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**The Effect of the Interest Rate on the Investment  
Expenditures of Mexican Manufacturing Firms**

by

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# **The Effect of the Interest Rate on the Investment Expenditures of Mexican Manufacturing Firms**

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## Abstract

The behavior of investment by Mexican manufacturing firms is analyzed for the period 1994-1999. Investment equations are estimated focusing on the relevance of financial constraints. The main findings are that internal funds play a relevant role in explaining investment expenditures by firms. As is customary in tests of the effects of capital market imperfections on investment, the sample is split depending on the importance of financial constraints for firms. We find that internal funds are less important for the subset of firms less likely to be financially constrained. Moreover, a statistically significant interest rate effect on investment is found for the whole sample when a measure of the foreign interest rate is used as a proxy for the cost of capital. Finally, there is some evidence that the interest rate effect is especially important for firms that are deemed a priori to be less financially constrained.

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## **I. Introduction**

As a result of the 1995 currency crisis, Mexico's financial system experienced an almost complete freezing of intermediation operations by banks, a void that severely constrained the supply of funds during the second part of the nineties. Parallel to this development, the economy went from a practically fixed exchange rate regime, to a fully-fledged floating exchange rate setting after 1995. The openness of the economy to trade together with more stable foreign investment flows improved the conditions and allowed Mexican firms to fill this void with credit from foreign sources. Therefore, both the evolution of the Mexican financial system and that of the macroeconomic framework influenced the Mexican firms' access to funds for investment. The present study attempts to provide some empirical evidence on the determinants of investment expenditures by manufacturing firms in an environment characterized by minimal presence of commercial banks in credit markets, close foreign trade ties, and free flow of capital from abroad.

The analysis contained in this study concentrates on the behavior of investment by manufacturing firms during the second half of the nineties, specifically from 1995 to 1999, a period characterized by the structural changes described above. Investment equations are estimated focusing on the influence that the environment created by the aftermath of a banking crisis implied for the accessibility of funds to firms. Therefore, the relevance that financial constraints have on the estimation of the determinants of investment expenditures is stressed. The main findings are that internal funds play a relevant role in explaining investment flows. This result is not surprising given that the absence of commercial banks exacerbated the difference between the costs of internal funds for firms versus the costs of funds generated from outside sources. This conclusion supports the likely scenario that some firms in Mexico remained commercial bank dependent for credit purposes after the crisis in 1995. Separating the subset of firms less likely to be financially constrained, i.e. large firms, from the rest, we find that internal funds are an important determinant of investment expenditures only for smaller firms. This result provides the evidence that chronic credit market imperfections have affected the behavior of a significant number of manufacturing firms in Mexico during the second part of the nineties. We extend the analysis to investigate whether there is a real interest rate effect on investment expenditures. We find that this is the case only after the foreign interest rate is introduced as a measure of the cost of capital. To reconcile this with prior evidence on credit market imperfections, we analyze whether the intensity of the interest rate effect is stronger in the case of those firms more likely to have accessed external sources of funds after the crisis. We find that to some extent this is indeed the case. We justify this result by considering that once we take into account the fact that during the period analyzed domestic interest rate fluctuations were

explained mostly by changes in the risk premium on foreign debt, and that larger firms were the ones likely to have been able to access funds from foreign sources.

The paper is organized as follows. In the next section an overview is given of the recent evolution of the Mexican economy, which is followed by a description of the theoretical mechanisms through which interest rate changes can affect investment expenditures by firms. In section IV the main hypothesis of the paper is proposed, immediately followed by a review of the relevant literature in section V. In Section VI a simple empirical model is suggested. In Section VII the dataset and the construction of the variables are described. The main results are presented in Section VIII, with Section IX offering some concluding remarks.

## **II. Recent Evolution of the Mexican Economy**

Financial liberalization was initiated in Mexico during 1988 when interest rate ceilings were liberalized, credit quotas and forced loans were eliminated, and the mandate for commercial banks to keep reserves at the central bank was abolished. Almost completed by 1990, financial liberalization was crowned with overall commercial bank privatization, a process that finished in 1992. From then on the government mainly issued domestic bonds to enhance the development of the domestic money market. This, together with a significant reduction in the public sector's financial requirements, led to an important crowding in effect for the private sector. The latter's access to credit increased significantly as domestic savings were complemented by foreign capital during the first half of the nineties (Figure 1).

Although growth recuperated somewhat in the early nineties, numerous frailties accumulated by the system during the years of large capital inflows plus the adverse external and domestic shocks faced by the economy, led to a financial crisis at the end of 1994.<sup>1</sup> In order to contain the inflationary effects of the devaluation, tight monetary policy was implemented after the currency was left to float freely during 1995. However, rising inflation was the least of the government's problems in the midst of a crisis that threatened with undermining the achievements of financial liberalization. Specifically, because of the steep increase in domestic interest rates, commercial banks were faced with ever-rising non-performing loans as companies struggled with the double shock of exchange rate depreciation and interest rate increases. Doubling dollar debt service expenses and elevated domestic debt payments left companies on the verge of bankruptcy. In order to evade a systemic crisis, the government reacted to by introducing programs to support commercial banks. To make this policy credible it became essential to spell out

publicly the intention to deal with the banking sector problems with specific programs, whose costs would be absorbed via future fiscal adjustments. This allowed the design of a coherent macroeconomic policy where an essential element was that monetary policy would be the nominal anchor whose sole objective would be inflation stabilization. Fiscal policy was tightened also, with a doubling of the primary surplus during 1995. Although significant, this effort was perceived as insufficient given that additional fiscal restraint was necessary in order to start absorbing some of the costs of the banking sector rescue package. Fiscal tightening was also recognized as key since the success of the stabilization program hinged on the widespread perception of viable public sector finances.

During the years that followed the crisis, economic activity and employment suffered considerably because of the fall in domestic demand, the reduction in government spending, tax rate increases, high real interest rates and vanishing credit. As the exchange rate stabilized, however, interest rates fell and international financial markets resumed lending to the Mexican economy. Thanks in part to the broad restructuring that the economy had gone through in the previous decade, with a key element being a tighter linkage with the U.S. economy, economic activity recovered rapidly as growth in the U.S. started to peak up again. Thus, consumption and investment in Mexico recovered strongly after 1995, with GDP growing at an average annual rate of 5 percent during 1996-2001. Moreover, the inflation rate dropped rapidly from 51.7 percent in 1995 to 4.6 percent in 2001.

Once the worst moment of the crisis passed, a substantial reduction of speculative pressures ensued, with freely determined interest rate lowering and the floating exchange rate appreciating during the second part of 1995. A relevant feature of the floating exchange rate regime was that it helped to limit the inflow of short term speculative capital, given the losses accrued by investors as the exchange rate fluctuated freely. This contributed to a rise in the proportion of the current account deficit that was financed by long-term capital inflows. This element persisted throughout the second part of the nineties as foreign direct investment covered more than 70 percent of current account deficits each year. During the period 1996-2001, Mexico continued the conversion of its industrial sector by turning it into an export platform, with the average share of exports in GDP doubling during the second half of the nineties. Economic growth and price stability contributed to favorable labor market conditions, with average annual growth of formal employment reaching 6.3 percent from 1996 on. On the other hand, the rate of open unemployment, that reached a level of 7.6 percent in august 1995, fell to a level of 1.9 percent in October 2000, the lowest rate since the statistic has been published. Finally, investment and consumption recuperated with GDP growth averaging 5 percent from 1996 to 2001.

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<sup>1</sup> To honor the financial commitments of the country, and more importantly, to induce creditors to roll-over maturing loans, the government negotiated a 52-billion dollar emergency support package from the international community, with the U.S. government and the IMF as the main suppliers of financial assistance.

With respect to the financial system, a comprehensive strategy was put in place to deal with the frailties that were exposed during the crisis in 1995, where the damaging effects of the over-indebtedness of firms and households threatened to cause a systemic run against the assets of the banking system. To preserve the integrity of this sector, a series of programs were implemented whose main objectives were: to combat moral hazard and minimize distortions, to strengthen regulation and supervision, and to reduce the need for the central bank to act as the lender of last resort. Based on these objectives, credit lines denominated in foreign currency were opened at a penalty rate by the central bank, so that commercial banks could find it easier to fulfill external obligations. Moreover, a program was established to promote the capitalization of the system, and legal reforms were undertaken to allow greater foreign participation. Despite all these measures, Mexico's banking system experienced a pronounced contraction between 1995 and 2001, with credit to the industrial sector retreating to the level observed prior to financial liberalization (Figure 1). Nonetheless, the rate of fixed capital formation recovered relatively quickly after 1995, remaining close to 20 percent from late 1998 on (Figure 2).

