The Effects of Financial Markets on Private Capital Formation: An Empirical Analysis of Turkish Data over 1968-1998 Period

Lutfi Erden
Mersin University
Mersin, Turkey

Contact:
Lutfi Erden
Iktisat Bolumu
Mersin Universitesi
Ciftlikkoy Kampusu, Mersin
e-mail: lutfierden@hotmail.com

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-Abstract-

Although the neoclassical investment theory postulates that private investment is strongly related to the cost of capital, empirical studies have indicated a weak and often insignificant link between the two. There are two potential reasons for this identified in the literature. One argument is that the availability of credits may be more binding than the costs in developing countries because of their institutional and structural characteristics. The other is that the uncertainty surrounding the cost of capital may have a more substantial impact on private investment than the level of cost. Given these arguments, this paper investigates the question of whether the cost, quantity of credits, and/or cost uncertainty stemming from financial markets play a more important role in determining private investment in a developing country such as Turkey. To this end, this study modifies the neoclassical investment model to include credit availability and an appropriate measure of cost uncertainty obtained by fitting a univariate GARCH process of real interest rate. While reinforcing the findings of previous studies that the quantity of credits significantly affects private investment, the results go on to indicate that cost uncertainty, but not the level, has an adverse impact on private investment in Turkey.

Keywords: Private investment, Credits, Cost uncertainty

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The main tenet of the neoclassical theory of investment is the prediction of a strong and negative relationship between private investment and the user cost of capital. However, the empirical tests applied to the data from industrial and developing countries have indicated a weak and often insignificant link between the two (see Chirinko, 1993 and Ram, 1993 for an overview). This finding has led researchers to question the assumptions underlying the neoclassical model of investment. The studies investigating the determinants of private investment in developing countries have provided one explanation, arguing that the quantity of external credits rather than the costs may be more binding in developing economies because of credit rationing and lack of well-functioning financial markets (e.g., Tun Wai and Wong, 1982; Blejer and Khan, 1984; Ramirez, 1994). Empirical tests have consistently shown that credit availability plays a significant role in determining private investment in developing countries, but not the cost of financing investment projects. Accordingly, these studies have jumped into the conclusion that the availability of credits, but not the costs, has a significant impact on private investment activities in developing countries because of their institutional and structural characteristics. There is, however, another theoretical explanation provided in the literature of irreversibility approach to modeling investment behavior (e.g., Pindyck, 1991; Caballero, 1991; Dixit and Pindyck, 1994; Abel and Eberly, 1994, 1995). For instance, Dixit and Pindyck (1994) argued that uncertainty surrounding the costs of credit may have a more substantial impact on private investment than the level of costs.

Given these arguments, this paper investigates the question of whether the cost, quantity of credits, and/or cost uncertainty stemming from financial markets play a more important role in determining private investment in Turkey. To this end, this study modifies the neoclassical investment model to include credit availability and an appropriate measure of cost uncertainty. While reinforcing the findings of previous empirical studies that the quantity of credits significantly affects private investment, the results go on to indicate that uncertainty over the costs of funding have a negative and large impact on private investment.

Theoretical Perspectives: The effects of cost, cost uncertainty, and availability of credits

As is well known, the neoclassical model of investment posits that investment is negatively related to the cost of capital. This, however, has not been fully supported by the empirical studies of both developing and industrial countries (see Chirinko, 1993). The analytical and empirical studies of developing countries in particular have attributed this result to the institutional and structural characteristics of these countries (Blejer and Khan, 1984 and Ramirez, 1994). It is argued that private investment in developing countries is constrained mainly by the availability of external funds rather than the cost. Credit constraint in developing countries is likely to be more important partly because the quantity of financial resources is limited due to the lack of equity financing instruments. Moreover, controls over interest rates and credit rationing in the financial markets in most developing countries reduce the role of the cost of capital (proxied by the interest rate) while highlighting the importance of credit availability.

In light of these arguments, adding the credit availability to the model instead of the cost of capital, empirical studies found that the availability of credits to private sector positively affects private investment (Blejer and Khan, 1984 for a panel of developing countries and

Ramirez, 1994 for Mexico). Therefore, they suggested that credit availability exerts a binding constraint on private investment that makes the cost of financing less important in explaining private investment in developing countries. However, the sensitivity of private investment to the cost may have increased after the debt crisis in late 1970s given the fact that most developing countries implemented structural and financial stabilization programs. Therefore, it is also reasonable to expect that such measures increased interest rates and thus private investment became more sensitive to the cost of capital than to the quantity of credits (Greene and Villanueva, 1991; Guncavdi, Bleaney, and McKay, 1998). Accordingly, there may be another reason why the cost of capital (often proxied by real interest rate) does not show up as a statistically significant determinant of private investment. For example, private firms/investors may not respond to the changes in real interest rate because of uncertainty surrounding the real cost of capital.

