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Financial Liberalization and Real Investment: Evidence from Turkish Firms

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Abstract

There is increasing emphasis on the importance of efficient financial markets for sustained real investment and economic growth, yet limited empirical research on the effects of the deregulation of financial markets on the firm's investment decisions. To test the ability of the 1980 financial reforms to relax the borrowing constraints faced by Turkish firms, this paper builds a dynamic investment model, where financial variables and real investment are linked through the net present value of the firm. A dynamic panel data methodology is used on a panel data set of 1,036 Turkish firms over the 1983-86 period. In addition, time-series analysis is employed on Turkish aggregate data over the 1971-91 period.

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I. INTRODUCTION

The objective of this paper is to evaluate the impact of financial reforms on the investment decisions of the firm. The paper builds a general framework for linking financial variables and real investment decisions. This framework is then applied to Turkey to assess whether the period of financial liberalization in 1980 relaxed the borrowing constraints faced by Turkish firms and resulted in higher levels of real investment activity.

A large body of literature now emphasizes the positive link between financial markets and economic growth.[2] However, this literature tends to focus on the macroeconomic impact of financial market deregulation and tests their predictions on aggregate data, leaving empirical research on the effects of financial reforms at the firm level limited. Firm-level studies can provide more detailed information on how well a country's reforms are able to reduce the problems related to capital market imperfections. These imperfections sometimes arise through direct government controls on interest rates and sector- or industry-specific credit policies. Even in the absence of government intervention, capital market imperfections arise when asymmetric information problems constrain external financing for some firms and restrict their investment. The literature on investment under capital market imperfections introduces a role for financial variables in the investment decisions of the firm. The paper contributes to this literature by analyzing the impact of financial reforms on the borrowing constraints faced by the firm.

The investment model builds on the literature on investment under capital market imperfections. The paper extends the estimable dynamic investment model, in which the net present value of a firm is maximized subject to capital market imperfections, to a more precise specification of borrowing constraints. Two types of borrowing constraints are considered: an increasing premium on the firm's debt-to-capital ratio and credit rationing. In doing so, the model provides a framework that can be used for analyzing both developing and industrial countries and for addressing the impact of different deregulation policies on financial markets and firms.

This paper is the first study to use firm-level data to investigate the impact of the financial liberalization in 1980 on the borrowing constraints faced by Turkish firms. The current empirical literature provides little research on the impact of financial reforms on firm-level investment in a developing country. The few empirical studies on real investment in Turkey, for example, focus on aggregate investment (Conway, 1990; Anand, Chhibber, and van Wijnbergen, 1990; and Günçavdı, Bleaney, and McKay, 1998).

The advantage of the functional specification of the paper is that it is possible to use the same estimable investment equation for both firm-level and aggregate data. Hence, using empirical evidence from panel data, we can determine whether the 1980 financial reforms were successful in relaxing borrowing constraints for small, medium-sized, and large firms in the manufacturing sector in the 1983-86 period. In addition, the large number of firms in the data set makes it possible to study Turkey's largest industry, the textile industry, in more detail.

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[2] See Levine (1997) for a review of this literature.

Then, employing the same model, we can use aggregate data from the 1971-91 period to compare preliberalization and postliberalization periods and test for structural change in the model across time.

The paper is organized as follows. Section II provides the background on financial liberalization in Turkey and an overview of the investment literature with capital market imperfections. Section III develops the theoretical model. Section IV presents the estimation results with panel data. Section V presents the estimation results with aggregate data. Section VI concludes.

II. Background

A. Financial Liberalization in Turkey

In the early 1970s, the Turkish economy recorded high growth rates together with low rates of inflation and current account surpluses. The high growth rate of the economy, which averaged 7.9 percent in the 1971-73 period, was primarily due to the high growth rate of real private fixed investment, which averaged 8.1 percent in the same period (see Table 1). An inward-looking import substitution strategy by the Turkish government was the driving force behind the high growth rate of investment. However, this strategy also created an industry that relied heavily on government protection and on the importation of certain key raw materials and intermediate goods.

The inefficiencies of the Turkish industry were soon exacerbated by external shocks initiated by the first oil crisis of 1974. Since Turkey is heavily dependent on the import of oil, the sharp increase in the price of oil led to a deterioration of Turkey's terms of trade. The government did not devalue in line with the terms of trade, resulting in the real appreciation of the Turkish lira. While the real appreciation of the currency helped to finance the imports of raw materials and intermediate goods for the Turkish industry, it also led to the stagnation of exports. As a result of these developments, the current account moved from a surplus of 3.0 percent of GNP in 1973 to a deficit of 6.5 percent by 1977. Initially, the current account deficit was financed by foreign exchange reserves, then, as these reserves were depleted, by short-term borrowing. By 1977, the share of short-term debt in total external debt had grown to 54.0 percent from 8.3 percent in 1973 (Rodrik, 1988; and Uygur, 1993). In these circumstances, Turkey experienced ever-increasing difficulties in financing import and debt-service payments. By 1978, the country was insolvent.

At the same time, the fall in exports adversely affected the manufacturing sector, with investment in that sector experiencing a particularly sharp decline. Overall, the macroeconomic picture presented a stark contrast with that of the early 1970s. In the 1978-80 period, the Turkish economy recorded an average growth rate of only 0.5 percent with negative growth rates in both 1979 and 1980. The increasing inaccessibility of foreign borrowing fueled a rise in the inflation rate to 71.1 percent in 1979 and 105.7 percent in 1980 as the current account deficit rose to 5.8 percent of GNP.

In January 1980, Turkey introduced a macroeconomic stabilization and a liberalization program. As part of this program, financial sector liberalization began in July 1980.[3] Until this period, the financial sector in Turkey had been highly repressed, with imposed ceilings on deposit and lending rates. By 1980, these had resulted in negative real interest rates, credit rationing and subsidized credits, high banking sector concentration ratios, with concomitant high intermediation costs, and the absence of alternative capital markets. Financial repression and the underdeveloped state of financial markets had resulted in inefficient internal savings and investment decisions.

There were two main objectives of the 1980 financial reforms. One objective was to remove the restrictions on interest rates and to encourage competition in the banking system through the entry of new financial institutions and instruments. The other objective was to develop a better-functioning capital market through the development of bond and equity markets outside the banking system.

This paper focuses on the banking sector within the Turkish financial system. The reason is that the banking sector dominated the Turkish financial system both before and after the financial reforms. For example, in terms of the stock of financial assets, bank deposits amounted to 57 percent of all financial assets in 1979 and 70 percent in 1986, and, in terms of new issues, the share of bank deposits was 64 percent of all new issues of financial assets in 1979 and about 70 percent in 1986 (Akyüz, 1990). In this respect, Turkey is similar to many developing economies. The *World Development Report 1999/2000* states that the banking sector typically accounts for a large share of the financial market in developing countries (World Bank, 1999).

The first step in the Turkish financial liberalization was the removal of the upper limit on interest rates in July 1980. In May 1985, new banking legislation was passed to address the structural weakness of the banking system. It included provisions to protect deposits through deposit insurance, the standardization of auditing and accounting systems, and the treatment of nonperforming loans.

There are no empirical studies of the cost and availability of credit for Turkish firms in the postreform period. More generally, the investment literature on Turkey is limited, with existing research focusing on aggregate investment. Conway (1990) identifies some factors that stimulated aggregate real private investment in Turkey in the 1962-86 period. However, his model does not capture credit-rationing constraints. Anand, Chhibber, and van Wijnbergen (1990) provide an econometric study of aggregate real private investment for the 1970-86 period. They use a proxy for credit rationing, the ratio of credit to the private sector over output, as an explanatory variable and find their proxy to have a strong and significant impact on private sector investment. The most recent study, Günçavdı, Bleaney, and McKay (1998), estimates the impact of financial liberalization on borrowing constraints in the 1964-93 period, again using aggregate investment. This paper is the first to use firm-level data to analyze the impact of financial liberalization on investment in Turkey.

[3] The financial policies of the 1980s are explained in detail in Akyüz (1990).

B. Investment Literature Under Capital Market Imperfections

The assumption of perfect capital markets implies that a firm's financial structure is irrelevant to its real investment decisions. Under perfect capital markets, external financing, that is borrowing and issuing new equity shares, is a perfect substitute for internal financing, that is, cash flow and retained earnings. Following the work of Modigliani and Miller (1958 and 1961), real investment decisions of the firm were separated from its financial structure. The argument was that, under perfect capital markets, the market value of a firm is independent of such financial factors as the amount of issued equity, the debt-to-capital ratio (leverage), and retained earnings. More recently, an increasing number of investment studies have begun to view external financing as an imperfect substitute for internal financing (Myers and Majluf, 1984; Fazzari, Hubbard, and Peterson, 1988; and Bond and Meghir, 1994, among others).