### **III. The Effect of Interest Rate Changes on Investment**

Conditions in the credit markets influence the behavior of investment expenditures by firms, and no other variables summarize these conditions better than interest rates. The channels through which interest rate changes affect the real economy have been traditionally analyzed in the context of the transmission mechanism of monetary policy by the central bank. In a small open economy under a flexible exchange rate and free flow of capital, domestic interest rate fluctuations are sometimes better explained by foreign interest rate changes or movements in the risk premium. Even though during the sample period studied here, this seems to have been the case for Mexico, the theoretical effects of interest rate changes on investment expenditures by firms still apply. Therefore, to analyze how interest rate changes affect investment we refer to the analysis of the monetary policy transmission mechanism, which considers direct interest rate effects, exchange rate effects, other asset price effects, and the so-called credit channel.<sup>2</sup>

#### *The Interest Rate Channel*

The transmission of interest rate changes to the rest of the economy is the principal mechanism in the basic Keynesian model. According to this traditional view, a rise in the interest rate increases the cost

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<sup>2</sup> See Mishkin (2000) for a thorough exposition of the monetary policy transmission mechanism.

of capital, thereby causing a decline in investment spending, and therefore a fall in aggregate demand. Moreover, whenever housing and consumer durables spending are also considered investment decisions, the interest rate channel of monetary transmission also applies to consumer spending.

### *The Exchange Rate Channel*

Whenever the economy is open to both trade in goods and trade in financial services, the transmission of interest rate changes on real economic activity works also through the effect of exchange rate changes on net exports. When domestic interest rates rise so does the return on holdings of domestic currency denominated assets relative to the return on foreign currency assets. This leads to an increase in the value of domestic currency deposits relative to foreign, and therefore to an appreciation of the exchange rate. The higher value of the domestic currency makes domestic goods more expensive than foreign goods, thereby causing a fall in net exports and hence in aggregate output.

### *The Asset Price Channel*

On the effect of interest rate changes on asset price fluctuations two different channels are often emphasized: the wealth effect on consumption and Tobin's  $q$  theory of investment. An increase in the interest rate makes bonds relatively more attractive than equity thereby causing the price of equity to fall. Tobin's  $q$  theory provides a mechanism through which the interest rate affects investment expenditures by firms through its effects on equity valuation. According to this theory of investment, whenever  $q$ , the market value of a firm divided by the replacement cost of its capital, is high, new plant and equipment are cheap relative to the market value of the firm. Companies can therefore issue equity at a higher relative to the cost of the plant and equipment. Thus, spending on these will rise because firms can buy a lot of these goods with a small equity issue.

### *The Credit Channel*

According to Bernanke and Gertler (1995) interest rate movements involve not only direct effects through changes in the cost of capital, but also affect the wedge between the cost of debt and the opportunity cost of internal funds. Two mechanisms have been suggested to explain how the credit channel of monetary policy transmission operates, namely: the bank lending channel and the balance sheet channel.

The bank-lending channel is based on the view that banks play a special role in the financial system, since they specialize in overcoming informational problems and other frictions in credit markets. Therefore, banks are especially well suited to deal with certain types of borrowers where the problems of asymmetric information can be pronounced, i.e. with small firms. This is why they remain the dominant source of intermediated credit in most countries. If the supply of bank loans is disrupted for some reason, bank-dependent borrowers (small and medium-sized businesses) may incur costs associated with finding a new lender or establishing a new credit relationship. Therefore, a reduction in the supply of bank credit, relative to other forms of credit, is likely to increase the external costs of funds for these types of firms.

According to the lending channel, monetary policies can alter the cost of intermediation by banks, which would lead to a widening of the margin between active and passive rates, reducing credit supply and thus discouraging investment<sup>3</sup>. A monetary contraction can increase banks' relative cost of funds in several ways. Whenever banks cannot easily replace lost deposits with other sources of funds, by limiting the supply of loans and thus reducing banks' access to funds. On the other hand, commercial banks monitoring costs also rise when an interest rate increase leaves only riskier projects in the pool of financially viable projects.

The balance sheet channel is based on the theoretical prediction that a borrower's financial position determines the size of the wedge between the opportunity cost of internal funds and the cost of funds raised externally. Intuitively, a stronger financial position enables a borrower to reduce the potential conflict of interest with the lender, either by self-financing a greater share of the investment project or by offering more collateral to guarantee the liabilities. Since borrowers' financial positions affect the overall credit terms that they face, fluctuations in the quality of borrowers' balance sheets should similarly affect their investment decisions.

According to the balance sheet channel, a rise in interest rate weakens borrowers' balance sheets in at least two ways. First, to the extent that borrowers have outstanding short-term or floating rate debt, rising interest rates directly increase interest expenses, reducing net cash flows and weakening the borrower's financial position. Because many firms rely heavily on short-term debt to finance inventories and other working capital, this direct effect on firms' net cash flows is quite important quantitatively. Second, rising interest rates are typically associated with falling asset prices, which among other things, shrink the value of the borrower's collateral.

Through the balance sheet effect, a rise in interest rates provokes a reduction in the stock of wealth owned by economic agents. Since assets are used as collateral, agency costs increase, aggravating the conditions under which agents access credit markets. An alternative version of the latter channel is the effect that interest rate changes have on stock prices, which in equilibrium should reflect the market value



of a firm's future income stream. As we saw before, whenever a firm's  $q$  value lays below the cost of capital a reduction in investment will ensue. The presence of asymmetric information in credit markets reinforces this effect; since the firm's access to external finance hinges on the warranties it is able to offer, with the latter being determined by the value of the firm's assets as approximated by the market value of its stock. Therefore, increases in interest rates that are associated with a fall in stock prices deteriorate the conditions under which firms access domestic credit markets.

The previous description applies in general to firms that have access to credit, and applies specially to those firms that are large enough to quote in the stock exchange. However, when for some reason a group of firms does not meet the conditions necessary to obtain funds from domestic credit institutions at reasonable costs, these effects will not be a factor in their investment decisions. The latter condition will be widespread in the economy whenever funds do not flow, either because financial markets are not liberalized with interest rates not freely determined, or when financial intermediation is dominated by credit bureaus with an agenda to support specific sectors. Another case is after a banking crisis when the capital of commercial banks is so deteriorated that it becomes prohibitively costly for them to supply credit at viable rates, a significant number of firms will be deprived of access to credit from these institutions.

#### **IV. The Hypothesis**

After Mexico's 1995 financial crisis, commercial banks were faced with ever growing non-performing loans. As interest rates increased and their capital deteriorated, it became almost impossible for them to supply credit at viable rates, forcing firms to seek alternative sources of finance. Some firms achieved this by broadening their relationships with trading counterparts abroad, whereas others acquired direct new foreign credit lines. Therefore, a significant portion of the funds that financed the recovery of investment after 1995 came from sources other than traditional commercial banks.

The objective of this study is to provide some empirical insight on the effect of interest rate changes on capital accumulation by manufacturing firms in Mexico. Since the traditional channels through which firms access funds for investment were not present during the period after the crisis of 1995, it is important to take into account alternative ways by which interest rate changes could be transmitted to the economy. Therefore, credit market imperfections play an important role in the analysis that follows. This is so because when imperfections persist in domestic credit markets, changes in the real rate of interest reduce capital expenditures by firms, not only through the direct effect on financing costs

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<sup>3</sup> Bernanke and Blinder (1988).

but through several additional channels as well. Moreover, comparing how investment of different types of firms responds to changes in macroeconomic conditions can reveal the relevance of these alternative channels of transmission.

## **V. Review of the Literature**

Recent work on the relevance of the credit channel as the transmitter of the effect of interest rate changes is reviewed first, to then review how capital market imperfections in the context of investment has been studied in the literature.