Recent theoretical studies have given attention to the nature of investment decision; namely, the roles of expectation and uncertainty, which are not included in the formulation of the neoclassical model (Abel, 1983; Pindyck, 1991; Caballero, 1991; Rodrik, 1991; Dixit and Pindyck, 1994; Abel and Eberly, 1994, 1995). The investment decision is expected to be responsive to the level of uncertainty about the future economic conditions because firms necessarily look into the future before undertaking any investments. More specifically, in contrast to the neoclassical model where investment decisions are costlessly reversible, investment is treated as a partially or completely irreversible process because of the sunk costs associated with the initial cost of investment. Thus, an important aspect of the reality is captured because once a firm purchases and installs new capital, the firm's ability to get rid of excess capital is quite constrained or it is costly to do so, which makes disinvestment more costly than

investment. The reasons for irreversibility may be that in most countries there is not well functioning secondary market for capital, and that most capital goods are of firm specific type.

The book by Dixit and Pindyck (1994) on the effect of uncertainty provides a valuable survey of advances in this literature. They presented an option-based model of irreversible investment in conditions of uncertainty. In their model, the ability to delay an irreversible investment decision is similar to a financial call option. The possibility of postponing an investment has a cost as well as a benefit. The benefits resulting from the arrival of new information might outweigh the cost under conditions of uncertainty. By waiting, the firm incurs a loss in the expected profits; however, new information under uncertainty is so valuable that it might lead to higher profits in the future. This suggests a critical threshold above which investment is undertaken. That is, investment is made at the point where net present value of the investment project is positive such that it is greater than the value of postponing the project to the investor. Uncertainty, by affecting the value of delaying an investment project, reduces the attractiveness of ex ante investment. For instance, a decrease in interest rate results in a reduction in the opportunity cost of delaying an investment project, which may lead to waiting for a more favorable economic environment.

At this point, it is worth noting that the model of irreversible investment under uncertainty identifies the conditions under which the investment should take place, rather than giving a structural model of investment. However, the predictions of this approach are quite clear in the sense that uncertainty plays an important role in determining private investment although the analytical studies present different results on the sign of the effect of uncertainty (see Serven, 1998 for an overview). Empirical studies simply add a proxy for uncertainty to a standard investment model, presenting evidence that increased uncertainty has an adverse impact on the

aggregate investment (Ferderer, 1993; Goldberg, 1993; Price, 1995, 1996; Aizenman and Marion, 1993, 1996; Serven and Solimano, 1993; Serven, 1998). For the present purpose, this paper uses the volatility of the real interest rate as a proxy for the cost uncertainty.

Specification of Empirical Model

According to the neoclassical model originally developed by Jorgenson (1963), solving the profit maximization problem of a representative firm yields the demand for capital as a function of output and the cost of capital under certainty (Ram, 1993).

$$K^*_{pt} = F(Y_t, C_t) \qquad (1)$$

where K^*_{pt} is optimal or desired capital stock by private sector in period t; Y_t is the output, and C_t is the cost of capital[1].

Under the conditions of uncertainty and irreversibility, this needs to be modified with the inclusion of uncertainty because the irreversibility approach suggests that uncertainty has an impact on both long run and the short run dynamics of private capital. In addition, in light of the arguments that the quantity constraints coming from the financial markets may be more binding than the cost of capital in a developing country such as Turkey, the flow of credits is also added to the model. Thus the equation becomes,

$$K^*_{pt} = H(Y_t, C_t, \Delta CRD_t, \sigma_t) \qquad (2)$$

where σ_t and ΔCRD_t denote the real interest rate uncertainty and flow of real credits available to the private sector respectively.

