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**INTERNAL CAPITAL MARKETS AND FINANCING CHOICES
OF MEXICAN FIRMS BEFORE AND DURING
THE FINANCIAL PARALYSIS OF 1995-2000**

BY

GONZALO CASTAÑEDA

UNIVERSIDAD DE LAS AMÉRICAS-PUEBLA

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Abstract*

This paper shows that, contrary to conventional wisdom, once the Mexican economy moved from financial liberalization to financial paralysis in 1995, liquidity constraints were relaxed for many large and financially healthy firms listed on the Mexican Securities Market. In the latter period, only those firms with a banking tie observe, on average, a dependence on cash stock to finance their investment projects. Econometric results are derived from dynamic panel data models estimated with the Generalized Method of Moments, where level and difference equations are combined into a system.

The econometric evidence is consistent with the real growth of the Mexican economy during the years 1996-2000, which took place in a context of a collapsed banking system and the paralysis of other domestic forms of external financing. This paper also provides evidence supporting the hypothesis that firms' membership in a network and firms' linkage to a bank produced weaker financial constraints before the banking crisis. However, additional research is needed to formally test the importance of the different sources of financing since 1995; suppliers' credit, foreign funding and internal capital markets are viable candidates for further study.

Finally, the paper provides an intuitive rationalization of the Mexican paradox based on the business groups' structure and their internal capital markets. It is argued that under a macroeconomic setting characterized by disarray in the domestic financial system, firms affiliated with business groups have more incentives to act coordinately rather than performing as autonomous profit centers. Consequently, in this new scenario, corporate headquarters are more interested in removing financial bottlenecks than in exerting market pressure on their divisions. In this environment, groups are capable of reallocating financial resources away from booming, export-oriented affiliates—the most likely to have access to foreign capital markets—and into cash-constrained firms within the same group. In other words, according to this theory, it is suggested that the presence of internal capital markets worked as a financial buffer that helped sustain economic growth.

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1. Introduction

Since the seminal paper by Fazzari, Hubbard, and Petersen (1988), many empirical studies linking investment and financial market imperfections have analyzed whether a firm's financial structure has real effects. The postulated hypothesis is not rejected when the estimated value of the cash-flow sensitivity of investment is larger for the sub-sample of liquidity-constrained firms, once one controls for growth opportunities. The most commonly used criteria for identifying the subset of cash-constrained firms are dividend pay-out behavior, firm's size and age, tangibility of assets, credit ratings, variations over time in the tightness of financial constraints, ownership concentration, banking linkages, and group membership.¹

With regard to the last classification criterion, it is presumed that financing bottlenecks faced by divisions of a conglomerate and by firms belonging to a business network, are loosened up mainly for two reasons. First, the existence of an internal capital market helps provide retained earnings to cash-constrained member firms that exhibit growth potential. Second, member firms share risk, collateral, and reputation, which help them avoid being rationed out from capital markets.

One of the advantages of using this criterion to partition the sample is that the possibility of an endogeneity problem, which could introduce a bias in the estimation of the cash-flow coefficient, is small. This is so because membership in a particular group is generally a stable component of corporate governance. In other words, in the short and medium terms, it is not likely that firms will change this feature of their corporate structure on the grounds of financial considerations.

The existing econometric evidence supports the view that internal and external sources of financing are not perfect substitutes, since the investment variable is more sensitive to cash flow (or cash stock) variations in independent firms than in group firms. Some of the empirical papers that have used this sorting criterion are Hoshi, Kashyap and Scharfstein (1991) for Japan; Schaller (1993) and Chirinko and Schaller (1995) for Canada; Cho (1995) and Shin and Park (1999) for Korea; Elston and Albach (1995) for Germany; Lamont (1997) for United States; Perotti and Gelfer (1998) for Russia; Babatz (1998) for Mexico; Schiantarelli and Sembenelli (2000) for Italy; and Gallego and Loayza (2000) for Chile.

¹ See Schiantarelli (1996).

This paper presents econometric evidence on this issue for Mexico during the 1990-2000 period. The late 1990s in Mexico were characterized by a banking crisis and limited new issues of financial instruments through domestic money and capital markets. Thus, the period under study provides an excellent natural experiment for analyzing firms' investment behavior under conditions of severe market failure.

Econometric results show a decreased sensitivity of investment to cash stock after 1994, contrary to prior expectations. Moreover, despite the fact that group membership helps in removing financial bottlenecks in the 1993-1994 period,² no empirical evidence is found to support the influence of internal capital markets on the observed weaker financial constraints since 1995. Accordingly, a more detailed database is required in order to test the hypothesis that group membership may have reduced financial constraints faced by large Mexican firms during the financial paralysis years (1995-2000) to a larger extent than during the financial liberalization years (1990-1994). Nevertheless, the results are consistent with the paradoxical Mexican growth observed during the 1996-2000 period, showing no financial constraints for financially healthy firms in a setting of banking crisis, yet no evidence is offered on how this growth really happened.

The main econometric findings of the paper, derived from a database of large firms listed on the Mexican Securities Market (BMV, by its Spanish acronym), are the following: (i) network firms and firms with banking ties show, as expected, a smaller cash stock coefficient in the 1993-1994 period than independent firms; (ii) sensitivity of investment to cash stock decreases during the financial paralysis period for all types of listed firms but those with bank-linkages; and (iii) for network firms and firms with banking ties, investment is positively related to the group's pooled cash stock only before 1995.

Other studies have shown that, at least for small firms, the cash-flow sensitivity of investment falls when moving from financial repression to liberalization. For instance, Harris, Schiantarelli and Siregar (1994) for Indonesia, Gelos and Werner (1998) for Mexico, and Gallego and Loayza (2000) for Chile obtained these results. Given that background, this paper shows an asymmetry in investment behavior in Mexico, in that financial paralysis is associated with weaker financial bottlenecks. It also proposes, in intuitive terms, a possible microfoundation

² One year of information is lost when lagging fixed assets, and two more years are lost when applying the dynamic panel procedure.

for this paradoxical result. It argues, in particular, that the network structure might have reduced agency problems and helped firms retain their access to external sources of financing. Moreover, it considers that, under the new macroeconomic setting, firms belonging to a network might have had an incentive to use their internal capital markets more heavily.

The paper is structured as follows. In the second section, some characteristics of the database are described, followed by a presentation of descriptive statistics that give a broad overview of the listed firms' investment patterns. The section ends with some remarks on the Generalized Method of Moments used to estimate econometric models with a panel data sample.

The impact of the firms' financing choices on its real activity is analyzed in the third section by means of two investment models. The first regression equation includes the following explanatory variables: lagged investment, to reflect adjustment costs, a proxy for the marginal product of capital, to control for growth opportunities, and cash stock (flow), as a result of considering liquidity constraints. In this way, it is possible to test whether firms' membership in a group, or banking ties, reduces the sensitivity of investment to cash flow, and whether such sensitivity changed during the financial paralysis period. A second regression equation attempts to provide evidence on the absence of a cash flow-investment link for firms belonging to networks. Cross-financing among affiliates is considered in an extended version of the first equation.