### **V.1. Review of the literature on the credit channel**

Among the empirical studies that have looked at the macroeconomic relevance of credit market frictions, Gertler and Gilchrist (1994) concentrate on the different responses of small versus large firms to changes in various monetary policy indicators. They find that small firms are more sensitive to monetary policy shifts, a fact that they explain with a model where credit market imperfections introduce a kind of risk aversion on the part of firms, making their behavior more sensitive to earnings flows and interest rate changes. Harris et al. (1994) discuss whether financial reforms have had an impact on investment and on the allocation of credit and whether these effects differ depending on the types of firms. They find that shifting from administrative toward market-based credit allocation has raised borrowing costs, particularly for smaller firms, but at the same time benefited them by allowing a wider access to external finance. Kim (1999) studies how the credit channel in Korea was affected by the financial crisis of 1997-98. He looks at aggregated financial data and disaggregated bank balance sheets, and finds that bank lending amplified the real contraction that resulted from the restrictive monetary policy adopted in response to the devaluation in 1997.

For the case of Mexico, Copelman and Werner (1995) analyze whether devaluation expectations, the cash-deposit ratio and a measure of financial deregulation resulted in a quantitative change of real credit in the economy. They find that, for the period 1984-94, the impact on investment and output by different indicators of credit shocks is very significant. Gelos and Werner (1999) examine the impact of financial liberalization on fixed investment in Mexico. They use establishment level data from the Yearly Industrial Survey of the manufacturing sector in Mexico<sup>4</sup>. They analyze changes in cash flow sensitivities across different firm sizes, and obtain estimations showing that cash flow is significantly correlated with

investment before and after financial liberalization. They also study the relevance of collateral in credit operations, and find that banks' reliance on collateral increased with financial constraints having eased for small firms after financial liberalization.

Finally, Martínez et al. (2000) analyze how the behavior of the spread between active and passive rates offered by banks is affected by changes in interest rates, and find a statistically significant and large effect. Moreover, the authors also analyze the behavior of non-financial firms that are listed on the Mexican stock exchange. They study how credit between companies is affected by real interest rate changes, finding again a statistically significant effect.

## **V.2 Review of the literature on capital market imperfections and investment**

If all firms have equal access to capital markets, their responses to changes in the cost of capital differ only because of differences in investment demand. Indeed, in a Modigliani-Miller world measures of firm's liquidity should not enter significantly in a correctly specified investment regression, given that internal and external funds are perfect substitutes for the firm. In contrast, in an environment where information asymmetries prevail as a result of bankruptcy costs and law enforcement problems, external funds will be more costly for the firm than internal funds. The wedge between them arises from the need to compensate lenders for adverse selection and moral hazard problems on the borrower's side. Generally, the theory predicts that the premium on external funds will decrease with the firm's net worth. Moreover, since internal funds in the form of cash flow improve the firm's current financial position, and since they also increase the funds available for investment, the latter should respond positively to increases in cash flow.

A substantial body of literature has emerged in recent years analyzing the effects of financial constraints on investment. The usual methodology is to examine whether adding cash-flow measures to standard investment equations helps to explain the behavior of capital expenditures. Empirically, the main problem with the approach comes from the possibility that cash flow may be correlated with investment for other reasons. Even without financial constraints firms' acquisition of new assets will respond to increases in current cash flow whenever this variable is a good predictor of future profitability, which is most of the time.

This identification problem can be set aside by including in the regression a proxy for expected profitability, such as Tobin's marginal  $q$ . However, in practice it generally appears that average  $q$  has low explanatory power in investment equations.<sup>5</sup> Moreover, including a traditional proxy for  $q$  in the

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<sup>4</sup> The dataset utilized in the present study also comes from the Mexican Yearly Industrial Survey.

<sup>5</sup> Gilchrist and Himmelberg (1998)

regression together with a liquidity variable has a weak theoretical justification.<sup>6,7</sup> In principle, the problem can be avoided by estimating Euler equations directly, since this way the impact of future profitability on current decisions can be controlled for. The difficulty with this method is that its small sample properties are poor and it is very susceptible to misspecification problems.

Another way to solve the identification problem is to focus on differences across firms, which are likely to indicate their relative access to external financing and the size of the premium on external funds they face, as suggested by Fazzari et al (1988). A large literature has emanated from this simple idea; the common feature of this body of work is that the base for the test on capital market imperfections on investment is the identification of a subset of firms for which financial constraints are likely to be more important. For example, small firms are more likely to be liquidity constrained, because they are more likely to have lower collateral and to be exposed to higher idiosyncratic risks. This approach exploits the idea that small firms are likely to confront a higher premium on financing via external funds. Larger firms not only have a stronger starting position in terms of the collateral they are able to put forward to acquire better credit conditions, but are also more likely to be able to fulfill the requirements for listing in the domestic stock exchange or for placing corporate debt abroad. Also, there are economies of scale in collecting and processing information on a firm's situation, which helps overcome problems associated with asymmetric information between borrowers and lenders.

The rest of this paper follows Fazzari et al's methodology. This, however, does not mean that it is void of problems.<sup>8</sup> As pointed out in Schiantarelli (1995), one concern is the possible endogeneity of the sample splitting criteria, which has made economists look for criteria based on the firm's explicit access to cheaper sources of external funds, such as belonging to a conglomerate or keeping a close relationship with financial intermediaries. However, whenever the characteristics of the sample allow only firm size as the possibility for splitting criteria, as is the case of the present study, it is important to consider explicitly the possibility of parameter bias. Nevertheless, as long as the sample used for estimation includes at least a portion of the lower tail of the size distribution, then size seems to be a useful criterion to identify firms that are more likely to be financially constrained.<sup>9</sup>

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<sup>6</sup> See Chirinko (1997).

<sup>7</sup> Another problem for studies that are conducted on non-financial data is that a proxy for  $q$  is hard to come by.

<sup>8</sup> There is a heated discussion about whether investment cash flow sensitivities provide useful measures of financial constraints. To review the details of this discussion see Kaplan and Zingales (1997), and Fazzari et al (1997).

<sup>9</sup> See Schiantarelli (1995) page 201.

## VI. A Simple Empirical Model

The econometric specifications that are more utilized to explain the behavior of investment flows are Tobin's q model of investment and the accelerator model. Since the dataset that we have available does not contain information on the firm's financial flows, it is hard in this context to arrive at a reasonably accurate estimate of Tobin's q. Therefore, the accelerator model seems a suitable specification.

Accelerator models come in many forms.<sup>10</sup> We start by assuming that under the absence of adjustment costs, the desired capital stock can be written as a log linear function of output and the user cost of capital. Thus, under a CES production function subject to constant returns to scale we have that the desired capital stock will be given by

$$k_{it} = a - bC_{it} + y_{it}$$

where  $k_{it}$  denotes the (natural) log of the desired capital stock for firm  $i$  in period  $t$ ,  $C_{it}$  denotes the log of the real user cost of capital and  $y_{it}$  denotes the log of the firm's output. Taking first differences on both sides of the previous equation and using the approximation  $I_{it} \approx (\delta + \Delta K_{it})K_{it-1}$ , where  $\delta$  is the rate of depreciation, we obtain

$$\frac{I_{it}}{k_{it-1}} = \delta - br_{it} + \Delta y_{it} \quad (1)$$

where  $r_{it}$  is the real interest rate faced by firm  $i$  during period  $t$ . Equation (1) summarizes the fundamental relationship over which the empirical analysis that follows this section is based upon. It is important to note, however, that in the following econometric analysis we make several assumptions in order to be able to arrive at reasonable estimates of the parameters involved.