Because there is no data on capital stock available for Turkey, one can use the definition

[1] Based on the argument that public capital investment either complements or substitutes private capital, public capital is viewed as an important determinant of private capital investment (Sundararajan and Thakur, 1980; Ramirez, 1994). However, including public investment in the estimating function indicated that public investment

of the gross private investment given by,

$$PI_t = (K_{pt} - K_{pt-1}) + \delta K_{pt-1} \quad (3)$$

where δ is the depreciation rate of the private capital stock and PI_t is gross private investment. In the steady state, this equation becomes,

$$PI^*_t = \delta K^*_{pt} \quad (3a)$$

Inserting (3a) into (2), obtain

$$PI^*_t = \delta H (Y_t, C_t, \Delta CRD_t, \sigma_t) \quad (4)$$

The actual stock of private capital may not adjust completely to reach the desired level due to technical constraints, and the time it takes to plan, decide, build and install new capital. Such dynamic structure in private capital behavior can be introduced through a partial adjustment mechanism like the following,

$$K_{pt} - K_{pt-1} = \beta (K^*_{pt} - K_{pt-1}) \quad 0 \leq \beta \leq 1 \quad (5)$$

where β is the coefficient of adjustment. In this formulation, actual private capital adjusts to the difference between desired private capital in time t and actual private capital in the previous period. For practical purposes, one can express equation (5) in terms of gross private investment as,

$$IP_t - IP_{t-1} = \beta (IP^*_t - IP_{t-1}) \quad (5a)$$

Rearranging equation (5a), obtain,

$$IP_t = \beta IP^*_t - (1-\beta) IP_{t-1} \quad (5b)$$

Finally, inserting equation (4) into equation (5b), obtain the model for gross private investment as the following,

$$PI_t = \beta \delta H (Y_t, C_t, \Delta CRD_t, \sigma_t) + (1-\beta) PI_{t-1} \quad (6)$$

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has no significant effect on private investment in the Turkish case, and did not affect the sign or significance of the

Taking a linear approximation of H, the estimating equation becomes,

$$PI_t = a_0 + a_1 Y_t + a_2 C_t + a_3 \Delta CRD_t + a_4 \sigma_t + (1-\beta) PI_{t-1} + u_t \qquad (7)$$

$$a_1 > 0;\ a_2 < 0;\ a_3 > 0;\ a_4 > < 0$$

where $a_i = (\beta\ \delta)\ \alpha_j$ and i=j=0,1,2,3,4. u_t is a random disturbance[2]. The only unobservable variable in equation (7) is the real interest rate uncertainty, which can be obtained by specifying a univariate a generalized autoregressive conditional heteroscedasticity (GARCH) process (Price, 1995, 1996; Serven, 1998). The GARCH specification developed by Bollerslev (1986) has recently become a popular specification in modeling volatility because it not only separates out the predictable and unpredictable components but also allows for heteroscedasticity in the unpredictable component, and so takes into account of the fact that uncertainty may be greater during the bad than the good states of the economy and is time variant. Thus, a simple univariate model of GARCH (1, 1) is specified to obtain a measure for the real interest rate uncertainty,

$$C_t = \alpha_0 + \alpha_1 t + \alpha_2 C_{t-1} + \upsilon_t; \qquad t = 1,\ldots, T; \qquad (8)$$

$$\sigma^2_t = \gamma_0 + \gamma_1 \upsilon^2_{t-1} + \gamma_2 \sigma^2_{t-1} \qquad (9)$$

where $\upsilon_t \sim N(0, \sigma_t)$ and σ^2_t shows the variance of υ_t conditioned on an information set up to period t. The fitted values of the conditional variance were defined as uncertainty over real interest rate.

Empirical Results

Various specifications of equation (7) were estimated using annual data for Turkey over the 1968-98 period. Table 1 reports the results. Data on gross private investment, PI, and gross

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other variables of interest.

[2] In order to estimate a single equation such as this, the right hand side variables are assumed to be exogenous. Further, the variables in question are assumed to be cointegrated (see, Engle and Granger, 1987).

domestic product (GDP) used as a proxy for output, Y, are obtained from State Planning Organization (SPO). Bank credits to the private sector, CRD, and nominal deposit rate (NINT) are taken from International Financial Statistics Yearbook, IMF (IFS). All quantity variables are measured in current prices in 1995. The cost of capital is proxied by the real interest rate calculated using log $[(1+NINT_t) / (1+INF_t)]$[3] where INF denotes inflation rate computed as the annual difference in the logs of CPI taken from IFS. Cost uncertainty measure, σ, is the estimated conditional variance of the real interest rate from estimating equations (8,9).