If internal and external financing are not perfect substitutes, investment decisions will depend on financial factors, such as the availability of internal funds and the firm's access to equity or debt financing. Problems in capital markets, especially asymmetric information, make it costly for credit institutions to evaluate the quality of firms' investment proposals. This implies that the cost of financing through new debt and equity can be substantially higher than the opportunity cost of using internally generated cash flow and retained earnings. In these cases, real investment decisions will depend on financial factors. In the extreme, asymmetric information can lead to credit rationing.

Empirical evidence suggests that the investment decisions of firms with asymmetric information problems will be more sensitive to cash flow. Fazzari, Hubbard, and Peterson (1988) estimate an investment equation across U.S. manufacturing firms classified by their dividend behavior and find that investment is more sensitive to cash flow and liquidity for firms that retain all of their income. Whited (1992) finds that the investment model with perfect capital markets is rejected for U.S. firms with low-dividend payout but cannot be rejected for firms with high-dividend payout. Bond and Meghir (1994) use panel data on U.K. firms and find that investment is correlated with lagged cash flow after controlling for leverage and output fluctuations. Jaramillo, Schiantarelli, and Weiss (1996) test the significance of borrowing constraints in a developing country, Ecuador, and find that these constraints are significant for young or small firms but not significant for large or mature firms.

This paper uses Euler equations to examine the effects on investment of two types of costs related to debt financing. The first one is the premium above the risk-free interest rate faced by firms that borrow; this cost arises from the risk of financial distress and increases in the firm's debt-to-capital ratio. Costs of financial distress are incurred when it becomes difficult for a firm to honor the interest or even principal payments of its debt. The extreme case of financial distress is bankruptcy. The second type of cost arises when firms face credit rationing, that is, when there is an exogenous upper limit on the debt-to-capital ratio (Jaffee and Russell, 1976; and Stiglitz and Weiss, 1981). These two types of costs arising from financial market imperfections can be incurred in both developing and industrial countries. However, they are likely to be more pronounced in developing countries, where the infrastructure for the lending institutions is not as well established as in industrial countries.

III. Theoretical Model

A. The Standard Model of Investment with Perfect Capital Markets

In this section, the investment decision of the firm is modeled as independent of its financial structure. This model is taken from the literature and is used as the benchmark for the introduction of borrowing constraints.

Define $\Pi\ (K_t, L_t, I_t)$ as the cash-flow function, where K_t is the capital stock, L_t represents all variable (costlessly adjustable) factors of production, and I_t is investment. Investment is immediately productive. However, the firm faces strictly convex costs of adjustment in changing its capital stock. The cost-of-adjustment function is $G(I_t,\ K_t) = \frac{1}{2} b K_t \left[\frac{I_t}{K_t} \right]^2$, where b is the marginal adjustment cost parameter. $G(.)$ is a time-invariant, symmetric adjustment cost function and is convex in the rate of investment. The production function, $F(K_t, L_t)$, displays constant returns to scale. It is increasing, concave, and satisfies the Inada conditions. The price of output is p_t, and the vector of prices for the variable inputs is w_t. The price of output, p_t, and the price of investment goods, p_t^K, are stochastic. $p_t = \bar{p}_t + u_t$ and $p_t^K = \bar{p}_t^K + u_t^K$, where u_t and u_t^K are independent and identically distributed (i.i.d.) error terms. Furthermore, symmetric information is assumed.

The optimal choice of variable factors involves static optimization under certainty. The short-run (restricted) profit function at time t, $R\ (K_t,I_t,w_t,p_t)$, can be defined as

$$\begin{aligned} R\ (K_t,I_t,w_t,p_t) &\equiv \max_{L_t > 0} \left\{ p_t F(K_t,L_t)\ - w_t L_t\ - p_t G(I_t,K_t) \right\} \\ &\equiv p_t F\left(K_t, L^*(K_t,w_t,p_t)\right)\ - w_t L^*(K_t,w_t,p_t)\ - p_t G(I_t,K_t) \end{aligned} \tag{1}$$

where $L_t^* = L^*(K_t,w_t,p_t)$ denotes the optimal choice of the costlessly variable factors.

The cash-flow function is given by

$$\Pi\left(K_t,\ I_t,\ w_t,p_t,p_t^K\right) = R\left(K_t,\ I_t,\ w_t,p_t\right) - p_t^K I_t. \tag{2}$$

The representative firm has an infinite horizon. r_t is the firm's nominal required rate of return between periods t and $t+1$, and $\beta_t = \frac{1}{(1+r_t)}$ is the firm's discount factor, $0 < \beta_t < 1$.[4]

[4] In the investment literature, r_t is called the required rate of return owing to the arbitrage condition between the shares of a firm and a riskless asset. Let V_t be the value of the firm at time t and D_t be the dividends of the firm at time t+1. If risk-neutral individuals arbitrage between the

(continued...)

The objective of the firm is to maximize the wealth of the marginal shareholder. The firm chooses investment at time 0, I_0, and sequences for future investment plans, $\{I_t\}_{t=0}^{\infty}$, to maximize the expected present value of future cash flows, subject to the law of motion for the capital stock, $K_t = (1-\delta)K_{t-1} + I_t$, where $0 < \delta < 1$ is the constant rate of depreciation for capital. The firm solves the following dynamic problem:

$$\max_{I_t} E_0 \sum_{t=0}^{\infty} \beta_t \, \Pi \, (K_t, I_t, w_t, p_t),$$

subject to $K_t = (1-\delta)K_{t-1} + I_t$ given K_{-1}. The expectations operator, $E_t\,[.]$, is conditional on the information available at the beginning of period t. Using dynamic optimization, the following Euler equation is obtained:

$$\frac{\partial \Pi}{\partial K_t} + \frac{\partial \Pi}{\partial I_t} - \beta_t E_t \, (1-\delta) \left[\frac{\partial \Pi}{\partial I_{t+1}} \right] = 0. \tag{3}$$

Equation (3) is a first-order-difference equation that describes the firm's optimal investment choice. It incorporates the Modigliani-Miller assumption that the firm's financing decisions are irrelevant to its optimal investment choice. In this equation, the firm's optimal investment choice depends only on the firm's production decisions, such as how much to invest, how much labor to hire, and how much to produce. By assuming rational expectations and using the explicit form of the Π (.) function (and the production and adjustment cost functions within), equation (3) can be estimated.

B. The Model of Investment with Borrowing Constraints

In this section, it is assumed that there is asymmetric information between the borrower (shareholders) and the lender. Define D_t as dividends paid in period t and N_t as the value of new shares issued in period t. The value of the firm at time t, V_t, is given by the expected present value of the future stream of dividends minus the expected present value of the future stream of new shares. A difference between the personal income tax rate on dividends and interest income (m_t) and the tax rate on capital gains (z_t) is introduced and defined as $\gamma_t = \frac{1-m_t}{1-z_t}$.

The value of the firm is given by

$$V_t = E_t \sum_{j=0}^{\infty} \beta_t^j \left[\gamma_{t+j} D_{t+j} - N_{t+j} \right], \tag{4}$$

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shares of the firm and the riskless asset, then the expected rate of return on the shares must equal the riskless rate: $\frac{\left(E_t V_{t+1} - V_t\right) + E_t D_{t+1}}{V_t} = r_t.$

where $\beta_t^j = \prod_{i=0}^{j}\left(\frac{1}{1+r_{t+i}}\right)$ and $0 < \beta_t^j < 1 \quad \forall t$. Firms maximize the value of the firm subject to four constraints: cash-flow identity, credit-rationing constraint, capital accumulation constraint, and nonnegativity constraints.

Cash-flow identity. A cash-flow identity holds between the firm's sources of funds (i.e., internally generated funds plus external financing) and expenditures. External financing consists of new share issues plus borrowing (by issuing new debt) less the costs of borrowing. The cash-flow identity for a firm that issues both new shares and one-period debt can be represented as follows:

$$\begin{aligned} D_t = \left(1-\tau_t\right)&\left[p_tF\left(K_t,L_t^*\right) - p_tG\left(I_t,K_t\right) - w_tL_t^* - \left(i_{t-1} + \Psi\left(B_{t-1},v_{t-1}\right)\right)B_{t-1}\right] \\ &+ \left(B_t - B_{t-1}\right) - p_t^K I_t + N_t \end{aligned} \tag{5}$$

where τ_t is the corporate tax rate and i_{t-1} is the nominal interest rate (determined in period t-1) on one-period loans issued in period t-1. The number of one-dollar, one-period loans is denoted by B_t. $\left(B_t - B_{t-1}\right)$ is the increase in nominal debt at time t, $\Psi(.)$ is the financial distress function, and $v_{t-1} = p_{t-1}^K K_{t-1}$. $\Psi(.)$ represents the premium paid above the nominal interest rate. This premium is due to the asymmetric information between the borrower and the lender.[5] In the literature, the nominal interest rate, i_{t-1}, is referred to as the risk-free interest rate. "Risk free" means that the interest rate is free of the financial distress risk associated with the firm's leverage ratio but does capture the risk associated with macroeconomic conditions in the country. For example, the one-year interest rate on government treasury bills would be considered the risk-free interest rate.