In the context of an economy where credit markets have not functioned effectively during long time spans (namely, during the period before financial liberalization, 1984-88; and after the financial crisis, 1995-2000), we want to be able to account for the effect of financial factors when estimating a behavioral relationship for capital expenditures by the firm. Therefore, in order to study the effect of liquidity constraints on investment we include the firm's cash flow ( $CF_{it}$ ) as an additional explanatory

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<sup>10</sup> See Eisner and Nadiri (1968).

variable. So, in the specification given by equation (2),  $\phi$  captures the sensitivity of investment to changes in cash flow

$$\frac{I_{it}}{K_{it-1}} = \beta \frac{\Delta S_{it}}{K_{it-1}} + \phi \frac{CF_{it}}{K_{it-1}} + \lambda_t + v_i + \varepsilon_{it} \quad (2)$$

where  $K_{it-1}$  and  $\Delta S_{it}$  denote firm  $i$ 's capital stock at  $t-1$  and the change in sales in period  $t$ , respectively;  $\beta$  measures the sensitivity of the flow of investment to changes in sales<sup>11</sup>, and where  $\varepsilon_{it}$  is a stochastic error. Other variables that are incorporated in the estimation will be discussed below. In this specification  $v_i$  denotes firm specific effects and  $\lambda_t$  attempts to capture time-variant factors that are common to all firms. Note that since we do not have access to data on the user cost of capital specific to each firm, we must assume that this variable enters equation (2) as a factor that is common to all firms in the sample. In the equations that we estimate below we allow  $\phi$ , the cash flow coefficient, to vary with the size of the firm, and in order to be able to capture the difference in these coefficients we introduce interactive dummies for the different firm sizes considered.

## VII. Dataset and Variable Definitions

This study utilizes annual panel data of Mexican manufacturing industries covering the period 1994-1999.<sup>12</sup> The dataset comes from the Annual Industrial Survey conducted by Mexico's National Institute of Statistics, Geography and Information (INEGI<sup>13</sup>). The methodology of this survey changed in 1994. The new methodology effective after 1994 amplified the number of establishments considered in the sample and partitioned some 3-digit level industries into two or more industrial classes, improving the specificity of the information provided. Therefore, for the period 1994-99, the survey covered 6226 establishments grouped into 205 industries. Since the Annual Industrial Survey is used as an input for the Industrial Census and yearly GDP calculations, its universe attempts to account for roughly 80 percent of value added in manufacturing. The completion of the questionnaire is compulsory, and the purpose of the survey is merely statistical and not linked to tax collection.

The unit of observation of the survey is the manufacturing establishment. However, since the collecting agency does not provide information at the establishment level, we were forced to work at the

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<sup>11</sup> Instead of using the change in total production the change in sales was utilized, the empirical results should not vary significantly.

<sup>12</sup> In-bond industries (maquiladoras) are not included.

3-digit industry level, where establishments are grouped into industrial classes. However, the collecting agency allowed us to classify establishments within each industry into two size groups. The first subset contained information on all the variables relevant for this study (which will be described below) for the group of establishments that have fewer than 100 employees on average during the period between 1994 and 1999. The second subset contains information on those establishments that have at least 100 employees on average during this same period.<sup>14</sup> After the elimination of extreme outliers and classes with incomplete and inconsistent data, we ended analyzing a panel of 205 industrial classes.

The Annual Industrial Survey comprises several variables covering mainly production, input use, labor force, sales, inventories, investment expenditures and capital stocks. Data on capital expenditures are grouped into five categories: machinery, transport equipment, land, buildings, and others. As can be noted, although no information on financial flows is provided, the survey is not only very specific in terms of capital expenditures, but also in the types of capital purchased by the establishments. We consider this as the strongest point of the Annual Industrial Survey and make an effort to exploit this feature as much as possible. Based on the variables provided by the survey, we were able to construct data on investment, capital stock, number of employees, and change in sales and cash flow. The variables that are utilized in this study were constructed according to the following methodology:

**Investment ( $I_{it}$ ):** it is calculated as the sum of acquisitions of machinery, transport equipment and buildings plus improvements minus sales of these types of assets.

**Capital Stock ( $K_{it}$ ):** The survey includes this variable for five asset classes (machinery, land, buildings, transport equipment and other) valued at reposition cost for each year. However, we constructed our own values for the stock of capital based on a perpetual inventory method. With the reposition value of capital reported for 1994 (the beginning of the survey) we utilized reported investment values to build the capital stock for the subsequent year. We assumed depreciation rates for land, buildings and other assets.

**Cash Flow ( $CF_{it}$ ):** Since Mexican law requires every firm to pay out ten percent of profits to its employees, to obtain cash flow we simply multiplied profit-sharing figures reported by ten and added reported depreciation (which in most cases reflects accounting, not economic values).<sup>15</sup>

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<sup>13</sup> Instituto Nacional de Estadística, Geografía e Informática.

<sup>14</sup> The dataset is balanced in the sense that exiting plants are discarded from the sample by the collecting agency, according to whom few exiting plants were discarded.

<sup>15</sup> See Gelos and Werner (1999) for more details on the reasoning behind this methodology as a measure of Cash Flow in the context of Mexico's Annual Industrial Survey.

**Change in Sales ( $\Delta S_{it}$ ):** This variable is defined simply as the yearly change in reported sales of products in the establishment.

**Price Indices:** The producers price index was used as a deflator for Investment and the Capital Stock. For Cash Flow and the Change in Sales we utilized the wholesale price index. All indices were the average in the corresponding year.

According to the total number of employees, the establishments were classified into two size categories. Establishments with fewer than 100 employees were classified as small, establishments with more than 100 employees were considered large. The main characteristics of the different group of plants are presented in Table 1.

## **VIII. Empirical Results**

In what follows we describe our empirical results in three subsections for clarity of exposition. The analysis of the relationship between investment expenditures and cash flow is presented first. This is followed by the introduction of the real interest rate effect. Finally, we analyze how substituting the latter variable for two different measures of the foreign interest rate improves the results obtained.

### **VIII.1 Investment and cash flow**

Initial results are presented in Table 2. In this table the results of the estimation of a simple equation for the share of current investment on the capital stock are presented. The explanatory variables are the yearly change in sales and the corresponding firm's cash flow for the present period, both as a proportion of the lagged capital stock. The basic idea behind this regression is that once the effect of future investment opportunities for the firm is included, as captured by the change in sales, the level of the firm's cash flow will capture the importance of internal funds as a source of finance for investment. The coefficient on this variables will therefore tell us something about how dependent are Mexican manufacturing firms on funds generated within the firm.

Although not shown in Table 2, in order to capture the year effects dummy variables are included in each of the regressions for every year in the sample period. Moreover, in order to account for the possibility that the effect of the firm's cash flow be different for large and small firms a dummy variable that signals whether the firm is large (according to the number of employees) is allowed to interact with



the cash flow level. Also, wherever this interactive dummy is utilized the size dummy also enters by itself in the regression. Finally, each column in the table contains the parameter estimates with the corresponding t-statistics appearing below the coefficient, and the sample size and goodness of fit statistics for each regression are also specified at the bottom of the column.

In regression number 1 of Table 2, the coefficients of both the change in sales and the firm's cash flow come out statistically significant and positive. Therefore, a rise in sales causes a significant increase in the firm's investment expenditures. This result is important because only when this variable is able to capture the effect of future opportunities on today's investment, can cash flow be considered a determinant of the firm's reliance on internal funds. As to the latter variable in regression 1 we find that the firm's cash flow as a proportion of last period's capital stock turns out to have a positive and significant effect on investment expenditures. It is important to note however that this regression was estimated without taking into consideration the possibility of autocorrelation in the error structure.

In regression number 2, the structure of the errors that is considered is more elaborate, where the possibility of first order autocorrelation is considered explicitly in the estimation. As can be observed from the results in this regression the significance of the coefficients is not significantly altered. More specifically, both variables remain statistically significant and retain their signs. From this we conclude that once account is taken of a possible misspecification in the error structure, cash flow levels seem to be a relevant determinant of capital expenditures by firms, suggesting a cost differential between internal and external funds.

Regressions 1 and 2 of Table 2 provide evidence in favor of the relevance of internal funds for investment finance. The logic behind this result is that large firms have the possibility to access several means of finance for investment expenditures. This is so because of the reputations they enjoy in product and credit markets, the size of their assets which can be used as collaterals for commercial bank loans, and the possibility to place corporate debt in foreign markets. Since small firms do not enjoy some or all of these possibilities, they are not as capable of harvesting funds outside the firm, and therefore become more reliant on funds generated internally. Moreover, this effect would be exacerbated by the lack of presence of commercial banks as effective financial intermediaries, since small firms tend to be more commonly dependent on commercial bank loans. However, was the previous argument true, we should also be able to observe that internal funds are a more important determinant of investment expenditures when the firm is small. Therefore, in regressions 3 and 4 of Table 2, an attempt is made to capture whether cash flow levels affect investment in a differential manner depending on the size of the firm. Incorporating dummy variables that interact with cash flow levels according to whether the firm is large or small does this. In these two regressions the cash flow coefficient will be therefore an estimate of the response of investment by small firms to changes in their respective cash flow levels. Whereas we obtain

the response of investment by large firms to changes in their cash flow by adding the latter coefficient to the one corresponding to the interactive dummy variable for large firms.

