature of the model is to be based on an explicit theoretical model that includes some imperfections in financial markets.

The results indicate that financial factors are important in the determination of private investment behaviour. In particular, the borrowing constraint, indebtedness of firms (the square of the leverage variable), are most important factors influencing investment demand. Despite the financial liberalisation programme undertaken in 1982, financial factors continue to be as important as before the liberalisation.

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