Credit rationing constraint. The firm also faces an upper limit (credit ceiling) on its debt-to-capital ratio. Beyond this limit, the firm becomes too risky for lenders and, therefore, credit is rationed (Whited, 1992):

$$\frac{B_{t-1}}{p_{t-1}^K K_{t-1}} \leq \bar{B}. \tag{6}$$

Capital accumulation constraint. This constraint is defined as follows:

$$K_t = I_t + (1-\delta)K_{t-1}. \tag{7}$$

Nonnegativity constraints. These are defined as follows:

$$D_t \geq 0, \quad B_t \geq 0, \quad N_t \geq 0. \tag{8}$$

[5] Some papers have introduced agency function as a cost function in the cash flow identity (e.g., Jaramillo, Schiantarelli, and Weiss, 1996).

Functional specifications

The financial distress function

The financial distress function is parameterized as

$$\Psi\left(B_{t-1}, v_{t-1}\right) = a\left(\frac{B_{t-1}}{v_{t-1}}\right) \qquad a > 0. \tag{9}$$

Given this specification, the interest rate on debt issued at the end of period t-1 is equal to the nominal interest rate, i_{t-1}, plus a premium that is constant with respect to the leverage ratio, i.e. $\frac{\partial\Psi}{\partial\left(\frac{B_{t-1}}{v_{t-1}}\right)} = a > 0$.[6] For notational simplicity, until the empirical part of the paper, $\Psi(.)$ will be expressed as a general function of B_{t-1} and v_{t-1}.

The cash-flow function

As explained earlier, the cash-flow function is parameterized as

$$\Pi\ (K_t, L_t, I_t) = p_t F(K_t, L_t^*) - p_t G(I_t, K_t) - w_t L_t^* - p_t^K I_t, \tag{2}$$

where $G(I_t, K_t) = \frac{1}{2} b K_t \left[\frac{I_t}{K_t}\right]^2$. The variable p_t in the cash-flow function represents marginal revenue. To allow for imperfect competition, one can set the marginal revenue equal to $p_t\left[1 - \frac{1}{|\varepsilon|}\right]$, where ε is the constant elasticity of demand facing the imperfectly competitive firm, that is, $\varepsilon\left(y\right) = \frac{p}{y}\frac{dy}{dp}$. Then,

$$\frac{\partial\Pi}{\partial I_t} = -\alpha b p_t \frac{I_t}{K_t} - p_t^K, \tag{10}$$

where $\alpha = 1 - \frac{1}{\varepsilon}$, and

$$\frac{\partial\Pi}{\partial K_t} = \alpha p_t \frac{Y_t}{K_t} - \alpha p_t\left(\frac{\partial F}{\partial L_t}\frac{L_t}{K_t}\right) + \frac{1}{2} b \alpha p_t\left(\frac{I_t}{K_t}\right)^2 . \tag{11}$$

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[6] The marginal financial distress premium with respect to B_{t-1} is $\frac{\partial\Psi}{\partial B_{t-1}} = \frac{a}{v_{t-1}} > 0$, which implies that the larger the amount borrowed, the higher the financial distress premium. The marginal financial distress premium with respect to v_{t-1} is $\frac{\partial\Psi}{\partial v_{t-1}} = -a\frac{B_{t-1}}{v_{t-1}^2} < 0$, which implies that the higher the collateral of the firm, the lower the financial distress premium.

In the above equation, it is assumed that $F(K_t, L_t)$ is homogeneous of degree one in its arguments, and Euler's Theorem is used.

The model and the solution

The firm solves the following discrete time problem to determine the optimal levels of K_t, I_t, D_t, B_t, and N_t:

$$\max \; E_t \sum_{j=0}^{\infty} \beta_t^j \left[\gamma_{t+j} D_{t+j} - N_{t+j}\right],$$

subject to

$$D_t = \left(1-\tau_t\right)\left[p_t F\left(K_t, L_t^*\right) - p_t G\left(I_t, K_t\right) - w_t L_t^* - \left(i_{t-1} + \Psi\left(B_{t-1}, v_{t-1}\right)\right) B_{t-1}\right] + \left(B_t - B_{t-1}\right) - p_t^K I_t + N_t \tag{5}$$

$$\frac{B_{t-1}}{v_{t-1}} \le \bar{B}, \tag{6}$$

$$K_t = I_t + (1-\delta) K_{t-1}, \text{ and} \tag{7}$$

$$D_t \ge 0, \quad B_t \ge 0, \quad N_t \ge 0. \tag{8}$$

The following are the Kuhn-Tucker conditions:

$$\frac{\partial Z_t}{\partial K_t} = \left(\gamma_t + \lambda_t^D\right)\left(1-\tau_t\right)\left(\alpha p_t \frac{\partial F}{\partial K_t} - \alpha p_t \frac{\partial G}{\partial K_t}\right) - E_t \beta_{t+1}\left(\gamma_{t+1} + \lambda_{t+1}^D\right)\left(1-\tau_{t+1}\right)\frac{\partial \Psi}{\partial v_t} p_t^K B_t + \lambda_t^C \frac{B_t}{p_t^K K_t^2} + E_t \beta_{t+1} \lambda_{t+1}^K \left(1-\delta\right) - \lambda_t^K \le 0 \tag{12}$$

$$\frac{\partial Z_t}{\partial I_t} = -\left(\gamma_t + \lambda_t^D\right)\left(1-\tau_t\right)\left(\alpha p_t \frac{\partial G}{\partial I_t}\right) - \left(\gamma_t + \lambda_t^D\right) p_t^K + \lambda_t^K = 0 \tag{13}$$

$$\frac{\partial Z_t}{\partial B_t} = -E_t \beta_{t+1}\left(\gamma_{t+1} + \lambda_{t+1}^D\right)\left(1-\tau_{t+1}\right) i_t - E_t \beta_{t+1}\left(\gamma_{t+1} + \lambda_{t+1}^D\right)\left(1-\tau_{t+1}\right)\left(\Psi + B_t \frac{\partial \Psi}{\partial B_t}\right) + \left(\gamma_t + \lambda_t^D\right) - E_t \beta_{t+1}\left(\gamma_{t+1} + \lambda_{t+1}^D\right) - E_t \beta_{t+1} \lambda_{t+1}^C \frac{1}{p_t^K K_t} + \lambda_t^B \le 0 \tag{14}$$

$$\frac{\partial Z_t}{\partial N_t} = \left(\gamma_t + \lambda_t^D\right) + \lambda_t^N - 1 \le 0, \tag{15}$$

where λ_t^C, λ_t^K, λ_t^D, λ_t^B, and λ_t^N are the Lagrange multipliers associated with the credit-rationing constraint, the law of motion for the capital stock, the nonnegativity constraint on dividends, the nonnegativity constraint on debt (implying no lending for the firm), and the nonnegativity constraint on new shares, respectively.[7]

There are four possible cases for new shares and dividends. However, the case that is most relevant for a developing country is the one in which current and future dividends are positive and no new shares are issued, that is, $\boldsymbol{D_t > 0}$ and $\boldsymbol{N_t = 0}$.[8] The dominance of the banking system within the financial system of the developing country and the relatively undeveloped nature of bond and equity markets are the main reasons why borrowing is the most common method of financing investment. In Turkey, the share of equities and corporate bonds in the total stock of financial assets was only 8.4 percent in 1979 and 4.3 percent in 1986 (Akyüz, 1990).

From the complementary slackness condition, $\lambda_t^D = \lambda_{t+1}^D = 0$. The Euler equation for capital is determined by using the first-order conditions for investment, equation (13), and for capital, equation (12). Using equation (13) and assuming that $\lambda_t^D = \lambda_{t+1}^D = 0$,

$$\lambda_t^K = \gamma_t \left(1 - \tau_t\right)\left(\alpha p_t \frac{\partial G}{\partial I_t}\right) + \gamma_t p_t^K. \tag{16}$$

With $K_t > 0$, equation (12) equals zero. Hence, substituting the above expression into (12) with $\lambda_t^D = 0$, the following expression is obtained:

$$-E_t\beta_{t+1}\left(1 - \delta\right)\left[\frac{\partial \Pi}{\partial I_{t+1}}\right] = -\frac{\partial \Pi}{\partial K_t} - \frac{\partial \Pi}{\partial I_t} + E_t\beta_{t+1}\lambda_{t+1}^C \frac{B_t}{p_t^K K_t^2} + E_t\beta_{t+1}\frac{\partial \Psi}{\partial v_t} p_t^K B_t. \tag{17}$$

We have set $\gamma_t = \gamma_{t+1} = 1$ and $\tau = 0$ to be able to compare equation (17) to the Euler equation for capital obtained from the standard model of investment, equation (3). Except for the last two terms on the right-hand side, all other terms are the same, that is, the unconstrained model is nested within the finance-constrained model. The last two terms are associated with the credit ceiling constraint and the financial distress premium, respectively.

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[7] The model also has complementary slackness conditions that have not been reported for reasons of space.