In regression number 3 of Table 2 the coefficient for the change in sales comes out statistically significant and positive, again capturing the direct effect that future opportunities have on today's investment for the firm. With respect to the coefficient of the cash flow level in the firm, we find that it is positive and statistically significant. This indicates that internal funds are a positive determinant of investment for small firms. When attempting to discriminate the effect of changes in cash flow on investment between small and large firms we find evidence that investment by large firms is less sensitive. This is the case because the coefficient corresponding to the dummy variable for large firms that interacts with cash flow comes out negative and statistically significant. In regression number 4 we estimate regression 3 again taking into account the possibility of a misspecification in the error structure. As we do this we find that again the change in sales comes out statistically significant and of the expected positive sign. Moreover, we find again statistical evidence that the cash flow coefficient is different for small and large firms, as illustrated by the fact that the dummy variable that interacts with the cash flow level comes out statistically significant and negative. This latter result means that although a firm's cash flow is a positive determinant of investment expenditures in the case of small firms, this is not true in the case of large firms. That is, a rise in a small firm's cash flow would increase its acquisition of capital goods during the period. However, in the case of large firms, a rise in cash flow does not increase investment expenditures.<sup>16</sup>

From the results so far we conclude that there is evidence that both explanatory variables, the change in sales and the cash flow level, play a role in determining investment expenditures by firms. As pointed out previously, the inclusion of the change in sales as a proportion of the capital stock is done in order to account for the possibility that future investment opportunities be relevant in determining current investment levels. Moreover, once account is taken of the relevance of this effect, the presence of the level of cash flow as a significant determinant of investment implies that there must be a wedge between the cost of internal and external funds for firms. That is, when a variable that signals the existence of future investment opportunities is present, the reliance of firms on cash flow levels to finance investment expenditures would imply the presence of credit market imperfections. Finally, this conclusion is reaffirmed by the finding that large firms rely less on cash flow levels for investment financing.

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<sup>16</sup> It is important to note here that the following results hold qualitatively even when different criteria are used to discriminate between small and large firms.

## VIII.2 Investment and the real interest rate

Given the evidence of credit market imperfections, the responses of investment by firms to macroeconomic disturbances will not be the same as those that would prevail in the perfect markets. This is so because capital expenditures by financially constrained firms could be affected in alternative ways when agency problems are present. In particular, the effect of real interest rate changes on investment would be transmitted not only through the traditional cost channel but also via balance sheet effects, as explained in Section III. Therefore, when the latter is the case, the intensity of the effect of a change in the real interest rate on investment would be different for small and large firms, since these firms access the credit market under different conditions. In what follows we attempt first to analyze whether there is a real interest rate effect on investment expenditures by manufacturing firms in Mexico. Once we find evidence in favor of such an effect, we test the hypothesis whether small firms are being denied funding because of credit market imperfections. We do this by analyzing whether the intensity of the effect of real interest rate changes on investment is stronger for large firms.

In order to capture how real interest rate fluctuations affect capital expenditures by manufacturing firms we now introduce an additional variable into the analysis done so far, namely, the real interest rate. A proxy for this variable is constructed by adjusting the nominal rate on short-term government bonds (Cetes) by the observed inflation rate for the previous twelve months.<sup>17</sup> Therefore, ex-post real interest rates are utilized here, given that prior to 1997 no other indicator of inflation expectations is available for the Mexican economy.

Therefore, in this section we estimate the following econometric model

$$\frac{I_{it}}{K_{it-1}} = \beta \frac{\Delta S_{it}}{K_{it-1}} + \phi \frac{CF_{it}}{K_{it-1}} + r_t + \varepsilon_{it}$$

where  $r_t$  is the real interest rate.

In Table 3 we elaborate on the investment equation estimated in the previous section. The explanatory variables are again the yearly change in sales and the corresponding firm's cash flow for the current period, both as a proportion of the lagged capital stock. Now the level of the real interest rate is included in each of the regressions, the basic idea being that this variable should play a significant role in investment financing for firms given evidence in favor of credit market imperfections. It is relevant to

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<sup>17</sup> That is,  $r_t = \frac{1 + i_t}{1 + \pi_t} - 1$ , where  $i_t$  is the nominal return on 28 day CETES, and  $\pi_t$  is the inflation rate observed during the past twelve months.

note here that the fact of a diminished presence of commercial bank credit in Mexico since the crisis in 1995 does not imply that funds have not been intermediated towards firms through alternative channels, like commercial paper emissions, equity finance or loans from trading partners. Therefore, it is important to be able to analyze the real interest rate effect in the light of the result obtained in the previous section. That is, once evidence in favor of credit market imperfections is taken into account, the real interest rate effect on investment expenditures could arise through several channels.

Once we are able to obtain evidence in favor of a significant effect of interest rate changes on investment, we proceed, just as in the previous section, to look for evidence about whether this effect is more intensive for large firms. This is the reason why in the regressions presented in Table 3 we add the real interest rate as an explanatory variable in the investment equation estimated previously, and, in order to figure out whether firms respond differently to interest rate changes, we include a real interest rate interactive dummy in the last two regressions as well. Although not presented in the table, the size dummy is included wherever interactive dummies are introduced and, in order to capture year effects, dummies were included for every year in the sample in each of the regressions in the table.

In regression 1 of Table 3 we observe that the change in sales, the level of the firm's cash flow and the level of the real interest rate come out statistically significant and of the expected sign, positive for the first two variables and negative for the third. Given the conclusion of the previous section, this result points towards a significant effect of the interest rate on investment that plays out through several channels. Let us analyze this result in steps. Once the effect of future investment opportunities is accounted for, the presence of cash flow as a determinant of investment is evidence of the existence of a wedge between the cost of internal and external funds to the firm. Moreover, the significance of the real interest rate as a determinant of investment expenditures implies that it plays a role in capital expenditures by firms even when credit market imperfections are taken into account. In other words, it implies that a firm's investment could be affected not only through balance sheet effects but also via the more direct cost channel. Were this not the case then the statistical significance of cash flow in this regression would have been diminished by the presence of the real interest rate. This result is noteworthy especially because of the fact that the traditional mechanism of intermediation of credit flows via commercial banks has not been in place in Mexico during the sample period here analyzed.

In regression number 2 of Table 3, the structure of the errors that is considered is more elaborate, where the possibility of first order autocorrelation is considered explicitly in the estimation. As can be observed from the results in this regression the significance of the coefficients is altered. More specifically, although the change in sales and the cash flow level remain statistically significant and retain their positive sign, this cannot be said of the coefficient for the level of the real interest rate, which loses its sign and significance. From this all we can say is that the conclusion outlined in the previous

paragraph resulted from a misspecification in the error structure. Therefore, once account is taken of credit market imperfections interest rate changes do not seem to affect investment expenditures by firms. Although our pursuit of a statistically significant real interest rate effect on investment is frustrated by this result, as we will observe in the analysis of the subsequent section once the right measure of the cost of capital for firms is introduced we can find stronger evidence in favor an interest rate effect on investment.

In regressions 3 and 4 of Table 3 we attempt to capture whether real interest rate changes affect investment in a differential manner depending on the size of the firm. Incorporating dummy variables that interact with the real interest rate according to whether the firm is large or small does this. In these two regressions the coefficient for the real interest rate is an estimate of the response of investment by small firms. Whereas we obtain the response of investment by large firms to the real interest rate by adding the latter coefficient to the one corresponding to the interactive dummy variable for large firms.

In regression number 3 the coefficient for the change in sales comes out statistically significant and of the expected sign, pointing again at the importance of market opportunities as a determinant of investment expenditures. On the other hand, cash flow levels seem to still play a role in capital expenditures by firms. Moreover, in this regression we find evidence that investment by small and large firms responds differently to cash flow levels. This is illustrated by the fact that the coefficient for the dummy variable for large firms that interacts with cash flow, comes out negative and statistically significant. With respect to the effect of the real interest rate on investment the story told by regression 3 is that this variable affects investment expenditures with the expected negative sign, a result similar to that obtained from regression 1. Moreover, the lack of significance of the coefficient on the large firm dummy that interacts with the real interest rate indicates that there is no evidence of a difference in the real interest rate effect on investment decisions by small and large firms.