In the fourth section, a brief description of the macroeconomic context is presented. It is suggested that the puzzling finding of a weaker investment-cash stock relationship during the financial paralysis period could contribute to an explanation of the also paradoxical recovery of the Mexican economy, which began only one year after the 1995 banking crisis. Furthermore, a theoretical argument is developed to offer an explanation of this paradox in terms of business groups' structure and their internal capital markets. Finally, conclusions are presented in the fifth section, where the most important results are summarized and the contributions of this work to the business groups literature are discussed.

2. Database and Econometric Methodology

The database is described in this section. First, it is characterized in terms of its coverage, units of analysis, number of observations, variables, and selection bias; key variables, such as group membership and banking linkages, are formally defined, and some of their limitations for hypothesis testing are noted. Second, descriptive statistics for the main variables later used in the econometric analysis are presented. In particular, and as a motivation for the analysis of investment behavior under conditions of macroeconomic financial disarray, means and medians of cash flows, investment, and production are presented, all of them measured as a share of net fixed assets. The section ends with some remarks on the econometric technique used to estimate the models with an unbalanced panel data set.

2.1. Database

The database contains a panel of non-financial firms listed on the Mexican Securities Market (BMV). The raw data, collected by the BMV, are available on microfilm for the early years of the sample and through two different electronic systems for firms that are currently listed on the market: SIVA (Integral System of Automated Securities) and Infosel-Financiero. The database has information on balance sheets and income statements for an unbalanced panel of 176 firms, and it allows for building a balanced panel of 69 firms over the 1990-2000 period, as shown in the Appendix, Table 4.

Each firm in the database presents at least four years of information; this is necessary to provide an adequate lag structure for the explanatory variables and their instruments. In some years, a subset of firms was not quoted on the stock exchange (although their information is public since they issued bonds or commercial paper in BMV); consequently, Tobin's Q cannot be calculated for the entire unbalanced panel. The sample covers two contrasting periods: financial liberalization (1990-1994) and financial paralysis (1995-2000); this allows testing for structural change during the banking crisis of 1995.

One advantage of the unbalanced panel, with some firms de-listed before 2000 and others included only after 1990, resides in that it incorporates richer information. The unbalanced panel precludes the introduction of a survivor bias that might handicap the models' statistical inferences if one were to focus only on the firms that are present for the entire period. It is possible that some firms were de-listed because of financial difficulties; hence, by removing

these firms from the data set the econometrician might artificially diminish the impact of cash constraints on investment.

Likewise, by incorporating latecomers to the market, the econometrician is also taking into account changes in the macroeconomic context that induced the listing of new firms. Removing from the database this type of information would also bias the statistical results. Moreover, it is also important to emphasize that firms included in the sample, either independent or members of a group, are very large by Mexican standards and, hence, that they are the least likely to miss profitable investment opportunities due to lack of external financing. Undoubtedly, this last feature of the data set will work in favor of rejecting the null hypothesis. Consequently, a rejection of the presence of financing constraints using this data set might be reversed with another data set that includes small and medium firms. On the contrary, if one finds evidence in favor of financing constraints for these firms, the results will be very robust.

The database contains financial information used in the different models of the paper: fixed assets, net sales, export sales, depreciation, inventories, cash flow and stock. The precise definition of all variables is presented in the Appendix. Additional microeconomic data of a qualitative nature are also included: group membership, bank links, and export orientation. The first two variables are constructed from the list of boards of directors presented in the Annual Financial Facts and Figures, published by BMV. All monetary variables are presented in real terms; the consumer price index to adjust for inflation is available in the web pages of INEGI and Banco de México.

In the database, dummy variables are created for group membership, banking linkages and export orientation. Network membership is present when at least two board members of a particular firm are sitting on the board of at least another listed firm, whatever their position. A bank tie exists when at least one of the firm's board members belongs to the directorate of one or more banks. Finally, a firm is defined as export oriented when its export ratio is larger than 50 percent.

The definition of business group deserves some clarifications. It is well known that many of the firms listed on the BMV belong to business groups; however, lack of information about ownership structure and about non-public firms precludes the possibility of a more precise categorization of groups. Nonetheless, a simple definition based on the interlocking of directorates is helpful to distinguish between firms composed of at most a narrow network of

divisions—here referred to as “independents”—and firms with extended connections far beyond the legal concept of holding. In other words, “independent” firms consist of either truly independent firms or holding companies with some affiliates, while extended groups are formed by legally independent firms, which may or not be constituted as holdings. This classification will allow testing whether firms that are part of extended business groups face weaker financial bottlenecks than the rest of the listed firms.

2.2. Descriptive Statistics

The description of investment patterns is made by dividing the sample into two periods: financial liberalization (1991-1994) and financial paralysis (1995-2000). The last period is, in turn, split into banking crisis (1995-1996) and steady recovery (1997-2000). The sample is also divided into two categories: network and independent firms. It is expected that the analysis of averages and medians will offer a meaningful first view of the dynamics of investment, and its relation with firms’ structure. Table 1 shows that the investment rate fell in both types of firms after 1994, although the last two columns make it clear that investment rates were particularly hit during the banking crisis years. In addition, it shows that disparities in the investment rates within each category were much smaller during 1995-2000 than before.

The mean cash flow ratio is close to 3.9 times larger in network firms than in independent firms, and this gap widened during the period of steady recovery. In contrast to the financial liberalization period, network firms’ cash flow ratios surpassed their investment rates as of 1995; on the contrary, independent firms never had enough internal funds to cover their investment needs. There is no clear pattern of how investment rates vary across firm categories, except that they are somewhat higher among independent firms in terms of their means.

The mean cash flow ratio of non-member firms is high during the banking crisis and close to zero during recovery. This strange result seems to be caused by the presence of some extremely negative observations in the 1997-2000 period, as becomes evident when analyzing the medians, whose behavior is closer to expectations. This observation could explain why the recovery in average investment rate among independent firms after 1996 was not accompanied by a similar change in mean cash flows. Thus, it makes sense in the econometric analysis to run the regressions with a reduced sample that excludes seriously financially distressed firms.

From all these facts some simple conclusions emerge: (i) the financial paralysis years might have affected the growth potential of the sample firms by reducing investment levels; (ii) the crisis made the growth rates of the capital stock more uniform, probably because the macroeconomic context precluded outstanding performances, and some severely distressed cases disappeared from the sample; (iii) network firms seem to have more internal resources, some of which might have ended up invested in affiliates not included in the sample; in fact, network firms' cash flow could have been enough to cover the investment undertaken during the financial paralysis period; (iv) the financial situation of some listed firms might have been seriously affected by the banking crisis; and (v) at least in terms of means, corporate structure per se does not seem to be a key factor in explaining the level of investment and its dynamics. This last remark is in apparent contradiction with the idea that network firms had more chances to deal with the financial paralysis period due to the existence of financial cushions. However, the different strength of the link between investment and cash flow must be investigated more formally in a multivariate econometric setting.