[8] Of the four cases, the first one is the one in which the firm issues new shares and dividends, i.e., $\boldsymbol{D_t > 0}$ and $\boldsymbol{N_t > 0}$. This case is never optimal for the firm. Second, the firm finances its investment at the margin by new equity and no dividend payments, i.e., $\boldsymbol{D_t = 0}$ and $\boldsymbol{N_t > 0}$. Third, the firm uses up all its retained earnings such that dividends are zero and it is optimal not to issue new shares, i.e., $\boldsymbol{D_t = 0}$ and $\boldsymbol{N_t = 0}$. Fourth, the case of $\boldsymbol{D_t > 0}$ and $\boldsymbol{N_t = 0}$, which is considered in detail in this paper.

Euler equation with a nonbinding credit constraint

Consider the case in which the firm finances its investment through retained earnings and new debt, that is, $D_t > 0$ and $N_t = 0$, but in which the credit-rationing constraint is not binding, that is, $\lambda_t^C = 0$.

We assume rational expectations, which implies that the expected and actual values differ by a random forecast error, υ_{t+1}. By replacing expected by actual values and after some rearrangements, equation (17) can be rewritten as the following exactly identified equation:

$$\frac{I_{t+1}}{K_{t+1}} - \phi_{t+1}\left(\frac{I_t}{K_t}\right) + \frac{\phi_{t+1}}{2}\left(\frac{I_t}{K_t}\right)^2 + \eta_1\left(\phi_{t+1}\frac{w_t L_t}{p_t K_t} + \frac{\phi_{t+1}}{(1-\tau_t)}\frac{p_t^K}{p_t} - \frac{1}{(1-\tau_{t+1})}\frac{p_{t+1}^K}{p_{t+1}}\right)$$
$$+ \eta_2\left(\phi_{t+1}\frac{Y_t}{K_t}\right) + \eta_3\left(\frac{1}{(1-\delta)}\frac{p_t^K}{p_{t+1}}\left(\frac{B_t}{v_t}\right)^2\right) = \upsilon_{t+1} \quad (18)$$

where $\eta_1 = \frac{-1}{\alpha b}$, $\eta_2 = \frac{1}{b}$, $\eta_3 = \frac{a}{\alpha b}$.[9] The slope of the financial distress function, coefficient a, determines the relationship between the interest rate faced by the firm and its debt-to-capital ratio.

Euler equation with a binding credit constraint

If the credit constraint is binding, then λ_t^C in equation (17) will no longer be equal to zero. In this case, one can eliminate λ_t^C by using the first-order condition for debt. Assuming dividends are still positive, $\lambda_t^D = E_t\lambda_{t+1}^D = 0$. Since debt is also positive, $\lambda_t^B = 0$. Then, using the first-order conditions for debt, investment, and capital (equations (14), (13), and (12), respectively), we get the following exactly identified equation:

[9] The complete derivation is presented in Sancak (2000). We would briefly note that we have used the first-order condition in which the marginal products of the variable factors, $\frac{\partial F}{\partial L_t}$, are equal to $\left(\frac{w_t}{\alpha p_t}\right)$. In addition, $\phi_{t+1} = \frac{\gamma_t(1-\tau_t)}{\gamma_{t+1}(1-\tau_{t+1})(1-\delta)\beta_{t+1}}\frac{p_t}{p_{t+1}}$, and $\frac{1}{\beta_{t+1}}\frac{p_t}{p_{t+1}}$ is the real discount rate, as in Bond and Meghir (1994).

$$
\begin{aligned}
&\frac{I_{t+1}}{K_{t+1}} - \phi_{t+1}\left(\frac{I_t}{K_t}\right) + \frac{\phi_{t+1}}{2}\left(\frac{I_t}{K_t}\right)^2 \\
&+ \eta_1\left(\phi_{t+1}\frac{w_t L_t}{p_t K_t} + \frac{\phi_{t+1}}{\left(1-\tau_t\right)}\frac{p_t^K}{p_t} - \frac{1}{\left(1-\tau_{t+1}\right)}\frac{p_{t+1}^K}{p_{t+1}}\right) \\
&+ \eta_2\left(\phi_{t+1}\frac{Y_t}{K_t}\right) \\
&+ \eta_3'\left(\frac{1}{\left(1-\delta\right)}\frac{p_t^K}{p_{t+1}}\left(\frac{B_t}{v_t}\right)^2\right) \\
&+ \eta_4\left(\left(\frac{\phi_{t+1}}{1-\tau_t}\frac{p_t^K}{p_t}\left(1-\beta_{t+1}\frac{\gamma_{t+1}}{\gamma_t}\right) - \frac{1}{1-\delta}\frac{p_t^K}{p_{t+1}}i_t\right)\left(\frac{B_t}{v_t}\right)\right) \\
&= \upsilon_{t+1}
\end{aligned}
\tag{19}
$$

where $\eta_1 = \frac{-1}{\alpha b}$, $\eta_2 = \frac{1}{b}$, $\eta_3' = \frac{-a}{\alpha b}$, $\eta_4 = \frac{1}{\alpha b}$.[10]

In equation (19), η_1 and η_2 are precisely the same as in equation (18), $\eta'_3 = -\eta_3$, and there is an additional coefficient, η_4. The coefficients η'_3 and η_4 will determine the importance of capital market imperfections. If $\eta'_3 < 0$ and $\eta_4 > 0$, then coefficient a from the financial distress function is positive and significantly different from zero, which implies that the firm faces an increasing premium for external finance, and in addition, that the firm's credit constraint is binding. If $\eta'_3 > 0$ and η_4 is not significantly different from zero, then the case of nonbinding credit constraint holds. If $\eta'_3 = 0$ and $\eta_4 = 0$, then there are no financial constraints.

IV. Estimation with Panel Data

In the previous section, two types of borrowing constraints were introduced to the standard model of investment with perfect capital markets. It was found that the standard model of investment is nested within the model with a nonbinding credit constraint, and the model with a nonbinding credit constraint is, in turn, nested within the model with the binding credit constraint (with the note that the sign of η_3 is reversed). This means that only the model with a binding credit constraint needs to be estimated. Based on the significance of the coefficients of this model, there are three possibilities. First, the model with a binding credit constraint holds, which would imply that firms face both an increasing premium and credit rationing. Second, the model with a nonbinding credit constraint holds, which would imply that firms face an increasing premium but not credit rationing. Third, the standard model of investment holds, which would imply that firms face neither an increasing premium nor credit rationing.

[10] The complete derivation is presented in Sancak (2000).

A. Description of the Data Set

Firm-level data are collected by the Industrial Statistics Section of the State Institute of Statistics (SIS) of Turkey. They cover all manufacturing establishments in the public sector and establishments with 25 or more employees in the private sector. The data set is balanced with annual observations on 1,655 plants from 1983 to 1986. It covers all plants in the greater Istanbul area, which has a heavy concentration of the manufacturing sector in Turkey. The plants are identified only by a code, and if a firm has multiple plants, then each plant is counted individually. In the empirical analysis, the terms "plant" and "firm" are used interchangeably.

B. Descriptive Statistics

Five consistency tests were employed to eliminate firms with inconsistent data. The first test eliminated firms that had a reported capital value of less than or equal to zero in any year. The second test eliminated firms that had a replacement value of capital less than or equal to zero in any year. The third test eliminated firms with total sales less than or equal to zero in any year. The fourth test eliminated firms which had a leverage ratio greater than or equal to ten in any year. Finally, the fifth test eliminated firms that invested more than ten times the value of their capital or disinvested more than their capital in any year. This elimination step is used in the literature to screen out the cases of mergers and acquisitions. In the end, 1,036 out of 1,655 firms passed all five tests.

Table 2 presents the descriptive statistics for all firms in the manufacturing sector over the 1983-86 period. The moments of the capital stock indicate that the manufacturing sector in Turkey is identified by predominantly small firms and a few very large firms. The standard deviation of the firms' capital stocks is quite large. The distribution of capital is highly skewed to the right, as indicated by the highly positive skewness coefficient and by the median which lies well below the mean. The positive and large coefficient of kurtosis indicates that the distribution is highly peaked. The coefficients of skewness and kurtosis both indicate that the majority of the firms have very low levels of capital. In fact, Figure 1, the histogram for the 1983 capital stock for the 1,036 firms, shows that about 80 percent of the firms are clustered together in the highly peaked section of the distribution. The remaining 20 percent of the firms are spread out to form an overall right-skewed distribution.

Investment is also highly skewed to the right and highly peaked. The average mean of the investment-capital ratio over the entire 1983-86 period is 0.16. This is consistent with the investment-capital ratios reported in other studies, for example, 0.15 for the manufacturing firms in Italy (Galeotti, Schiantarelli, and Jaramillo, 1994) and 0.19 for those in the United States (Whited, 1992). The average mean of the debt-capital ratio over the entire period is 1.4. This ratio is slightly higher than the leverage ratios reported in other studies, for example, 1.05 for the manufacturing firms in Italy (Galeotti, Schiantarelli, and Jaramillo, 1994) and 0.96 for those in Ecuador (Jaramillo, Schiantarelli, and Weiss, 1996). The average mean of the output-capital ratio over the entire period is 7.5 and is fairly stable over the years.