In regression number 4 we take into account the possibility of a misspecification in the error structure in the previous regression. As we do this we find again that the change in sales and the cash flow levels come out statistically significant and of the expected sign. Moreover, for the cash flow level both the coefficient by itself and the interactive dummy's come out statistically significant and the latter is negative, corroborating the result obtained in regression 3. For the real interest rate effect on investment the story told by regression 4 is ambiguous. The results show that the real interest rate is not a determinant of investment in the case of small firms, since the coefficient on the real interest rate comes out of the wrong sign and not statistically significant. Moreover, the real interest rate effect on investment does not come out different for small and large firms. That is, although the large firm interactive dummy comes out of the expected negative sign, it is not statistically significant. Therefore, from these results we observe that when account is taken of credit market imperfections the effect of real interest rate changes on investment expenditures by firms is not definite. Moreover, we do not find conclusive evidence that

there is a difference in the intensity of the effect that real interest rate changes have on investment for small and large firms.

From the analysis so far we can conclude that investment financing by manufacturing firms in Mexico can be characterized by a duality. That is, for small firms the access to external funds is limited by both the absence of commercial bank credit after 1995 and their inability to resort to alternative sources of finance. Therefore, cash flow levels play a determinant role in investment decisions with real interest rate changes not significant in the equation. This story implies that small manufacturing firms are commercial bank dependent and therefore not affected by other conditions in domestic credit markets.

For large firms, the results obtained so far make the story somewhat different from that of small firms. Namely, although the cash flow level is a positive determinant of investment expenditures in the case of small firms, this is not true in the case of large firms. Therefore, a rise in a small firm's cash flow would increase the acquisition of capital goods in the same period, whereas for large firms it would not increase investment expenditures. Moreover, although we do not find evidence in favor of a statistically significant real interest rate effect on investment, notice how once the interactive dummies for large firms are introduced the real interest rate effect comes out negative. Although the size of the coefficient for the interest rate interactive dummy means that there is not even evidence of a negative real interest rate coefficient for large firms, it does suggest the presence of a cost of funds effect for the group of firms that in the present study are associated with fewer financial constraints. Moreover, as will be concluded from the analysis of the next section, as alternative measures of the cost of capital to firms are introduced, the suspicion of a significant interest rate effect on investment is well founded.

It should be noted that the results presented in Tables 2 and 3 are similar to those obtained in Sanchez (2001) with the only difference being that the real interest rate effect on investment by both small and large firms came out statistically significant in this previous work. This result, however, was conditional on a sample that encompassed fifteen years, the period that goes from 1984 to 1999. Moreover, in that preliminary analysis we looked at the behavior of the average firm in the industry, normalizing observations at the industry level by the number of plants surveyed. The differences in the results between these two studies can also be explained by the larger variability experienced by the real interest rate during the second half of the eighties and early nineties, due to the process of financial liberalization that took place during that time in Mexico. Finally, in that previous study the number of industries analyzed was considerably smaller, a necessary step for being able to reconcile a change in the methodology of the industrial survey carried out in 1994.

### VIII.3 The Effect on investment of changes in the foreign interest rate

Under a flexible exchange rate regime with perfect capital mobility, fluctuations in the foreign interest rate or the risk premium will be reflected either in domestic interest rate movements or counterbalancing exchange rate fluctuations. In Mexico, an economy open to international capital inflows, interest rates fluctuations observed during most of the sample period analyzed in this study seem best explained by movements in foreign interest rates or in the risk premium. Indeed, as pointed out by Martinez et al. (2000), until 1999 domestic interest rate movements reflected mostly the behavior of foreign interest rates in general and in the risk premium on government bonds placed abroad in particular. Although since 1995 the floating exchange rate regime finally allowed the central bank of Mexico the capacity for autonomous monetary policy actions, it has been only during the last couple of years that domestic interest rate fluctuations have followed a path that is consistent with an independent monetary policy aimed at reducing inflation. Moreover, all along the period considered in the present study, fluctuations in the risk premium have dominated by far the movements in risk free foreign interest rates for Mexico.<sup>18</sup> Therefore, given evidence of credit market segmentation, and given the fact that commercial bank credit has been scant during the second half of the nineties, it seems likely that the relevant variable to account for the cost of capital to firms be some measure of the foreign interest rate. In the present section we test whether the foreign interest rate or the risk premium on government bonds placed abroad would perform better than the real interest rate in the regressions analyzed in the previous section.

In what follows we analyze how changes in foreign interest rates, measured by the return of government bonds placed in international capital markets, affect the results we have been finding so far for the behavior of capital expenditures of manufacturing firms in Mexico. To approximate the movements in foreign rates we utilize the implicit return of the EMBI (Emerging Market Bond Index) for Mexico. The results of this analysis are presented in Table 4 where we follow the same methodology applied so far. From the analysis of the previous section we observed that the real interest rate does not seem to affect investment expenditures once credit market imperfections are taken into account. However, from regressions 1 and 2 of Table 4 we observe that this conclusion is reversed when the foreign interest rate is utilized as a measure of the cost of capital for firms. Note that even considering first order autocorrelation in the error structure leaves us with the same result. Therefore, we arrive at the conclusion that there seems to be a statistically significant cost of capital effect on investment once we introduce the

right measure of the cost of funds from outside sources for firms. This result is noteworthy given the fact that during the second half of the nineties, the sample period, traditional sources of finance have not been present, giving firms the incentive to search for alternative credit sources. Moreover, because of the expansion of the manufacturing exports platform experienced by Mexico following the opening of the trade account since the mid 1980s, a good proportion of manufacturing firms established trading relations with foreign counterparts. Therefore, the possibility that these trading relations opened the door to credit relations and hence alternative sources of funds for firms is highly likely. Finally, the statistical significance of the interest rate effect once the foreign interest rate is introduced would imply that this source of funds has been widespread in the Mexican economy since the mid-nineties<sup>19</sup>.

As we look for evidence of a difference in the intensity that foreign interest rate movements have on investment by small and large firms, here again we find that the foreign interest rate seems to affect only investment expenditures of large firms. We reach this conclusion because of the negative sign on the coefficient of the dummy variable that interacts with the EMBI. We should note however, that this coefficient does not quite make it to statistical significance. Therefore, even when we do not find a differentiated impact of changes in foreign interest rates on large versus small firms, there seems to be some evidence that it is movements in this latter variables that influence capital expenditure decisions by firms.

In Table 5 we repeat the exercise substituting the foreign interest rate with a measure of the risk premium associated with government debt placed abroad. That is, the spread between the foreign interest rate and the risk free rate as measured by the U.S. long-term bond. As observed from the results in regressions 1 and 2 of the table, the sign and statistical significance of the coefficients for the cash flow and the change in sales remain intact. Moreover, we observe again that the spread comes out statistically significant even when account for future investment opportunities, credit market imperfections and first order autocorrelation of the error term is accounted for. Moreover, we also find evidence of a differentiated cost of funds effect between small and large firms. Although the corresponding coefficients do not come out statistically significant they result of the expected negative sign indicating evidence to support this conclusion. Finally, it should be noted that these results hold even as the conclusion in favor of credit market imperfections remains intact.

The reasoning behind the previous result can be realized more clearly once account is taken of the evolution of the Mexican foreign exchange regime during the past two decades. Up to 1994 Mexico had a

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<sup>18</sup> Between January 1994 and December 1999 the standard deviation of the EMBI spread (a measure of the risk premium paid by Mexican government bonds placed abroad) was 3.17%, versus a standard deviation of 0.74% of the US long-term bond.

<sup>19</sup> In Sanchez (2002) we separate the set of firms with a significant share of exports in their sales from the rest, and find that exporting firms are more sensitive to interest rate changes.



practically fixed exchange rate, there was no independent monetary policy to speak of up to that date. Moreover, when the country moved into a flexible exchange rate regime, one would have expected monetary policy to start to become relevant. However, after the devaluation in 1994, the domestic banking system was practically absent from the picture, with most investment funds in Mexico coming from alternative sources. Therefore, it is under this light that the result that the foreign interest rate (as opposed to domestic interest rate) seems to be a better proxy for the cost effect on capital expenditures by manufacturing firms in Mexico.