Two caveats are in order. First, many "independent" firms in the sample are in fact business groups with a holding company structure. That is, the two categories used here may be more precisely defined as narrow and extended groups. Second, financial constraints are only one part of the story; investment is also determined by growth opportunities, among other things, as will be analyzed with the regression model. In fact, as can be seen from the mean and the median of the production to capital ratio in Table 1, independent firms had, in general, better growth opportunities than network firms with the exception of the banking crisis years. Notice also that when the 1995-2000 period is split the investment rate seems to vary with the production to capital ratio for both categories of firms.

Moreover, although the sample firms' investment rate during the financial paralysis years did not recover to the levels attained in the early nineties, net sales growth showed great dynamism after 1996. In particular, the median growth rates increased between financial liberalization and steady recovery from 4.2 percent to 4.6 percent, and from 5.4 percent to 8.7 percent for network and "independent" firms, respectively.

Table 1. Descriptive Statistics for the Investment Pattern of Firms Listed on the BMV

Variables	Financial Liberalization (1991-1994)	Financial Paralysis (1995-2000)	Banking Crisis (1995-1996)	Steady Recovery (1997-2000)
Network firms				
Num. Observations	349	513	164	349
--Means--				
Cash flow ratio	0.134 (0.653)	0.131 (0.672)	0.068 (0.887)	0.160 (0.542)
Investment rate	0.441 (4.621)	0.116 (0.546)	0.038 (0.228)	0.152 (0.641)
Production ratio	2.532 (7.502)	2.710 (5.680)	2.303 (5.482)	2.902 (5.770)
--Medians--				
Cash flow ratio	0.101	0.108	0.059	0.131
Investment rate	0.144	0.058	-0.001	0.072
Production ratio	1.311	1.264	1.069	1.394
Independent firms				
Num. Observations	126	284	95	189
--Means--				
Cash flow ratio	0.035 (0.330)	0.033 (0.797)	0.099 (0.631)	-0.004 (0.869)
Investment rate	0.500 (2.330)	0.135 (0.472)	0.053 (0.232)	0.177 (0.551)
Production ratio	2.702 (3.945)	3.236 (5.141)	2.081 (2.875)	3.816 (5.885)
--Medians--				
Cash flow ratio	0.068	0.079	0.053	0.100
Investment rate	0.147	0.060	0.009	0.082
Production ratio	1.451	1.551	1.255	1.673

Notes: (i) Standard deviations are in parenthesis. The investment rate is the current gross acquisition of fixed assets divided by one period lag of net fixed assets. (ii) The production ratio or value of capital (MPK) is defined as the current value of production (net sales minus inventories) divided by one period lag of net fixed assets. (iii) The cash flow ratio is defined as the one period lag of the ratio of cash flow to net fixed assets. (iv) 1990 is not included since a year of observations is lost when lagging net fixed assets. (v) Calculations were made with an unbalanced panel of firms. (vi) The group definition considered here is based on the interlocking of directorates.

Source: Own calculations with data from BMV and Infosel.

2.3. Econometric Techniques and Software

The models were estimated by the Generalized Method of Moments (GMM) of Hansen (1982), but using a system specification, where equations in levels and differences are jointly estimated, as suggested by Arellano and Bover (1995) for dynamic panel models. The econometric literature recognizes the existence of an endogeneity bias in the estimated coefficients when the

explanatory variables are simultaneously determined with the dependent variable or when there is a two-way causality relationship. This joint endogeneity calls for an instrumental variable procedure to obtain consistent estimates.

However, the use of weak instruments might result in biased estimators as well, as shown by Staiger and Stock (1997) and other authors. Therefore, a dynamic GMM technique is attractive since the panel nature of the data allows for the use of lagged values of the endogenous variables as instruments, as suggested by Arellano and Bond (1991). For this method to work it is necessary to assume that explanatory variables are weakly exogenous, that is, they are not correlated with future innovations of the dependent variable.

Furthermore, the panel data allow us to address the issue of firm specific components of the error term. In particular, such components are removed when taking first differences in the regression equation expressed in levels. Moreover, if the original error term is serially uncorrelated or follows a moving average process of finite order then, under weak exogeneity, lagged values of the dependent and explanatory variables in levels are valid instruments for the equation in differences. In other words, when the error term in the level equation is serially uncorrelated, then the equation in differences presents a first-order moving average error term; thus, endogenous variables lagged two or more periods are appropriate instruments.

According to Blundell and Bond (1998) the difference estimator has statistical problems when the dependent and explanatory variables are very persistent over time, in the sense that these variables are weak instruments for the equation in differences. In this scenario, the system estimator of Arellano and Bover (1995) can be implemented. An efficient GMM estimator can be achieved when lagged differences of the endogenous variables are used to instrument the equation in levels in combination with the level instruments suggested above for the equation in differences.

The GMM models were estimated using the Dynamic Panel Data routines (version 1.0) for the Ox Professional package (Version 2.2). The DPD software was written by Doornik, Arellano and Bond, and thus their statistical procedures replicate the results of Arellano and Bond (1991). Likewise, DPD was used interactively with GiveWin (Version 1.2), a menu-driven program.³

³ Ox Professional and GiveWin are distributed by Timberlake Consultants (<http://www.timberlake.co.uk>), and the DPD package is available for downloading at <http://www.nuff.ox.ac.uk/Users/Doornik/>.

3. Investment Behavior and Internal Capital Markets

Undoubtedly, the paralysis experienced by the Mexican financial system in the 1995-2000 period had consequences on the real side of the economy. In particular, it can be argued that investment decisions at the firm level were modified during this period. The aim of this section is to estimate two investment equation models where the influence of a change in financial structure is formally analyzed. As mentioned in the introduction, the Mexican economy was able to grow regardless of the financial paralysis in formal domestic markets; hence, financing for real investment—and production—had to be channeled through alternative mechanisms, such as the international capital markets or business groups' internal capital markets. Therefore, the role of asymmetric information in financial constraints and investment might have changed in a context of banking crisis and its aftermath.

In a scenario of financial collapse and total disruption of economic activity, a traditional investment equation can hardly be estimated. However, in the natural experiment offered by the recent Mexican experience, investment was in general positive during the years of financial paralysis, and especially during the steady recovery of the economy. Consequently, the econometric models will test for a sub-sample of the database whether asymmetric information conditions varied between the financial liberalization and paralysis periods.