Turning to Table I, the models as whole are statistically significant with a high degree of explanatory power as given by their adjusted R-squares. Furthermore, the Durbin-*h* statistics indicate that there is no first order serial correlation in the errors. As seen in the first column, all variables enter the model significantly and have the expected signs except for the real interest rate. The estimated coefficient of real GDP is positive and significant, indicating the presence of an accelerator effect of output on private investment, a result that is in line with virtually all previous work. Also, the flow of credit available to the private seems to have a positive effect on private sector investment. This finding is in agreement with the studies by Blejer and Khan (1984), Ramirez (1994), and Serven (1998). This suggests that the quantity constraints play a significant role in inhibiting the investment activities of private sector in Turkey. Interestingly, the level of real interest rate is not statistically significant, but its volatility is, indicating the presence of an adverse impact of interest rate uncertainty on private investment. The second column shows that excluding the level of real interest rate does not alter the robustness of the results. The magnitudes and signs of the variables of interest remain approximately the same. The estimated coefficient of the lagged dependent variable indicates the speed of adjustment, which is approximately 23 percent ($1-\beta=0.23$). This suggests that the gap between short run level

[3] When the real interest rate is calculated on a forward-looking basis, the estimated results do not alter significantly.

(actual) and the long run level (desired) of private investment closes up by a 23 percent within a year.

The last column of Table 1 includes the impact of a qualitative factor such as the financial liberalization program in 1982 by defining a dichotomous variable (Dum). In 1980, Turkish government implemented a major structural reform in which one of the aims was to reduce government's involvement in economic activities and to adopt many of the market-oriented strategies. Following this, the financial markets were liberalized in 1982, which resulted in a positive real interest rate, attracting more credits to be borrowed (Guncavdi et al., 1998). These might affect the dynamics of private investment, causing a structural shift in the investment function. However, as can be seen in the third column, the coefficient of the dichotomous variable is insignificant, suggesting that the dynamics of private investment remain the same in the pre and post liberalization periods. One of the reasons for this result may be that the time span used is not long enough to capture the effect of such a major policy change.

Conclusions

The main objective of this paper was to examine the determinants of private investment in the Turkish case, with the emphasis on the roles of the factors stemming from the financial markets such as the cost of capital, cost uncertainty and credit availability. To this end, the study modified the neoclassical model of investment to include the impacts of the quantity of credits and cost uncertainty variables, based on the conceptual framework derived from the literature. Two potential reasons were identified in the literature as to why the cost of credit turns out to be an insignificant factor in explaining private investment activities. One argument was that because of credit controls, ceilings on interest rates and other imperfections in financial markets in most

developing economies, the availability of credit to the private sector is a constraining factor on private investment rather than the cost of credits. An alternative explanation was that, due to the irreversibility of investment, cost uncertainty might play a more significant role than the level of cost of funds.

Using annual data for Turkey during the 1968-1998 period, this study found that while the cost of credits has no significant effect, the credit availability and cost uncertainty impose binding constraints on private investment. Put differently, uncertainty over the cost of credit has an adverse impact whereas the quantity of credits available to the private sector has a positive impact on private sector investment. In light of these findings, in order for policy makers to stimulate private investment, and thus achieve a high level of economic performance, the key areas to focus on should be to re-structure financial institutions in a way to provide sufficient amount of credit to be borrowed, and to avoid unnecessary fluctuations in real interest rate.

Table 1 Dependent variable: Log of Real Private Investment: 1968-1998

	Regressions		
	(1)	(2)	(3)
Constant	-0.298	-0.635	-0.536
	(0.852)	(0.683)	(1.522)
Real GDP[a]	0.213	0.250	0.239
	(0.121)*	(0.106)**	(0.187)
Real Interest Rate	0.089		
	(0.132)		
Flow of Real Credits[a]	0.293	0.320	0.322
	(0.109)**	(0.101)***	(0.105)***
Interest Rate Uncertainty[b]	-3.936	-4.075	-4.049
	(0.954)***	(0.922)***	(1.006)***
Real Private Investment$^{a}_{t-1}$	0.784	0.765	0.771
	(0.088)***	(0.083)***	(0.111)***
Dum			0.005
			(0.065)
Adjusted R^2	0.97	0.97	0.97
Durbin-*h* stat.	-0.31	-0.30	-0.35

Notes: Asterisks *, **, *** denote 10, 5 and 1 percent significance levels respectively. The figures in parentheses are standard deviations.

a. Expressed in logarithms.
b. Estimated conditional variances of real interest rate obtained by fitting a GARCH (1,1) process.
c. Dum is a dichotomous variable that takes a value of 0 pre-liberalization period (1968-1981), and of 1 otherwise.