The results obtained above reinforce the evidence found earlier in favor of the existence of credit market imperfections. Moreover, based on the results of this section we can conclude that:

- a) There is a cost of capital effect playing a relevant role in the behavior of investment expenditures by manufacturing firms in Mexico, and
- b) The effect of changes in the interest rate seems more intense in the case of financially unconstrained firms, which are here associated with large firms.

#### **VIII.4 Robustness**

In this section we test whether the results obtained so far hold when investment expenditures by firms are normalized by a variable other than the previous period's capital stock. Tables 6 to 9 display regressions that are essentially the same as the ones presented so far with the difference being that the dependent variable (investment) is being now normalized by lagged sales rather than fixed assets. It is not hard to see that when compared with the results obtained in Tables 2 to 5 there are no qualitative changes. In particular, we keep finding a statistically significant effect of the level of cash flow on investment expenditures. As was the case before this effect plays out in the presence of a statistically significant positive effect of the change in sales on investment. As interpreted before, this implies the reliance of firms on internal funds for financing capital outlays. Moreover, we find evidence in favor of a minimal effect of the level of cash flow in the case of large firms, whereas for small firms this variable remains significant throughout the analysis. As for the real interest rate effect, in Tables 7 to 9 we observe how under a different normalization we find a statistically significant effect of the EMBI and the EMBI spread on overall investment. Moreover, just as before, in the case of large firms there seems to be some evidence in favor of an interest rate effect. This plays out more clearly when the gross rate for the EMBI is used as a proxy for the cost of capital. In summary, there does not seem to be a qualitative contradiction in the results when the analysis is approached through a different normalization of the dependent variable.

## IX. Conclusions

The present study attempted to shed some light on the determinants of investment expenditures of manufacturing firms in Mexico during the second half of the nineties. We estimated standard investment equations focusing on the relevance of a difference between the costs of internal versus external funds to the firm. We find that internal funds in the form of cash flow have played a relevant role in explaining investment expenditures. Moreover, when separating a priori those firms more likely to be financially constrained we find that these are more sensitive to changes in cash flow than the rest. This result, which has also been found in previous studies on the behavior of Mexican manufacturing firms,<sup>20</sup> stresses the relevance of credit market imperfections in Mexico during the second half of the nineties. Moreover, the consequences of these imperfections are largely exacerbated when considering the absence of traditional sources of finance during the period. The result of these phenomena must be playing an important role in the configuration of manufacturing industries, and on the prevalence of a competitive industrial structure.

Investment expenditures also respond to changes in real interest rates. Although the effect only materializes when account is taken of the fact that during most of the sample analyzed here domestic interest rate fluctuations were largely determined by changes in the risk premium on bonds placed in international capital markets. Because of the statistical significance of the foreign interest rate overshadowing the effect of domestic interest rates, we therefore conclude that it is a measure of the foreign interest rate, or the foreign interest rate risk premium, that explains investment behavior best. Moreover, separating the set of firms that a priori seem less likely to be liquidity constrained from the rest, some evidence is found on a differentiated response of investment to interest rate changes. The presence of this effect is interpreted as a confirmation of the existence of credit market imperfections. Given the lack of traditional commercial bank loans, some firms, because of their size or market preeminence, had the capacity to either place corporate debt abroad, or were able to access foreign funds because of their close ties with foreign partners.

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<sup>20</sup> Gelos and Werner (2001).

## References

Bernanke B. And Gertler M. (1989), "Agency Costs, Net Worth, and Business Fluctuations", *American Economic Review*, 79, No. 1, marzo, pp 14-31.

Bernanke B. And Blinder (1988), "Credit, Money and Aggregate Demand", *American Economic Review*, mayo, pp. 435-439.

Copelman M. and Werner A. M. (1995), "The Monetary Transmission Mechanism in Mexico," Board of Governors of the Federal Reserve System, *International Finance Discussion Papers*, Number 521.

Eisner R. And Nadiri M.I. (1968) "Investment Behavior and Neo-Classical Theory", *The Review of Economics and Statistics*, pp. 369.390.

Fazzari S., Hubbard G. R. and Petersen B.C. (1988), "Financing Constraints and Corporate Investment," *Brookings Papers on Economic Activity*, 1988:I, pp.141-205.

Fazzari S., Hubbard G. R. and Petersen B.C. (2000), "Investment Cash Flow Sensitivities are Useful: A comment on Kaplan and Zingales", *Quarterly Journal of Economics*, May.

Gelos G. and Werner A.M. (1999), "Financial Liberalization, Credit Constraints, and Collateral: Investment in the Mexican Manufacturing Sector," *IMF Working Paper*, WP/99/25.

Gertler M. and Gilchrist S. (1994), "Monetary Policy, Business Cycles, and the Behavior of Small Manufacturing Firms," *Quarterly Journal of Economics*, Vol. 109, Issue 2, pp. 309-340.

Harris J., Schiantarelli F. and Siregar M. G. (1994), "The Effect of Financial Liberalization on the Capital Structure and Investment Decisions of Indonesian Manufacturing Establishments," *The World Bank Economic Review*, Vol. 8, No. 1, pp. 17-47.

Iscan, T.B. (2000), "Financing Constraints and Investment Decline in Mexico," *The Manchester School*, Vol. 68, No. 1, pp. 24-43.

Jaramillo F.F., Schiantarelli F. And Weiss A. (1993) “Capital Market Imperfections before and after Financial Liberalization: An Euler-equation Approach to Panel Data for Ecuadorian Firms”, IBRD Working Paper No. 1091, Washington D.C..

Kaplan S.N. and Zingales L. (1997) “Do Investment-Cash Flow Sensitivities Provide Useful Measures of Financing Constraints?”, *Quarterly Journal of Economics*, February.

Kim, H.E. (1999), “Was Credit Channel a Key Monetary Transmission Mechanism Following the Recent Financial Crisis in the Republic of Korea?,” The World Bank, *Policy Research Working Paper*, No. 3003.

Martínez L., Sánchez O. and Werner A.M. (2001) “Consideraciones sobre la Conducción de la Política Monetaria y el Mecanismo de la Transmisión en México,” Banco de México, *Documentos de Investigación*, No. 2001-2.

Sánchez O. (2001) “La inversión en la empresas manufactureras y el impacto de las tasas de interés”, Banco de México, *Documentos de Investigación*, No. 2001-8.

Sánchez O. (2002) “Has the openness of the Mexican economy rendered monetary policy irrelevant?”, *Working paper*, Center for Research on Economic Development and Policy Reform, Stanford University.

Schiantarelli F. (1995) “Financing Constraints and Investment: A Critical Review”, *Working Paper*, Boston College. May.

**Table 1. Summary of Characteristics by Type of Establishment\***

	<b>Employees by Firm</b>	<b>Investment/ Kt-1</b>	<b>Cash Flow/ Kt-1</b>
<b>Small</b>	68	0.17	0.31
	<i>17</i>	<i>0.1</i>	<i>0.2</i>
<b>Large</b>	287	0.21	0.26
	<i>146</i>	<i>0.14</i>	<i>0.3</i>

\* Averages. Standard deviations in italics.