The failure of many banking institutions and the implosion of the formal capital market might have caused a widening in the information gap between borrowers and lenders, aggravating this asymmetry. However, access to international capital markets and the rise of a network source of financing might have curtailed some of these information problems, at least for firms that are export oriented or belong to business groups. In summary, the purpose of this section is to provide empirical evidence on the nature of the financial constraints during the sampling period and on the positive role played by business groups in reducing financial bottlenecks.

For those firms that belong to a network it is common to find interlocking directorates, overlapping majority shareholders, and the presence of holding structures; hence, when financial resources move throughout the network's internal capital market, information flows more freely and agency costs are reduced. Consequently, because of a change in firms' financial structure from traditional liabilities to network financing, it might be expected that investment should be less sensitive to cash flow and collateral after 1994 in an environment where the real side of the

economy kept growing until 2000. In the database, the ratio of suppliers' credit to fixed assets increased from 0.226 to 0.336, as the economy moved from financial liberalization to financial paralysis. Given the typical network structure of Mexican firms, these averages reinforce the hypothesis that the financial relaxation would be due, at least to some extent, to the workings of internal capital markets.

Presumably, the availability of financial resources before the crisis was high enough to give some independence to the different affiliates of a business group. In fact, in Section 4 it is argued that these affiliates may be more efficient under stable market conditions, since this allows them to operate as autonomous profit centers, although this comes at the cost of facing more stringent financial constraints.

This section presents two models for analyzing investment behavior. First, a traditional model is estimated to test whether the significance of financial restrictions varies across different types of firms and over time. Second, a model of cross-financing is estimated to test whether in fact the weakening of financial bottlenecks observed at the firm level is explained by the presence of internal capital markets.

3.1. Methodology for Hypothesis Testing

The traditional way to analyze the asymmetric information theory of investment is to test whether investment in those firms a priori considered less affected by asymmetric information problems is indeed less sensitive to variations in cash flows. In this exercise, firms associated with networks are assumed to face weaker financial constraints due to the presence of an internal capital market. In addition, a smaller coefficient for the investment-cash stock (flow) relationship during the 1995-2000 period would be evidence of a relaxation of financial constraints for firms.

The investment equations to be estimated in this section are not explicitly derived from an Euler equation and mathematical microfoundations; that is, they do not come from the first order conditions of a manager's inter-temporal maximization problem taking into consideration a non-negativity constraint on dividends. However, the equation models presented here are, under certain assumptions and a first-order Taylor approximation, very close to other models derived under those conditions.⁴ As suggested above, the main hypothesis to be tested with the first

⁴ Supposedly, the estimations from an Euler equation represent a manager's rational investment decisions. However, it is still not clear that the typical characterization of the maximization problem is flawless. Is it true that decision-

model is that financial constraints may have been relaxed during the 1995-2000 period for large network firms. However, it is not possible to assume from the model whether this is so because of the existence of an internal capital market or because these firms have better access to foreign capital markets.

3.2. The Econometric Models

This section sets forth the regression equations to be used. The neoclassical microfoundation of the investment model is well known in the literature. Two recent references are Love (2000) and Laeven (2000). These authors present a model where firms face adjustment costs in fixed capital acquisition distributed over time and an imperfect capital market characterized by financial rationing. These two features justify the introduction of lagged values of investment and cash stock as independent variables.

Furthermore, as shown in Gilchrist and Himmelberg (1998), the marginal profitability of capital equals the ratio of sales to capital stock (up to a scalar parameter) under a Cobb-Douglas production function, and thus, a sales or production ratio can be used in the regression model to capture growth opportunities. This option is preferred to the use of Tobin's Q, since this variable is not available for all the sampled firms. Moreover, the adequacy of the latter variable is questionable because of the small turnover rate of most of the stocks in the Mexican market, which reduces the possibility of price efficiency.

3.2.1. The Traditional Model

Although a network structure is not assumed in the neoclassical investment literature, the econometric model estimated here is adjusted in that regard. Financial restrictions are captured alternatively through firms' cash flow or stock. Furthermore, dummy variables are used to estimate shifts in the investment-financial restriction link defined according to the nature of firms and periods.

making is made by professional managers taking care of fragmented shareholders? Does each firm perform as an autonomous profit center, irrespectively of the possible overlapping of majority shareholder in different firms? Is a firm's profitability the only concern of maximizing managers or are they also preoccupied by prestige and relative profitability? Is there a learning process and a myopic behavior in decision-making? These are just a few of the issues that deserve further exploration before discarding any econometric work not based on standard microfoundations. Consequently, in this paper it was preferred to follow a more modest approach by estimating an ad hoc regression equation, which, in any case, is conventionally used in the literature.

Investment behavior in a traditional model is given by:

$$\frac{I_{i,t}}{K_{i,t-1}} = \alpha + \beta_1 \frac{I_{i,t-1}}{K_{i,t-2}} + \beta_2 \frac{Y_{i,t}}{K_{i,t-1}} + \beta_3 \frac{Y_{i,t-1}}{K_{i,t-2}} + \beta_4 FR_{i,t-1} + \beta_5 DU_{i,t} FR_{i,t-1} + f_i + d_t + \mu_{i,t} \dots\dots\dots(1)$$

where $I_{i,t}$ is gross investment in fixed assets, $K_{i,t-1}$ is the stock of fixed assets at the beginning of the period, $Y_{i,t}$ is firm's production (or net sales), $FR_{i,t-1}$ indicates financial restrictions (or the lack there of) at the beginning of the period; f_i is the firm-fixed effects variable, d_t is the time-fixed effects variable, $\mu_{i,t}$ is the error term, and $DU_{i,t}$ is a dummy variable used to capture variations in the impact of financial restrictions for specific firm-year observations. In particular, $DU_{i,t}$ takes the value of one if the year-firm observation is a priori financially restricted and zero otherwise.

The financial restrictions variable ($FR_{i,t-1}$) introduced in the model is cash stock (or cash flow) that measures internal funds available to the firm, which in principle can be used for financing the firm's investment projects. This variable is considered at the beginning of the period because current year projects are financed with resources accumulated in previous years. Furthermore, it is normalized by the stock of fixed assets at the beginning of the period.⁵

In the model we use a time dummy variable to test whether 1995 was in fact a threshold year where financial structure changed; we also use dummy variables to sort the sample into independent and network firms, independent and bank-linked firms, and non-export and export-oriented firms. With these distinct variables, it is possible to analyze different implications of financial restrictions, depending on the time period and on the nature of the firm. Finally, the production (net sales) ratio is included as a proxy for the firm's expected marginal profitability of capital (MPK) and growth opportunities. The model uses current and lagged values of the production rate.

⁵ Some authors argue that cash flow measures investment opportunities rather than the availability of internal funds. On the other hand, the cash stock can be interpreted as the "cash on hand" to be used to finance firms' investment projects. Myers and Majluf (1984) present a theoretical justification in this regard.