C. Estimation and Results

The derived investment equation, equation (19), is estimated by using the generalized method of moments (GMM) estimator on a panel data set for Turkish firms. A number of recent studies, such as Arellano and Bond (1991), Ahn and Schmidt (1995), and Keane and Runkle (1992), have suggested using the GMM estimator with dynamic panel data models, that is, panel data models with predetermined as opposed to exogenous regressors. The advantage of the GMM estimator is that it allows us to obtain asymptotically efficient estimates with dynamic panel data models without imposing independence over time or conditional homoscedasticity on the disturbances of the model.

A test of overidentifying restrictions is used as a specification test. This test determines whether there is zero correlation between the disturbances and the set of instruments –in other words, whether the instruments are exogenous.

We assume fixed-firm effects, which we eliminate by first differencing. The choice between the fixed effects and the random effects depends on the nature of the panel data set. In general, if the observations exhaust the population, the fixed-effects model is reasonable. Since the data in this study have been collected by a census rather than by a random sample selection, a fixed-effects model is used. We also introduce a time dummy to incorporate time-specific effects common to all firms. First differencing the equations introduces a moving-average component of the error term, MA(1). To account for this induced serial correlation, where possible, instruments are selected from time period $t-2$. We start with three Euler equations covering time periods 1983-84, 1984-85, and 1985-86. After first differencing, there are two equations covering time periods 1983-85 and 1984-86. For the second equation, we use, as instruments, variables $\frac{I}{K}, \left(\frac{I}{K}\right)^2, \frac{wL}{K}, \frac{Y}{K}, \frac{B}{pK}, \left(\frac{B}{pK}\right)^2$, and time dummies, all dated $t-2$ in levels. While any variable dated t or earlier is a valid instrument, Monte Carlo experiments suggest that one should be stringent with the choice of instruments. A good instrument must not only be uncorrelated with the error term but also strongly correlated with the regressors. This principle was kept in mind in choosing the instrumental variables.

For the first equation, we use the same instruments dated $t+1$. Under the assumption that the disturbances are serially independent, future values of the regressors can be used as instruments. In other words, it is assumed that the disturbance term and the future values of the regressors are independent (see Hayashi and Inoue (1991) for a similar assumption). This assumption had to be imposed to be able to use the future values of the regressors as instruments, since the time dimension of the data is already short and there are no data available earlier than 1983. If this assumption turns out to be incorrect, then the test of overidentifying restrictions (the J test) will be rejected.

The analysis is performed on the 1,036 firms in the manufacturing sector and on firms within the largest two industries. The industry analysis is performed only on the largest two industries because the GMM is an asymptotic estimation technique. Only in these two industries is the sample size large enough to get efficient estimates. For the same reason, we do not take less than 20 percent of the whole sample of 1,036 firms in any estimation. The highly right-skewed nature of the skewness coefficient of the capital stock determines the method for the identification of large and small firms. We consider the largest 20 percent of the firms as large firms, the second-largest 20 percent as medium-sized firms, and the firms in the 0-60 percent range as small. In terms of size, these small firms are highly clustered together. For each year, we determine to which size group a firm belongs. This implies that a firm that is within the highest 20 percent in 1983 –and classified as a large firm– could be in the 0-60 percent range in 1986 and classified as a small firm. With this method, a firm is allowed to change its size group, that is, size determination is endogenized.

Two different methods are used to determine the size group. The first method is the one that is commonly used in the literature. All firms are ranked in terms of their capital stock each year. The firms are then divided into 20 percent size groups. This method allows mostly capital-intensive firms to fall into the large size group. However, there may be a firm that does not have a high level of capital stock, compared with all firms in the manufacturing sector, but still is one of the largest firms within its industry group (which may not be a capital-intensive industry). Such a firm may find it easier to borrow than a small firm within a highly capital-intensive industry. With this consideration in mind, we introduce a second method, which has not been previously encountered in the literature.

The second method also divides the firms into 20 percent size groups; however, it uses a different process. We first divide each industry into 20 percent size groups. Then, in order to determine which firms fall into the largest 20 percent size group in the manufacturing sector, we group the firms that belong to the largest 20 percent size group within each industry. We follow the same method to determine which firms comprise the second-largest 20 percent, and the 0-60 percent size groups.

The objective of the estimation is to determine the joint significance of all variables in the equation, that is, the joint significance of the financial variables as well as the significance of each of the variables.

Table 3 presents the estimates obtained using the first method of determining size groups. The estimates for small, medium-sized, and large firms are presented in the first, second, and third columns, respectively. Based on the *J* statistic, the overidentifying restrictions are not rejected, which implies that there is no sign of misspecification for any of the three regressions. Wald test 1, the test of joint significance of all coefficients of the equation, suggests that the model with borrowing constraints cannot be rejected at the 1 percent level for small firms, the 5 percent level for medium-sized firms, and the 10 percent level for large firms. Wald test 2, the test of joint significance of the two coefficients on the borrowing constraints, η'_3 and η_4, suggests that these constraints cannot be rejected for medium-sized and large firms but can be rejected for small firms. A further examination of the estimates of η'_3 and η_4 reveals quite different results for all three size groups. For large firms, η'_3 is significant, implying that these firms face an increasing premium for external finance, and η_4 is not significant, implying that they do not face binding credit constraints. For medium-sized firms, both η'_3 and η_4 are significant, although only η_4 has the expected sign. The sign of η'_3, however, is consistent with the model with an increasing premium but a nonbinding credit constraint. For small firms, neither η'_3 nor η_4 is significant. The coefficients η_1 and η_2, which are functions of the adjustment cost parameter, *b*, and of the elasticity of demand, ε, have the expected sign and are significant, with the exception of an insignificant η_2 for large firms. The coefficient for the time dummy, η_5, is significant only for small and medium-sized firms. This implies that there were differences across periods for small and medium-sized firms but not for large firms.

Table 4 presents the estimates obtained using the second method of determining group sizes. The results are very similar to those obtained using the first method; furthermore, many of the results are stronger. This implies that the results obtained by using the two different methods of size determination are quite robust. While these were not the results expected before performing the empirical analysis, they are quite reasonable, given the size distribution of firms in the Turkish manufacturing sector. As Figure 1 indicates, the small firms in the manufacturing sector have very low levels of capital stock. The absolute amount of debt issued by these firms may not depend on their capital stock. These firms may borrow using collateral other than their capital stock (e.g. car, house, etc.), they may use personal savings, or they may borrow from family or friends. However, the large firms have very high levels of capital stock. To give a sense of the size differences, in 1983 when the smallest firm had only TL71,000 in capital stock, the largest firm had TL18 billion worth, which is more than 250,000 times larger. When these big firms issue external debt, the amount is expected to be very large. They may face an increasing premium on their large debt but they are not rationed out of the credit market. The firms in the medium-sized group seem to be the most affected by the borrowing constraints. Although these firms lie much closer to the left on the capital stock histogram of the manufacturing sector, they are not very small. These firms are large enough that they cannot just use personal savings or family funds; rather, they have to borrow on the credit markets. Regardless of the method used to determine size, the medium-sized firms seem to face both an increasing premium and a credit-rationing constraint.

Since the unconstrained model did not support the constraint, $\eta_1 = -\eta_4$, and since the results are, in general, more consistent with the model containing nonbinding borrowing constraints than with the model containing binding constraints, the constraint, $\eta_1 = -\eta_4$, is not imposed in any of the regressions.

Table 5 presents the estimates for the two largest industry groups, with the textile industry in the first column and the fabricated metal products, machinery, and equipment industry in the second column. The results are similar for both industries. The test of overidentifying restrictions is not rejected, which implies that there is no sign of misspecification for either industry. The Wald test of joint significance of all coefficients of the equation suggests that the model cannot be rejected at the 5 percent level for the textile industry and at the 1 percent level for the fabricated metal products, machinery, and equipment industry. The Wald test of joint significance of η_3' and η_4 suggests that these constraints jointly cannot be rejected at the 5 percent level for either industry. However, a further look at the individual significance of η_3' and η_4 suggests that although the increasing premium constraint cannot be rejected, the credit-rationing constraint can be rejected for both industries. In terms of the significance of each of the estimated coefficients, the signs are the same and as expected for both industries, but stronger estimates are obtained for the textile sector. In fact, even though η_2 has the expected sign, it is not significant for the fabricated metal products, machinery, and equipment industry. The coefficient of the time dummy is significant for both sectors.

We will now use the estimates of the coefficients in the textile sector to determine the magnitudes of the structural parameters of the model, namely, the elasticity of demand, ε, the marginal adjustment cost parameter, b, and the slope coefficient of the financial distress function, a. From the estimates of coefficients η_1, η_2, and η_3', $\alpha = 0.74$, $b = 27.32$ and $a = 3.55$.