**TABLE 2**

<u>Dependent Variable</u>				
<u>Investment//Kt-1</u>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
<b>Constant</b>	18.70	18.07	19.54	16.21
	9.48	8.54	9.64	9.31
<b>ChSales/Kt-1</b>	3.01	3.55	3.04	3.63
	8.04	7.64	8.14	7.81
<b>Cash Flow/ Kt-1</b>	0.08	0.07	0.12	0.12
	3.00	2.23	3.46	3.21
<b>CF(dummy Lg)</b>			-0.09	-0.16
			-1.76	-2.42
<b>Sample</b>	95-99	95-99	95-99	95-99
<b># of Observations</b>	2050	1640	2050	1640
<b>Overall R2</b>	0.15	0.18	0.14	0.16
<b>F</b>	19.6	18.8	17.3	16.8

**TABLE 3**

<u>Dependent Variable</u>				
<u>Investment//Kt-1</u>	1	2	3	4
<b>Constant</b>	20.56	19.60	21.64	21.59
	10.59	9.69	10.57	9.98
<b>Sales Change/Kt-1</b>	3.01	3.56	3.05	3.63
	8.04	7.64	8.16	7.78
<b>Cash Flow/ Kt-1</b>	0.08	0.07	0.11	0.12
	3.00	2.23	3.38	3.21
<b>Cash Flow(dum Lg)</b>			-0.09	-0.16
			-1.65	-2.42
<b>Real Interest Rate</b>	-0.39	0.11	-0.49	0.16
	-4.14	0.56	-3.50	0.52
<b>RIR (dum Lg)</b>			0.14	-0.09
			0.83	-0.25
<b>Sample</b>	95-99	95-99	95-99	95-99
<b># of Observations</b>	2050	1640	2050	1640
<b>Overall R2</b>	0.15	0.18	0.14	0.15
<b>F</b>	19.6	18.8	15.2	14.4

**TABLE 4**

<u>Dependent Variable</u>				
<u>Investment/Kt-1</u>	1	2	1	2
<b>Constant</b>	30.69	38.90	32.12	29.74
	7.80	4.59	7.97	3.85
<b>Sales Change/Kt-1</b>	3.01	3.56	3.05	3.64
	8.04	7.64	8.14	7.84
<b>Cash Flow/ Kt-1</b>	<b>0.08</b>	<b>0.07</b>	<b>0.12</b>	<b>0.12</b>
	<b>3.00</b>	<b>2.23</b>	<b>3.39</b>	<b>3.25</b>
<b>Cash Flow(dum Lg)</b>			<b>-0.09</b>	<b>-0.17</b>
			<b>-1.65</b>	<b>-2.56</b>
<b>Embi</b>	<b>-0.97</b>	<b>-1.78</b>	<b>-1.17</b>	<b>0.20</b>
	<b>-4.14</b>	<b>-2.53</b>	<b>-3.19</b>	<b>0.20</b>
<b>Embi (dum Lg)</b>			<b>0.27</b>	<b>-1.49</b>
			<b>0.58</b>	<b>-1.28</b>
<b>Sample</b>	95-99	95-99	95-99	95-99
<b># of Observations</b>	2050	1640	2050	1640
<b>Overall R2</b>	0.15	0.18	0.15	0.05
<b>F</b>	19.6	18.8	15.2	14.7



**TABLE 5**

<u>Dependent Variable</u>				
<u>Investment/Kt-1</u>	1	2	1	2
<b>Constant</b>	24.39	25.57	25.61	28.16
	9.35	6.90	9.45	7.37
<b>Sales Change/Kt-1</b>	3.01	3.56	3.04	3.63
	8.04	7.64	8.14	7.82
<b>Cash Flow/ Kt-1</b>	<b>0.08</b>	<b>0.07</b>	<b>0.12</b>	<b>0.12</b>
	<b>3.00</b>	<b>2.23</b>	<b>3.40</b>	<b>3.25</b>
<b>Cash Flow(dum Lg)</b>			<b>-0.09</b>	<b>-0.17</b>
			<b>-1.66</b>	<b>-2.54</b>
<b>Spread</b>	<b>-1.01</b>	<b>-1.41</b>	<b>-1.19</b>	<b>-0.79</b>
	<b>-4.14</b>	<b>-2.53</b>	<b>-3.06</b>	<b>-0.94</b>
<b>Spread (dum Lg)</b>			<b>0.24</b>	<b>-1.16</b>
			<b>0.49</b>	<b>-1.15</b>
<b>Sample</b>	95-99	95-99	95-99	95-99
<b># of Observations</b>	2050	1640	2050	1640
<b>Overall R2</b>	0.15	0.18	0.15	0.10
<b>F</b>	19.6	18.8	15.1	14.6

**TABLE 6**

<u>Dependent Variable</u>				
<u>Investment/Vt-1</u>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
<b>Constant</b>	2.36	3.20	4.35	4.28
	5.75	6.58	9.35	8.37
<b>ChSales/Vt-1</b>	1.44	1.69	0.79	1.45
	2.28	1.96	1.29	1.72
<b>Cash Flow/ Vt-1</b>	0.27	0.24	0.82	0.74
	5.43	3.94	10.16	8.04
<b>CF(dummy Lg)</b>			-0.84	-0.79
			-8.46	-6.76
<b>Sample</b>	95-99	95-99	95-99	95-99
<b># of Observations</b>	2050	1640	2050	1640
<b>Overall R2</b>	0.07	0.09	0.10	0.13
<b>F</b>	7.5	5.5	17.2	13.1

**TABLE 7**

<u>Dependent Variable</u>				
<u>Investment/Vt-1</u>	1	2	3	4
<b>Constant</b>	3.02	3.11	3.21	3.24
	6.81	7.22	6.91	7.32
<b>Sales Change/Vt-1</b>	1.45	1.69	1.38	1.70
	2.28	1.96	2.17	1.97
<b>Cash Flow/ Vt-1</b>	0.27	0.24	0.29	0.26
	5.43	3.94	5.56	4.12
<b>Cash Flow(dum Lg)</b>			-0.22	-0.22
			-1.33	-1.18
<b>Real Interest Rate</b>	-0.03	0.05	-0.03	0.05
	-1.56	1.17	-1.54	1.28
<b>RIR (dum Lg)</b>			0.01	-0.03
			0.28	-0.39
<b>Sample</b>	95-99	95-99	95-99	95-99
<b># of Observations</b>	2050	1640	2050	1640
<b>Overall R2</b>	0.07	0.09	0.07	0.09
<b>F</b>	7.5	5.5	5.8	4.2

**TABLE 8**

<u>Dependent Variable</u>				
<u>Investment/Vt-1</u>	1	2	1	2
<b>Constant</b>	3.81	5.25	4.74	6.36
	4.65	3.60	5.83	4.17
<b>Sales Change/Vt-1</b>	1.45	1.70	0.91	1.45
	2.28	1.96	1.45	1.69
<b>Cash Flow/ Vt-1</b>	<b>0.27</b>	<b>0.24</b>	<b>0.55</b>	<b>0.51</b>
	<b>2.28</b>	<b>3.94</b>	<b>8.43</b>	<b>6.62</b>
<b>Cash Flow(dum Lg)</b>			<b>-0.62</b>	<b>-0.60</b>
			<b>-6.46</b>	<b>-5.23</b>
<b>Embi</b>	<b>-0.08</b>	<b>-0.02</b>	<b>-0.07</b>	<b>-0.07</b>
	<b>-1.56</b>	<b>-1.48</b>	<b>-0.94</b>	<b>-0.36</b>
<b>Embi (dum Lg)</b>			<b>-0.02</b>	<b>-0.25</b>
			<b>-0.23</b>	<b>-1.06</b>
<b>Sample</b>	95-99	95-99	95-99	95-99
<b># of Observations</b>	2050	1640	2050	1640
<b>Overall R2</b>	0.07	0.09	0.07	0.04
<b>F</b>	7.5	5.5	11.2	8.4

**TABLE 9**

<u>Dependent Variable</u>				
<u>Investment/Vt-1</u>	1	2	1	2
<b>Constant</b>	3.33	3.77	3.51	3.89
	5.90	5.52	6.06	5.64
<b>Sales Change/Vt-1</b>	1.45	1.70	1.38	1.70
	2.28	1.96	2.17	1.97
<b>Cash Flow/ Vt-1</b>	<b>0.27</b>	<b>0.24</b>	<b>0.29</b>	<b>0.27</b>
	<b>5.43</b>	<b>3.94</b>	<b>5.53</b>	<b>4.16</b>
<b>Cash Flow(dum Lg)</b>			<b>-0.21</b>	<b>-0.24</b>
			<b>-1.28</b>	<b>-1.29</b>
<b>Spread</b>	<b>-0.08</b>	<b>-0.16</b>	<b>-0.09</b>	<b>-0.14</b>
	<b>-1.56</b>	<b>-1.48</b>	<b>-1.55</b>	<b>-1.11</b>
<b>Spread (dum Lg)</b>			<b>0.04</b>	<b>-0.09</b>
			<b>0.34</b>	<b>-0.38</b>
<b>Sample</b>	95-99	95-99	95-99	95-99
<b># of Observations</b>	2050	1640	2050	1640
<b>Overall R2</b>	0.07	0.09	0.07	0.08
<b>F</b>	7.5	5.5	5.9	4.2