Consequently, according to theory, the coefficients associated with cash stock and current production ratio should be positive; that is, investment should respond positively to the availability of internal funds and growth opportunities. However, the coefficient associated with the interaction term should be negative when the less financially constrained firm-year observations have a value of one for the dummy. In an analysis across firms, when the dummy variable specifies group membership (banking linkage or export orientation) and the sum of the two coefficients associated with cash stock is zero, then it can be asserted that the network structure (bank tie or international scope) removes the financial restrictions caused by asymmetric information.

In an analysis across periods, when the dummy has a time dimension and the sum of coefficients associated to the financial constraint variables is close to zero, then it can be argued that during the financial paralysis period the change in financial structure helped to overcome bottlenecks. Finally, the coefficient for lagged investment is expected to be positive but smaller than one, reflecting the inertia behind adjustment costs in the capital stock.

3.2.2. The Cross-Financing Model

The previous model suffers from an identification problem with respect to the ultimate facts that help reduce financial bottlenecks for network firms. Even if the empirical evidence shows that in the post-banking crisis years financial restrictions on investment were less severe, this might be exclusively associated with foreign investment inflows, and not necessarily with an increased use of financing through internal capital markets. Financing from abroad could also result from repatriated capital, which left the country when domestic investors panicked due to the peso and banking crisis.

Attending to this criticism, a second equation is formulated to incorporate explicitly the functioning of a network capital market. This equation is an extension of the models presented in Lamont (1997) and Shin and Park (1999). If, indeed, the lower cash-stock sensitivity of investment for member firms is explained by transfers within the network, then investment in associate firms should be positively related to the conglomerate's aggregate resources, and especially to those of cash-rich affiliates.

Undoubtedly, it is not an easy task to specify the nature of this cross-financing. In a very detailed model, it would be necessary to define a priori the channels used to transfer resources

within these networks. On the one hand, it might be useful to classify firms within the group into cash-rich and liquidity-constrained categories. On the other hand, it might be important to estimate the pool of funds that were in fact transferred to constrained firms, as well as the mechanism used for such a transfer.

As a first approximation of the problem, in the more simplified model estimated below, all member firms are considered constrained, and the sum of cash flow (stock) from all associate firms included in the database is assumed to be a potential source of funding. From this perspective a group’s cash stock is a cash pool that can be transferred toward investment projects in financially constrained firms. Moreover, this consolidated cash flow (stock) also works as a back-up in case the internally generated cash in each firm is not enough to service debt obligations. That is, the group’s cash might function as virtual collateral for member firms, increasing in that way the willingness of lenders to grant additional credit.

Investment behavior with cross-financing is given by:

$$\frac{I_{i,t}}{K_{i,t-1}} = \alpha + \beta_1 \frac{I_{i,t-1}}{K_{i,t-2}} + \beta_2 \frac{Y_{i,t}}{K_{i,t-1}} + \beta_3 \frac{Y_{i,t-1}}{K_{i,t-2}} + \beta_4 FR_{i,t-1} + \beta_5 AFR_{i,t-1} + f_1 + d_1 + \mu_{i,t} \dots\dots\dots(2)$$

where $AFR_{i,t-1}$ is the group level financial variable, which in this case is the pooled cash flow (or cash stock) for each group at the beginning of the period ($AFR_{i,t-1}=AFR_{k,t-1}$ if k and i belong to the same group and $AFR_{i,t-1}=0$ if the firm is classified as independent). Moreover, the pooled cash stock is also defined grouping all listed firms connected with the same banks.

Additional extensions to the model are implemented using dummy variables for time period, group membership, and banking linkage as in model (1), which allows building new interaction variables with both FR and AFR . Therefore, the influence of group membership (banking tie) on the investment-cash stock sensitivity for own and pooled resources, before and after the banking crisis, can be tested.

In conclusion, if the group’s pooled cash stock is empirically related to individual investment in member firms for the entire sample period, the model with cross-financing helps solve the stated identification problem, and thus, the existence of financial networks in the

Mexican economy is not rejected. This result would not imply that foreign sources of financing were not relevant for loosening up financial constraints during the paralysis period. It only provides evidence that large Mexican firms used their networks in the 1990s. Even more, it is possible that part of the private sector foreign financing might have been relocated through internal capital markets more intensively after 1994.

3.3. Estimation Results

Due to the panel nature of the database, models (1) and (2) were estimated by the Generalized Method of Moments (GMM), using the dynamic approach suggested by Arellano and Bover (1995). Thus, the explanatory variables are instrumented with their lagged values, either in levels or in differences. In particular, both models were estimated by the GMM system, where the level instruments for the difference equation present two, three and four lags, while the equation in levels presents only one lagged value for the instruments expressed in differences. Both models were estimated with a refined database. In particular, firm-year observations with a negative cash flow ratio were removed, together with those reporting a zero annual depreciation or an investment ratio below zero or above 0.75.⁶ Once these deletion criteria were applied, the database diminished from 1096 to only 499 or 383 observations, depending on whether cash stock or cash flow was used in the regressions. This drastic reduction was primarily caused by the influence of the 1995-96 crisis on some firms' financial health.⁷

3.3.1 Estimated Results for the Traditional Model

With regard to equation (1), the GMM estimation results presented in Table 2 have p-values that suggest absence of misspecification for the Sargan test of over-identifying restrictions, which tests the validity of instruments.⁸ Furthermore, it can be seen that there is no persistent serial correlation, and that only first order serial correlation is not rejected; hence, it can be stated that

6 The upper limit was set to exclude those firm-year observations where mergers and acquisitions might have taken place, and which cannot be explained with the traditional investment model. On the contrary, the lower limit refers to those firms where divestment in fixed assets is taking place. In the period of study, there were 28 cases of mergers and acquisitions for the firms included in the sample according to news found in different issues of the magazine *Expansión*.

7 It is important to recall that when more stringent deletion criteria are applied some additional observations are removed from the unbalanced panel when constructing GMM instruments.

8 It is important to recall that only the Sargan test based on the two-step GMM estimator is heteroskedasticity-consistent, as pointed out by Arellano and Bond (1991).

the models are properly specified. Results shown in Table 2 come from the one-step estimation, which yields reliable standard errors. All models were run with the one-year lagged cash flow ratio and the one-year lagged cash stock ratio as proxies for the financial restriction variable, however, the latter ratio showed a better fit according to the estimated coefficients' p-values. Therefore, only estimations with cash stock are presented. Yet, as a form of comparison, column (5) estimates equation (1) as in column (2), but using the cash flow ratio instead.