Given that $\alpha = 1 - \frac{1}{\varepsilon} = 0.74$, then $\varepsilon = 3.91$. The elastic demand (because $|\varepsilon| = 3.91 > 1$) implies that the market structure in the textile industry is characterized by imperfect competition. Using the first-order condition for an imperfectly competitive firm, $p(y)\left[1 - \frac{1}{|\varepsilon|}\right] = c'(y)$, the markup over the marginal cost in the textile industry is calculated as 34.4 percent, which is a reasonable magnitude.[11]

The value of the marginal adjustment cost parameter is 27.32. Using the formula for the adjustment costs and the textile industry sample means for $\frac{I_t}{K_t}$ and $\frac{K_t}{Y_t}$ as 0.1775 and 0.1068, respectively, the adjustment costs as a percentage of total sales are calculated as 4.6 percent.[12]

The slope coefficient of the financial distress function is 3.55. It is positive as expected but quite large. The coefficient implies that, as the leverage ratio increases, firms could be facing high interest rates. For example, a firm with a leverage ratio of 0.1 would face a premium of 35.5 percent whereas a firm with a leverage ratio of 1.0 would face a premium of 355 percent. We are not aware of any other study that estimates this premium for the Turkish manufacturing sector. The large magnitude of the rate can be interpreted as a prohibitively high financial distress premium.

V. Estimation with Aggregate Data

This section investigates whether financial liberalization has relaxed borrowing constraints by testing for structural change in the model over the preliberalization and postliberalization periods. Given that Turkish firm-level data are available only for the postliberalization period, the test for structural stability is performed on aggregate data.

A. Description of the Data Set

The data for aggregate investment, output, and the cost of variable inputs are obtained from the *National Accounts Detailed Tables* of the Organization for Economic Cooperation and Development (OECD). The data for aggregate borrowing are obtained from the *International Financial Statistics Yearbook* of the IMF. These annual data cover the period 1971-91. The data

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[11] Whited (1992) estimates the mark-up to be in the 0-34 percent for 325 U.S. manufacturing firms in the 1975-86 period.

[12] Jaramillo, Schiantarelli, and Weiss (1996) estimate adjustment costs to be 6.2 percent of total sales in manufacturing sector during 1984-88 period in Ecuador.

for interest rates and price indices are from the *Quarterly Bulletin* of the Central Bank of Turkey and the *International Financial Statistics Yearbook* of the IMF, respectively.

B. Estimation and Results

The derived Euler equation, equation (19), is estimated using Turkish aggregate data. The same estimable investment equation can be used for both firm-level and aggregate data since the production function exhibits constant returns to scale and the financial distress function takes scale into account. The estimation is performed using the instrumental variables (IV) estimator. The GMM estimator is not appropriate in this section since the GMM is an asymptotic estimation technique and requires a larger sample size than the 22 observations provided by the aggregate data. Before discussing the results of the IV regression, however, we would like to present the results from some of the commonly used diagnostic/misspecification tests. These tests serve to check weather the assumptions of the classical linear regression (CLR) model have been violated.[13]

As presented in Table 6, The LM test for first-order serial correlation (Breusch-Godfrey test) suggests that there is no serial correlation. The LM heteroscedasticity test indicates that the residual variances are homoscedastic. Based on the Jarque-Bera (JB) test, the residuals are normally distributed. Wald test 1 suggests that the coefficients of the equation are jointly significant at the 10 percent level. Wald test 2 suggests that the coefficients of the financial variables, η_3' and η_4, are also jointly significant at the 10 percent level.

The main purpose of the aggregate data analysis is to compare the coefficients of the model before and after liberalization, so that it can be determined whether financial liberalization led to a structural change in the parameters of the model. The Chow test is used to test the stability of the regression coefficients before and after 1980, the initial year of the financial reform. This test statistic suggests that the parameters of the model are stable across the two time periods, 1971-79 and 1980-91. Given that there is no structural change in the model after 1980, the two credit constraints were significant both before and after financial liberalization. This result is consistent with the results of Günçavdı, Bleaney, and McKay (1998), who also show that the financial liberalization in Turkey did not lead to a structural break in a model with borrowing constraints.

As for the significance of the estimated coefficients, η_1, η_2, and η_4, each has the expected sign and is significant at the 1 percent level. Coefficient η_3' is significant at the 10 percent level. However, it has the sign expected in a model with a nonbinding credit constraint rather than in a model with a binding credit constraint.

To determine whether the financial reforms were anticipated or whether they were delayed, we also test for the stability of the regression coefficients by choosing different reference years for the structural break. First, we assume that the financial liberalization process was

[13] To test for stationarity of the variables of the model, the weighted symmetric (WS) and the Dickey-Fuller (DF) unit root tests were performed. The variables were found to be stationary.

anticipated, and that the structural break took place a year earlier than the financial reforms. Hence, we assume that 1979 is the year of the structural break. However, the Chow statistic, 0.6387 with a p-value of [.644], suggests that there is no structural change in the model after 1979. Second, we assume that the impact of the financial liberalization was delayed, and that the structural break took place a year after the financial reforms. In this case, we assume that 1981 is the year of the structural break. The Chow statistic, 1.4909 with a p-value of [.262], once again suggests that the model parameters are stable after 1981. These results indicate that, regardless of whether the financial reforms were anticipated or delayed, they were not able to relax the credit rationing and borrowing constraints.

The results from both the panel data and aggregate data analyses indicate that the liberalization process did not relax the borrowing constraints for Turkish firms. The poor response of the borrowing constraints to the reforms could be explained by the poor implementation of the reforms. In the 1980s, Turkey still lacked well-established and well-functioning financial institutions, instruments, and procedures (Inselbag and Gültekin, 1988). The banks and brokers were not well regulated or supervised. The banking sector presented a highly concentrated market structure and an inefficient banking system (Öniş and Riedel, 1993; and Denizer, 1997).

The market concentration rate did not improve from 1980 to 1991. The measures of concentration indicate that the top eight banks controlled 82 percent of total deposits both in 1980 and 1991. In terms of total assets, the top eight banks controlled 76 percent of assets in 1980 and about 70 percent in 1991 (Denizer, 1997).

The inefficiency of the Turkish banking sector also continues in the postliberalization years. A comparison of operating costs and the profitability of banking in OECD countries and Turkey in 1990 provides the following results. The operating costs as a percentage of total assets were 2.0 percent for OECD countries, while they were 5.1 percent for Turkey. The profits before taxes were 0.7 percent for OECD countries and 3.6 percent for Turkey (Denizer, 1997). This implies that in Turkey banking is 2.5 times more costly than in OECD countries, yet 5 times more profitable.

VI. Concluding Remarks

The purpose of this paper was to evaluate the impact of financial reforms on the borrowing constraints faced by the firm. An estimable investment equation with borrowing constraints was derived and tested using Turkish firm-level and aggregate data. The results from both panel data and aggregate data analyses indicate that the model with borrowing constraints cannot be rejected in the postreform period.

From the panel data analysis of the manufacturing sector in the greater Istanbul area, it is found that medium-sized firms faced both an increasing premium and credit rationing in the postliberalization period. Large firms also faced an increasing premium but were not rationed out of credit markets. As for small firms, there is no evidence of either an increasing premium or credit rationing. This unexpected result could be due to the very small value of the capital stock of the firms in this group. These firms would be expected to issue a very small amount of debt and, hence, may have used collateral other than their capital stock to borrow. Alternatively, these firms may not have borrowed on the credit markets at all, using instead personal savings or borrowing from family or friends.

The panel data analysis for the textile sector indicates that the firms in this sector faced an increasing premium but not credit rationing. Furthermore, it is found that the signs and the magnitudes of the structural parameters from estimates of the coefficients in the textile sector are reasonable.

In the aggregate data analysis for Turkey from 1971 to 1991, the coefficients of the model before and after the financial reform of 1980 are compared. It is found that the coefficients associated with the two credit constraints are significant both before and after the liberalization process, and that there is no structural change in the model after 1980.

The paper makes a contribution to the literature on investment under capital market imperfections. It builds an estimable dynamic investment model with borrowing constraints based on the existing models in the literature. This framework of analysis can be used to analyze the degree of credit constraints in other countries. The framework can also be applied to different financial deregulation policies. This study is the first to test the impact of financial liberalization on borrowing constraints by using microeconomic data on Turkish firms. The current literature offers very limited empirical research on the impact of financial reforms on firm-level investment in the context of a developing country. Future research with panel data can provide insights into the impact of deregulation on the investment decisions of the firm.

A number of policy implications come out of this study. The results from both panel data and aggregate data analyses indicate that the financial liberalization of the 1980s by itself was not successful in relaxing the borrowing constraints. In the postreform period, Turkey still lacked an effective supervisory system for banks, financial institutions, and capital markets. For financial liberalization to be successful, governments must ensure that the financial system is regulated and supervised under internationally acceptable standards.