References

Abel, A. B. (1983) Optimal investment under uncertainty, *American Economic Review*, **73**, 228-233.

Abel, A. B. and Eberly, J. C. (1994) A unified model of investment under uncertainty, *American Economic Review*, **84**, 1369-1384.

Abel, A. B. and Eberly, J. C. (1995) The effect of irreversibility and uncertainty on capital accumulation, *NBER Working Paper Series*, no. 5363.

Aizenman, J. and Marion, N. (1993) Macroeconomic uncertainty and private investment, *Economic Letters*, **41**, 207-210.

Aizenman, J. and Marion, N. (1996) Volatility and the investment response, *NBER Working Paper Series* no. 5841.

Blejer, M. and Khan, M. (1984) Government policy and private investment in developing countries, *IMF Staff Papers*, **31**, 379-403.

Bollerslev, T. (1986) Generalized autoregressive conditional heteroskedasticity, *Journal of Econometrics*, **31**, 307-327.

Caballero, R. J. (1991) On the sign of the investment-uncertainty relationship, *American Economic Review*, **81**, 279-288.

Caballero, R. J. (1993) On the dynamics of aggregate investment, in L. Serven and A. Solimano (eds), *Striving for Growth after Adjustment*, A. World Bank Regional and Sectoral Studies.

Chirinko, R. S. (1993) Business fixed investment spending: modeling, strategies, empirical results and policy implications, *Journal of Economic Literature*, **31**, 1875-1911.

Dixit, A. and Pindyck, R. S. (1994) *Investment Under Uncertainty*, Princeton University Press. Princeton, New Jersey.

Ferderer, P. J. (1993) The impact of uncertainty on aggregate investment spending: An empirical analysis, *Journal of Money, Credit and Banking*, **25**, 30-48.

Engle, R. F. and Granger, C. W. (1987) Co-integration and error-correction: Representation, estimation and testing, *Econometrica*, **55**, 251-276.

Goldberg, L. S. (1993) Exchange rates and investment in United States industry, *Review of Economics and Statistics*, **75**, 575-589.

Greene, J. and Villanueva, D. (1991) Private investment in developing countries: An empirical analysis, *IMF Staff Papers,* **38**, 33-58.

Guncavdi, O., Bleaney, M., and Mckay, A. (1998) Financial liberalization and private investment: Evidence from Turkey *Journal of Development Economics*, **57**, 443-455.

International Monetary Fund, *International Financial Statistics Yearbook*. Washington, (2000 and 1999 issues).

Jorgenson, D. W. (1963) Capital theory and investment behavior, *The American Economic Review*, **53**, 247-259.

Price, S. (1995) Aggregate uncertainty, capacity utilisation and manufacturing investment, *Applied Economics*, **27**, 147-154.

Price, S. (1996) Aggregate uncertainty, investment and asymmetric adjustment in the UK manufacturing sector, *Applied Economics*, **28**, 1369-1379.

Pindyck, R. S. (1991) Irreversibility, uncertainty and investment, *Journal of Economic Literature*, **29**, 1110-48.

Ram, M. (1993) Empirical investment equations for developing countries, in L. Serven and A. Solimano (eds) *Striving for Growth after Adjustment*, World Bank Regional and Sectoral Studies.

Ramirez, M. D. (1994) Public and private investment in Mexico, 1950-90: An empirical analysis, *Southern Economic Journal*, **61**, 1-17.

Rodrik, D. (1991) Policy uncertainty and private investment in developing countries, *Journal of Development Economics*, **36**, 229-242.

Serven, L. (1998) Macroeconomic uncertainty and private investment in LDCs: An empirical investigation, World Bank mimeo.

Serven, L. and Solimano, A. (1993) Economic adjustment and investment performance in developing countries: The experience of the 1980s, in L. Serven and A. Solimano (eds) *Striving for Growth after Adjustment*, World Bank Regional and Sectoral Studies.

Sundararajan, V. and Thakur, S. (1980) Public investment, crowding out, and growth: A dynamic model applied to India and Korea, *IMF Staff Papers*, **27**, 814-855

State Planning Organization, (1997 and various issues) *Economic and Social Indicators: 1950-1997*, Ankara, Turkey.

Tun Wai, U. and Wong, C. (1982) Determinants of private investment in developing countries, *The Journal of Development Studies*, **19**, 19-36.