In the model presented in column (1) the dummy in the interaction term has a time dimension, which makes a dynamic interpretation possible. Notice that all the coefficients are statistically significant and the signs are as suggested by the hypotheses stated above. The main result from this estimation is that not only did the 1995 banking crisis not exacerbate financial constraints for the average firm listed on the BMV, but also that these constraints were removed by the change in financial structure as suggested by the Wald test. Thus, this test does not reject the proposition that during the 1995-2000 period there is no relation between cash stock and investment. As will be explained in more detail in Section Four, this paradoxical result can be explained by the existence of an internal capital market. In that section, it is argued that control rights exerted by the parent company or surplus affiliates diminish conflicts of interest in a lender-borrower relationship, and hence in a network structure information asymmetries are less stringent. Accordingly, the investment-cash stock sensitivity might have been reduced because listed firms decided to use more actively their internal capital market since 1995.

In order to provide a more rigorous test for this statement, the model is reformulated in column (2) by allowing the interaction term of the financial restriction to vary across time and across firms. Notice that, indeed, group membership made a difference before 1995 since this type of firms did not seem to be financially constrained according to the Wald test. However, similar Wald tests show that financial bottlenecks were removed for both types of firms, member and non-member, once the banking crisis hit the economy.⁹ These striking econometric results

⁹ When the model in column (2) is run using the complete database, all firms before 1995 were financially constrained; moreover, the point estimation for independent firms' cash stock coefficient was higher than one (3.455), that is, an increased cash stock had a multiplying effect. Presumably, firms in financial distress decided to reduce their operations and sell physical assets, either because cash was needed to finance working capital and financial obligations or because it was simply decided to reduce the profile and size of the company. The multiplying effect in this case implies that the reduction of one peso in cash stock is associated with a divestment larger than one. This can be caused by the lumpiness of fixed assets, and thus, owners are forced to sell assets with a value higher than the financial needs. More generally, a firm may decide to sell sizable physical assets and reduce operations, perhaps induced by the need to liquidate outstanding debt.

are robust with the earlier finding that the domestic financial collapse did not paralyze large Mexican firms' investment. Nevertheless, these results do not directly support the theory that internal capital markets were used more actively since 1995. Perhaps, the observed change in financial structure is explained by the fact that many firms had the opportunity to tap international financial markets due to the rapid increase in manufacturing exports.

If the latter statement is true, it may be expected that export firms were capable of overcoming the negative effects of the financial paralysis. Furthermore, once fresh capital entered the economy, the internal capital market of business groups helped redistribute financial resources which, in turn, diminished financial constraints even in non-exporting firms affiliated with groups. This type of analysis is presented in column (3), where the financial constraint is interacted with an export-orientation dummy variable. Contrary to a priori expectations, export orientation increased investment-cash stock sensitivity before 1995. Nonetheless, once domestic financial markets were paralyzed, export and non-exporting firms did not present financial constraints according to their respective Wald tests. That is, although not explicitly tested, it is plausible that listed firms do not exhibit financial bottlenecks in the 1995-2000 period either because they obtained foreign funding directly in international capital markets or because they received financial resources from their linkages with firms that issued bonds or equity abroad. However, the fact that before 1995 export orientation is not connected with foreign financing, and hence with lower financial constraints, is consistent with the suggestion of not having very active internal capital markets in that particular period. Another explanation could be that cash-rich firms within a group, presumably export firms, used to "subsidize" non-export firms in times of limited foreign financing. This scenario reduces the investment sensitivity to cash stock for non-export firms as long as both types of firms belong to the same business group, but not for the export firms that had to rely on their own cash stock.

The importance of membership before the crisis is also evident in column (4), where banking linkages are used as the grouping criteria. Although a policy of financial liberalization was implemented during this sampling period, firms linked to banks through interlocking directorates resulted much less financially constrained than "independent" firms. Additionally, the sum of the corresponding coefficients was not statistically different from zero according to the Wald test. Moreover, additional Wald tests show that this situation was reversed for the 1995-2000 period. While "independent" firms did not have to rely any longer on retained

earnings for their investment projects, bank-linked firms maintained a certain dependence on cash stock since the point estimate of 0.137 was statistically different from zero. These econometric results are in line with the presumption that the banking crisis harmed the financial health of firms with banking ties. As opposed to firms without bank ties, where financial constraints were removed in 1995 onwards by taking advantage of international financing, firms with banking ties had to rely more on internal resources. A tentative explanation is that for the latter firms the access to international financing was somewhat limited, since the market took into consideration the troublesome banking connection.

As noted above, column (5) shows the corresponding estimations when the cash flow ratio is used instead of the cash stock ratio. Despite that three individual coefficients are not statistically different from zero in this regression, the Wald tests offer very similar conclusions to those in column (2). Again, group membership removes financial bottlenecks during the financial liberalization period, and all listed firms included in the sample are not financially constrained during the financial paralysis period.

In summary, group membership and banking ties were important to reduce financial constraints before the beginning of the banking and currency crises. Afterwards, these constraints were on average fully removed for all types of listed Mexican firms (exporting, non-exporting, affiliated, independent) but for firms with banking ties, where the investment-cash stock sensitivity became positive and statistically different from zero. As a tentative explanation, it is suggested that large Mexican firms were able to tap international capital market during the 1995-2000 period as long as they were financially sound. It is possible that in addition active internal capital markets moved resources from export to non-export firms, although no econometric evidence is presented here to support this possibility.

**Table 2. Estimation Results for the Traditional Investment Equation
with Financial Constraints**
(Dependent variable: gross investment to lagged net fixed assets ratio)

Variables:	(1) GMM system	(2) GMM system	(3) GMM system	(4) GMM system	(5) GMM system
Lagged investment rate	0.167 (0.024)	0.187 (0.028)	0.132 (0.094)	0.162 (0.042)	0.062 (0.469)
Production ratio	0.021 (0.010)	0.020 (0.002)	0.020 (0.015)	0.013 (0.063)	0.020 (0.011)
Lagged production ratio	-0.017 (0.027)	-0.014 (0.014)	-0.016 (0.038)	-0.009 (0.163)	-0.014 (0.025)
Lagged cash stock (flow) ratio (β1)	0.295 (0.004)	0.325 (0.080)	0.317 (0.003)	0.339 (0.013)	0.885 (0.038)
Time*lagged cash stock (flow) ratio (β2)	-0.272 (0.007)	-0.308 (0.099)	-0.294 (0.005)	-0.327 (0.017)	-0.862 (0.036)
Group* lagged cash stock (flow) ratio (β3)		-0.343 (0.093)			-0.626 (0.207)
Time* group*lagged cash stock (flow) ratio (β4)		0.405 (0.032)			0.517 (0.289)
Export * lagged cash stock ratio (β3)			0.509 (0.000)		
Time* export *lagged cash stock (flow) ratio (β4)			-0.390 (0.012)		
Bank tie * lagged cash stock ratio (β3)				-0.307 (0.053)	
Time* bank tie *lagged cash stock ratio (β4)				0.432 (0.008)	
Constant	0.112 (0.000)	0.164 (0.000)	0.113 (0.000)	0.153 (0.000)	0.140 (0.000)
No. observations	499	499	499	499	383
No. firms	120	120	120	120	97
Wald-tests (P-value)					
Joint (Chi ²)	(0.000)	(0.002)	(0.000)	(0.000)	(0.010)
Specification tests (P-values)					
Sargan test (Chi ²)	(0.815)	(0.999)	(1.000)	(1.000)	(1.000)
Serial correlation					
First order	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Second order	(0.316)	(0.487)	(0.305)	(0.523)	(0.893)
Third order	(0.898)	(0.449)	(0.814)	(0.460)	(0.949)
Wald test Linear restrictions (P-values)	H₀: β1+β2=0 (0.291)	H₀: β1+β2=0 (0.291) H₀: β1+β3=0 (0.915) H₀: β1+β2+β3+β4=0 (0.332)	H₀: β1+β2=0 (0.287) H₀: β1+β3=0 (0.000) H₀: β1+β2+β3+β4=0 (0.125)	H₀: β1+β2=0 (0.260) H₀: β1+β3=0 (0.809) H₀: β1+β2+β3+β4=0 (0.002)	H₀: β1+β2=0 (0.784) H₀: β1+β3=0 (0.223) H₀: β1+β2+β3+β4=0 (0.159)