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Description of Variables in Panel Data and Aggregate Data Analyses

Variables in panel data analysis

Investment (I_t). The sum of reported net expenditure (expenditure less sales) on machinery, transportation equipment, and buildings.

Capital stock (K_t). The reported value of the capital stock is, in general, not equal to its replacement (market) value. In order to calculate the replacement value of the capital stock, the perpetual inventory method is employed. The perpetual inventory method of Salinger and Summers (1983) can be explained as follows. The reported value of the capital stock in the first year is assumed to be equal to the replacement value. The following formula is used to calculate the replacement value of the capital stock in the subsequent years:

$$K_t = \left(K_{t-1} \left(\frac{p_t^K}{p_{t-1}^K} \right) + I_t \right) \left(1 - 2 / LF \right),$$

where LF indicates the useful life of the capital good. In this expression, the second term represents the amount of capital that depreciates each year. In deriving this expression, Salinger and Summers (1983) have made the following three assumptions: (1) all of a firm's capital has the same useful life; (2) firms use the straight-line method for book depreciation; and (3) both tax and actual depreciation are exponential with depreciation rate $2 / LF$. The useful life in any year can be estimated by $LF_t = \frac{RK_{t-1} + I_t}{DEPR_t}$, where RK_t is the reported value of the capital stock in year t, and $DEPR_t$ is the reported (book) depreciation in year t. Since LF_t can differ from year to year, the final LF can be calculated as the average of the LF_ts over the relevant years of analysis.

Output (Y_t). The value of goods sold plus the change in finished goods inventories.

Value of variable inputs (w_tL_t). The total annual payments to the production workers, and managerial, administrative, and other personnel, plus the payments for intermediate inputs.

Borrowing (B_t). This variable includes both short-term and long-term loans.

Price of capital goods (p_t^K). The price index for investment is not reported for the Turkish manufacturing sector. This index is proxied by the manufacturing general price index.

Price of output (p_t). Three-digit industry-specific output price index is used.

Risk-free interest rate (i). One-year interest rate on Turkish treasury bills.

Variables in aggregate data analysis

Investment (I_t). The sum of gross fixed capital formation for machinery and other equipment, transportation equipment, and nonresidential buildings.

Capital stock (K_t). The aggregate capital stock has been derived using the following method. As explained earlier, the manufacturing sector in the greater Istanbul area has a heavy concentration of the manufacturing sector in Turkey. Based on this concentration, the investment-capital ratio for the whole manufacturing sector in the greater Istanbul area is used as a proxy for the investment-capital ratio for the Turkish economy. The investment-capital ratio is calculated to be approximately equal to 0.15 for each year between 1983 and 1986. This ratio is consistent with the average investment-capital ratio reported in other studies, such as Galeotti, Schiantarelli, and Jaramillo (1994). This ratio of 0.15 is used to calculate the 1983 aggregate capital stock for Turkey. The aggregate capital stocks for all other years from 1970 to 1991 are then calculated by using the perpetual inventory method of Salinger and Summers (1983) backward and forward.

Output (Y_t). The gross domestic product (GDP) of Turkey.

Value of variable inputs ($w_t L_t$). The value for the aggregate compensation of employees, which is reported as a cost component of GDP.

Borrowing (B_t). Short-term and long-term loans to the private sector and nonfinancial public enterprises.

Price of capital goods (p_t^K). Since the price index for investment is not reported, the wholesale price index is used as a proxy for the price of capital goods.

Price of output (p_t). The GDP deflator is used as a proxy for the price of output.

Risk-free interest rate (i). One-year interest rate on Turkish treasury bills.

Figure 1. Histogram of 1983 Capital Stock
Total Manufacturing Sector
(1,036 Firms)

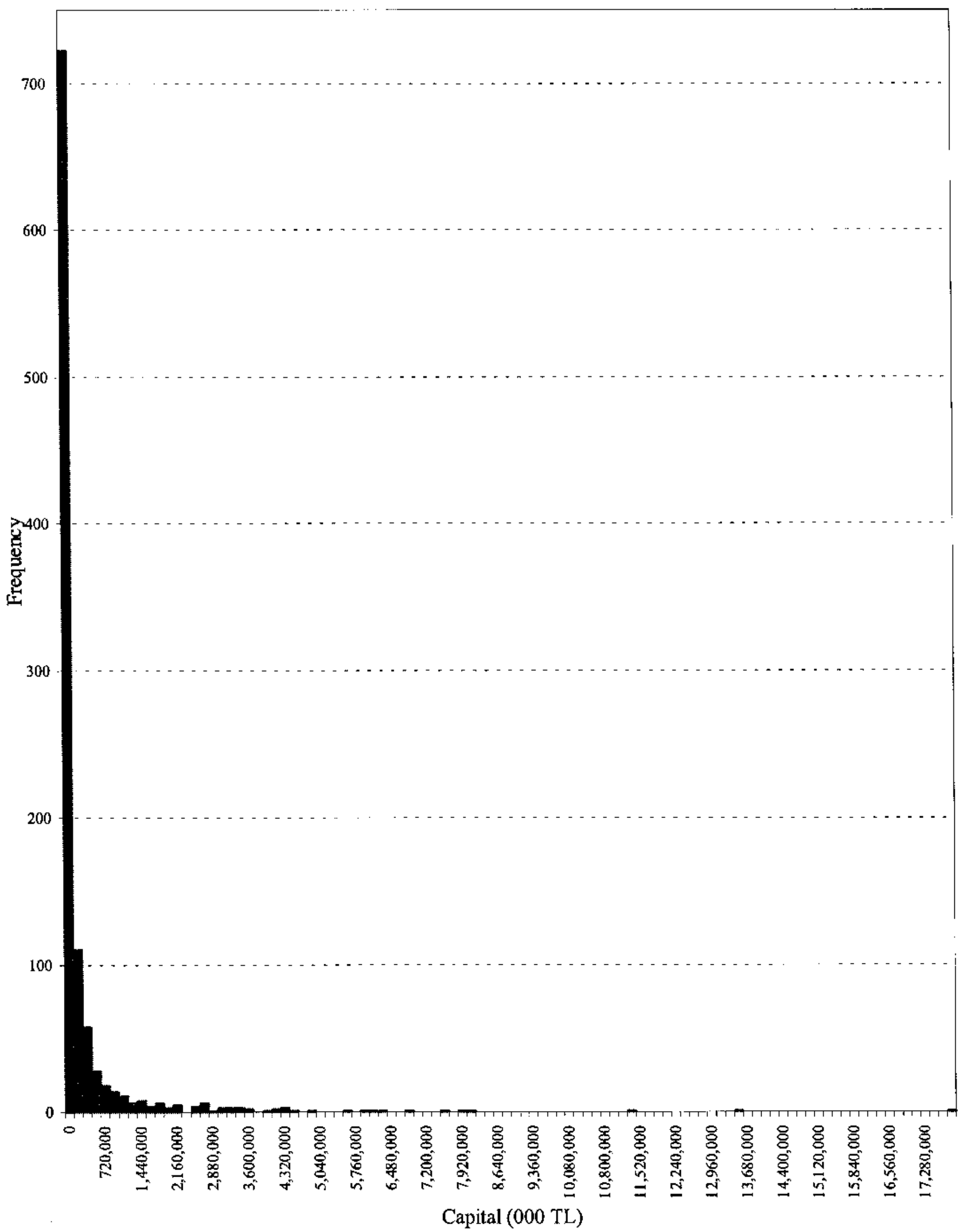

Table 1. Selected Economic Indicators of Turkey, 1971-91

	1971-73	1974-76	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
							(Annual percentage change)										
Real GNP	7.9	7.8	3.9	2.9	-0.4	-1.1	4.1	4.5	3.3	5.9	5.1	8.1	7.5	3.6	1.9	9.2	0.3
Real fixed investment	5.7	19.4	3.9	-10.0	-3.6	-10.0	1.7	3.5	3.0	0.4	16.9	11.0	5.4	-1.3	-1.0	13.9	-0.4
Public	3.5	23.0	11.0	-13.7	4.6	-3.7	9.4	2.2	1.9	-4.7	23.1	7.5	-3.7	-13.7	-5.8	8.0	3.8
Private	8.1	16.3	-2.7	-6.0	-11.6	-17.3	-8.7	5.5	4.7	8.4	8.2	16.4	18.6	13.5	3.3	18.8	-3.5
Implicit GNP deflator	18.1	20.4	24.5	43.7	71.1	105.7	41.9	27.2	28.0	49.9	43.2	29.6	32.0	70.5	64.0	52.3	55.3
							(Percent)										
Real interest rate	-7.9	-12.5	-15.5	-33.7	-53.8	-79.7	6.7	22.8	14.5	-4.9	6.8	22.7	17.8	-1.3	3.0	5.1	11.7
							(As a percentage of GNP)										
Current account	1.5	-3.7	-6.5	-2.4	-2.0	-5.8	-3.3	-1.8	-3.8	-2.8	-1.9	-2.5	-1.2	2.3	1.2	-2.4	0.2
Total debt	26.3	19.1	23.2	27.6	22.2	25.0	28.6	32.8	35.6	41.0	47.5	54.7	59.0	57.5	52.0	44.5	44.6
							(Turkish liras per U.S. dollar)										
Exchange rate	14	15	18	24	31	76	111	163	225	367	522	675	857	1,422	2,122	2,609	4,172

Sources: *International Financial Statistics Yearbook* of the IMF, various issues; and *Economic Surveys*, Turkey, of the OECD, various issues.

Table 2. Descriptive Statistics:
Total Manufacturing Sector
(1,036 Firms)

Capital stock (000 TL)	**1983**	**1984**	**1985**	**1986**
Mean	393,509	448,156	484,222	547,173
Median	68,717	81,561	86,031	98,968
Standard deviation	1,161,778	1,308,450	1,403,325	1,533,961
Skewness	7.58	6.70	6.48	6.37
Kurtosis	80.64	58.24	52.80	53.16
Minimum	71	64	403	658
Maximum	17,827,420	17,360,536	16,023,261	19,176,594
Investment (000 TL)	**1983**	**1984**	**1985**	**1986**
Mean	50,233	93,997	80,882	111,373
Median	5,044	6,783	4,024	7,217
Standard deviation	179,713	414,398	348,075	439,521
Skewness	7.68	10.38	10.68	9.11
Kurtosis	72.82	143.08	147.13	103.65
Minimum	-197,849	-487,005	-64,620	-480,875
Maximum	2,272,009	7,570,429	6,241,405	6,707,129
Investment-capital ratio	**1983**	**1984**	**1985**	**1986**
Mean	0.20	0.17	0.12	0.16
Median	0.08	0.10	0.05	0.09
Standard deviation	0.42	0.21	0.17	0.21
Skewness	10.88	0.87	1.04	1.24
Kurtosis	199.36	1.34	3.44	1.55
Minimum	-0.67	-0.78	-0.79	-0.58
Maximum	9.12	0.91	0.86	0.98
Debt-capital ratio	**1983**	**1984**	**1985**	**1986**
Mean	1.50	1.29	1.40	1.50
Median	0.97	0.81	0.79	0.99
Standard deviation	1.69	1.50	1.70	1.71
Skewness	2.01	1.95	2.08	2.05
Kurtosis	4.68	4.13	4.71	4.85
Minimum	0	0	0	0
Maximum	9.84	9.14	9.82	9.78
Output-capital ratio	**1983**	**1984**	**1985**	**1986**
Mean	7.62	7.58	7.58	7.41
Median	4.61	4.46	4.40	4.40
Standard deviation	17.03	20.81	10.99	9.45
Skewness	19.88	25.24	7.79	4.87
Kurtosis	506.69	741.98	105.10	41.79
Minimum	-0.20	-39.83	-0.10	-2.40
Maximum	463.41	623.32	196.61	126.34

Table 3. GMM Estimation Using Method 1:
Total Manufacturing Sector
(1,036 Firms)

	Small Firms	Medium-sized Firms	Large Firms
η_1	-0.0378	-0.0403	-0.0331
	(4.1533)***	(2.2280)**	(1.9153)*
η_2	0.0278	0.0393	0.0216
	(4.1739)***	(1.9098)*	(0.8010)
η_3'	0.0809	0.1112	0.2212
	(1.4960)	(2.1728)**	(3.2195)***
η_4	$4.01*10^{-5}$	$1.98*10^{-5}$	$9.17*10^{-7}$
	(1.5631)	(2.7745)***	(0.6153)
η_5	0.6570	0.4886	0.0826
	(3.7499)***	(2.1921)**	(0.4939)
Wald test 1	14.9954	6.3385	3.0297
d.o.f.	4	4	4
	[.000]	[.012]	[.082]
Wald test 2	2.2385	4.7225	10.3650
d.o.f.	2	2	2
	[.135]	[.030]	[.001]
J test	4.0425	13.6275	5.8501
d.o.f.	9	9	9
	[.909]	[.136]	[.755]

Notes:

(1) The instruments are $\frac{I}{K}, \left(\frac{I}{K}\right)^2, \frac{wL}{K}, \frac{Y}{K}, \frac{B}{pK}, \left(\frac{B}{pK}\right)^2$ and time dummies, all in levels.
(2) There are 624 small firms, 206 medium firms, and 206 large firms.
(3) Absolute values of *t*-statistics are in parentheses, and *p*-values are in square brackets.
(4) One, two, and three asterisks denote significance at the 10, 5, and 1 percent levels, respectively.
(5) Wald test 1 tests the joint significance of all variables, and Wald test 2 tests the joint significance of financial variables.
(6) d.o.f. denotes degrees of freedom.

Table 4. GMM Estimation Using Method 2:
Total Manufacturing Sector
(1,036 Firms)

	Small Firms	Medium-sized Firms	Large Firms
η_1	-0.0385	-0.0466	-0.0330
	(4.1682)***	(2.5017)**	(2.0030)**
η_2	0.0283	0.0411	0.0284
	(4.1881)***	(1.8765)*	(1.1304)
η_3'	0.0639	0.1868	0.2011
	(1.2503)	(2.8999)***	(3.3794)***
η_4	$3.38*10^{-5}$	$1.78*10^{-5}$	$2.19*10^{-6}$
	(1.2686)	(2.0006)**	(1.5222)
η_5	0.6045	0.6612	0.1796
	(3.4713)***	(2.6067)***	(1.0661)
Wald test 1	12.6523	9.4434	5.1614
d.o.f.	4	4	4
	[.000]	[.002]	[.023]
Wald test 2	1.5636	8.4098	11.4204
d.o.f.	2	2	2
	[.211]	[.004]	[.001]
J test	4.2446	10.2341	5.3008
d.o.f.	9	9	9
	[.895]	[.332]	[.807]

Notes:

(1) The instruments are $\frac{I}{K}, \left(\frac{I}{K}\right)^2, \frac{wL}{K}, \frac{Y}{K}, \frac{B}{pK}, \left(\frac{B}{pK}\right)^2$ and time dummies, all in levels.
(2) There are 622 small firms, 206 medium firms, and 208 large firms.
(3) Absolute values of *t*-statistics are in parentheses, and *p*-values are in square brackets.
(4) One, two, and three asterisks denote significance at the 10, 5, and 1 percent levels, respectively.
(5) Wald test 1 tests the joint significance of all variables, and Wald test 2 tests the joint significance of financial variables.
(6) d.o.f. denotes degrees of freedom.

Table 5. GMM Estimation for Two Largest Industries

	Industry A	Industry B
η_1	-0.0492	-0.0216
	(5.1779)***	(1.9711)**
η_2	0.0366	0.0093
	(5.3536)***	(0.8563)
η_3'	0.1747	0.1271
	(2.5926)**	(2.6472)***
η_4	$1.64*10^{-5}$	$3.12*10^{-6}$
	(1.5910)	(0.8549)
η_5	0.4284	4.63E-06
	(1.6536)*	(0.8552)
Wald test 1	5.0546	7.0541
d.o.f.	4	4
	[.025]	[.008]
Wald test 2	6.7223	7.0074
d.o.f.	2	2
	[.010]	[.008]
J test	4.1860	14.7712
d.o.f.	9	9
	[.899]	[.097]

Notes:

(1) Industry A is the textile industry; Industry B is the fabricated metal products, machinery, and equipment industry.

(2) The instruments are $\frac{I}{K}, \left(\frac{I}{K}\right)^2, \frac{wL}{K}, \frac{Y}{K}, \frac{B}{pK}, \left(\frac{B}{pK}\right)^2$ and time dummies, all in levels.

(3) There are 268 firms in Industry A and 318 firms in Industry B.

(4) Absolute values of *t*-statistics are in parentheses, and *p*-values are in square brackets.

(5) One, two, and three asterisks denote significance at the 10, 5, and 1 percent levels, respectively.

(6) Wald test 1 tests the joint significance of all variables, and Wald test 2 tests the joint significance of financial variables.

(7) d.o.f. denotes degrees of freedom.

Table 6. Instrumental Variables (IV) Estimation

η_1	-0.4136 (7.8945)***
η_2	0.3714 (9.7429)***
η_3'	9.0159 (1.6585)*
η_4	0.3744 (9.4627)***
Wald test 1 d.o.f.	2.8534 4 [.091]
Wald test 2 d.o.f.	2.8817 2 [.089]
LM test for serial correlation d.o.f.	0.3699 1 [.543]
LM heteroscedasticity test d.o.f.	0.1188 1 [.730]
JB test for normality d.o.f.	0.8552 2 [.652]
Chow test d.o.f.	0.8206 (4, 13) [.535]

Notes:

(1) Absolute values of *t*-statistics are in parentheses, and *p*-values are in square brackets.

(2) One, two, and three asterisks denote significance at the 10, 5, and 1 percent levels, respectively.

(3) d.o.f. denotes degrees of freedom.