Note 1: Numerical results come from the one-step covariance estimators, except the p-value of the Sargan test that corresponds to second-step estimates. Heteroskedasticity-corrected standard deviations are used to calculate the p-values presented in parenthesis. All models use the cash stock ratio but the model in column (5), which uses the cash flow ratio instead. Time fixed effects (not shown) were estimated when most coefficients were significant, as in column (2) and (4).

Note 2: Instruments for the difference equation (the instruments are included if the variable is present in the model equations) Level instruments: all variables dated (t-2,t-4), Instruments for the level equation: Dummies, Instruments in differences: All variables dated (t-1).

Note 3: Series period: 1993-2000, Longest time series: 8, Shortest time series: 1.

3.3.2 Estimated Results for the Cross-Financing Model

The significance of the interaction term with the group dummy in the first half of the 1990s only implies that firms with a network structure were less financially constrained. It is not possible to tell whether this result is explained by the existence of an internal capital market or because of the fact that those firms had better access to foreign financing sources. Therefore, a more detailed analysis of the workings of internal capital markets is needed to offer a definite answer.

With that purpose in mind, Table 3 presents the GMM-system estimation results for investment equation (2). The model's new feature is the introduction of the pooled cash stock (or flow) for each group –lagged one period-, as a proxy for the influence of the internal capital market on the member firms' investment. In the case of columns (1), (2), (4), and (6) pooled cash stock (or flow) is standardized with the sum of the pooled firms' capital stock at the beginning of the period. In columns (3) and (5), the sum of pooled cash stock is standardized with the firm's own capital stock at the beginning of the period. This last specification assumes that the pool of financial resources available in the internal capital market should have more influence on the firm's investment when that pool is larger relative to the size of the firm's physical assets.

Notice that the six sets of estimations presented in Table 3 are well specified according to the Sargan and autocorrelation tests, where again only first order serial correlation is not rejected. Moreover, most coefficients have the expected sign for the variables considered in the previous equation model (lagged investment, production, and the financial constraint variable introduced by itself and interacted with the time dummy, the group dummy, and the time-group dummy). Also in this model, the regressions with cash stock had the best fit in terms of p-values for the individual coefficients and the joint significance of the model. In fact, as can be seen from column (6), most of the non-expected signs are present when cash flow is used; moreover, all but two coefficients in this column are not statistically different from zero.

The coefficient's sign for the pooled cash stock variable is positive, as expected from theory, in four out of six columns. Likewise, in half of the regressions it is also statistically significant in the one-step estimation. Thus, the cash stock of associated firms spurred investment for the average member firm during the financial liberalization period. In other words, this model presents empirical evidence that validates the hypothesis of financial relaxation in network firms due to the workings of an internal capital market.

The only difference between columns (1) and (2) is the lagged investment ratio variable, which was not statistically significant in the first regression and then removed in the second regression equation. Once this is done, the coefficient for cross-financing is positive and statistically significant for the financial liberalization period. Although the individual coefficient for the pooled-cash stock variable interacted with time is not statistically significant, the corresponding Wald test indicates that pooled-cash stock for the 1995-2000 period is not a relevant variable. In other words, data do not show econometric evidence of a working internal capital market for the financial paralysis period. Moreover, the remaining Wald tests provide similar conclusions to those found when estimating equation model (1).

In column (3), when the criteria for the standardization of cash stock is modified, similar results are reached, as can be seen from the Wald tests. Thus, there is econometric evidence of an internal capital market operating in the first half of the 1990s, not only because member firms are less financially constrained than independent firms, but also because firms' individual investment rate is positively related to pooled cash stock. Once more, this relation disappears during the financial paralysis period. In columns (4) and (5) cross-financing is theoretically associated with firms' banking linkages for both standardization criteria. Only in the first of these regression equations is there evidence of a working internal capital market for the financial liberalization period. Furthermore, as in the previous regressions, the Wald test rejects the existence of this form of cross-financing for the financial paralysis period. Notice also that in the latter period, firms with bank ties show a positive and statistically significant investment-cash stock sensitivity, as was previously found in the estimations for equation model (1).

It is striking that large "independent" firms not linked to a bank do not show financial constraints once the Mexican banks collapsed and financing through the domestic capital market came practically to a halt. However, results presented here seem to be very robust, since the same story holds either when the time dummy variable is interacted with cash stock or with pooled cash stock. It is important to emphasize that these findings do not indicate that the internal capital market ceased to exist during the crisis years. As mentioned in the previous section, it is possible that exporting firms were issuing international bonds in order to finance their own investment as well as other firms' investments within the same group. Even if this feature is true, it does not necessarily have to appear in the econometrics since yearly data, and one-year lagged cash stock, might not be capturing a very dynamic internal market.

A plausible explanation could be as follows. The opportunity cost of money was relatively low during the financial liberalization period; hence, large and healthy firms were willing to hoard cash in their treasuries even for one-year periods before using it to cross-finance firms within an internal capital market. However, money became relatively expensive once the banking crisis emerged. From this moment onwards, firms did not accumulate cash and instead they decided to use idle resources to pay back debt. Furthermore, many of these firms had obtained access to international capital markets by 1995, thus they preferred to use this cheaper source of financing as their working and fixed capital. Therefore, pooled funds in this period came from retained earnings and from foreign sources. Consequently, internal capital markets were more active in terms of their volume of operations, and more efficient in terms of their speed in channeling resources from one firm to another.

All in all, regression results show only that there was a change in the financial structure in 1995 in comparison with the financial liberalization period, and that this change was not in favor of more internal financing but less. Such finding is consistent with the swift macroeconomic recovery of the Mexican economy since 1996. However, the source of the firms' liquidity remains an open question. Four alternatives seem feasible: international capital markets, internal capital markets, suppliers' credit, or a combination of strategies. The fact that there is evidence that internal capital markets operated before the crisis and that even non-exporting firms were not financially constrained after the crisis makes a strong case in favor of the dynamic internal capital market story. Nonetheless, further research is needed with a more detailed data set to provide sound econometric evidence.

Table 3. Estimation Results for an Investment Equation with Cross-Financing (GMM-system, one-step estimation)

Dependent variable: gross investment to lagged net fixed ratio

Variables:	(1)	(2)	(3)	(4)	(5)	(6)
	Standard- -ization: pooled fixed assets	Standard- -ization: pooled fixed assets	Standard- -ization: own fixed assets	Standard- -ization: pooled fixed assets	Standard- -ization: own fixed assets	Standard- -ization: pooled fixed assets
Lagged investment rate	-0.044 (0.711)		0.153 (0.037)	0.015 (0.864)	0.129 (0.088)	-0.080 (0.487)
Production ratio	0.032 (0.000)	0.009 (0.031)	0.021 (0.002)	0.018 (0.053)	0.011 (0.027)	0.029 (0.115)
Lagged production ratio	-0.029 (0.000)	-0.001 (0.000)	-0.017 (0.006)	-0.015 (0.137)	-0.006 (0.316)	-0.025 (0.153)
Lagged cash stock (flow) ratio (β1)	0.453 (0.001)	0.465 (0.006)	0.638 (0.000)	1.521 (0.072)	0.342 (0.008)	0.003 (0.984)

Table 3, continued

Variables:	(1)	(2)	(3)	(4)	(5)	(6)
	Standard -ization: pooled fixed assets	Standard -ization: pooled fixed assets	Standard- -ization: own fixed assets	Standard -ization: pooled fixed assets	Standard- -ization: own fixed assets	Standard- -ization: pooled fixed assets
Group* lagged cash stock (flow) ratio (β3)	-0.620 (0.000)	-0.571 (0.000)	-0.373 (0.078)			0.003 (0.984)
Time* group*lagged cash stock (flow) ratio (β4)	0.529 (0.079)	0.749 (0.000)	0.444 (0.021)			-0.019 (0.888)
Lagged pooled-cash stock (flow) ratio by group (β5)	-0.001 (0.959)	0.015 (0.000)	0.002 (0.103)			0.215 (0.334)
Time * lagged pooled-cash stock (flow) ratio by group (β6)	-0.009 (0.531)	0.004 (0.907)	-0.003 (0.052)			-0.448 (0.091)
Bank* lagged cash stock ratio (β3)				-1.627 (0.045)	-0.310 (0.068)	
Time* bank *lagged cash stock ratio (β4)				1.027 (0.195)	0.415 (0.018)	
Lagged pooled-cash stock ratio by banking tie (β5)				0.129 (0.007)	-0.000 (0.658)	
Time * lagged pooled-cash stock ratio by banking tie (β6)				-0.176 (0.000)	0.000 (0.935)	
Constant	0.241 (0.000)	0.212 (0.000)	0.104 (0.000)	0.131 (0.000)	0.160 (0.000)	0.201 (0.000)
No. observations	287	417	498	322	499	235
No. firms	75	100	120	87	120	63
Walt-tests (P-value)						
Joint (Chi ²)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(1.000)
Specification tests (P-values)						
Sargan test:	(1.000)	(1.000)	(1.000)	(1.000)	(1.000)	(1.000)
Serial correlation						
First order	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Second order	(0.512)	(0.387)	(0.311)	(0.730)	(0.613)	(0.892)
Third order	(0.548)	(0.864)	(0.648)	(0.783)	(0.450)	(0.916)
Wald test Linear restriction (P-value)	Ho: β1+β2=0 (0.574) Ho: β1+β3=0 (0.252) Ho: β1+β2+ β3+β4=0 (0.177) Ho: β5+β6=0 (0.474)	Ho: β1+β2=0 (0.533) Ho: β1+β3=0 (0.310) Ho: β1+β2+ β3+β4=0 (0.206) Ho: β5+β6=0 (0.595)	Ho: β1+β2=0 (0.272) Ho: β1+β3=0 (0.052) Ho: β1+β2+ β3+β4=0 (0.300) Ho: β5+β6=0 (0.803)	Ho: β1+β2=0 (0.102) Ho: β1+β3=0 (0.449) Ho: β1+β2+ β3+β4=0 (0.000) Ho: β5+β6=0 (0.276)	Ho: β1+β2=0 (0.292) Ho: β1+β3=0 (0.825) Ho: β1+β2+ β3+β4=0 (0.000) Ho: β5+β6=0 (0.203)	Ho: β1+β2=0 (0.392) Ho: β1+β3=0 (0.984) Ho: β1+β2+ β3+β4=0 (0.393) Ho: β5+β6=0 (0.002)

Note 1: Numerical results come from the one-step covariance estimators, except the p-value of the Sargan test that corresponds to second-step estimates. Heteroskedasticity-orrected standard deviations are used to calculate the p-values presented in parenthesis. All models use the cash stock ratio but the model in column (6) which uses the cash flow ratio instead. Time fixed effects (not shown) were estimated when most coefficients were significant, as in column (1), (2) and (5). Note 2: Instruments for the difference equation (the instruments are included if the variable is present in the model equations) Level instruments: all variables dated (t-2,t-4), Instruments for the level equation: Level instruments; dummies
Instruments in differences: All variables dated (t-1).
Note 3: Series period: 1993-2000, Longest time series: 8, Shortest time series: 1.

4. The Mexican Paradox

A main result from the previous econometric analysis is that liquidity constraints were relaxed for many large firms listed on the Mexican Securities Market after 1994, when the domestic financial system was paralyzed. The purpose of this section is to offer an intuitive explanation about the possible connections between this result and Mexico's macroeconomic situation from 1995 to 2000, characterized by a process of steady output growth.

It is argued that such an economic expansion, in a setting of banking crisis and financial disarray, requires a supply-side explanation. An intuitive microfoundation is provided, where weaker financial constraints are related to the moral hazard literature, and to the difference between arms-length transactions in financial markets and network operations, where the latter are distinguished by having a tighter control rights structure.¹⁰

4.1. The Macroeconomic Context

In the second half of the nineties, the Mexican economy experienced a severe financial crisis. After a badly managed financial liberalization and a disruptive overshooting in the exchange rate, many banks became bankrupt during 1995 and 1996, and the entire banking community was overburdened by massive defaults on loans. In the first two years of the financial crisis, the Mexican government implemented a wide variety of bailing-out programs, which entailed heavy fiscal costs. Despite these efforts, the high ratio of non-performing loans to outstanding debt created extreme liquidity problems and new lending was practically interrupted. In the first year of the crisis, aggregate demand sharply contracted and the annual GDP growth rate fell to -10 percent by mid-1995.

The depressed demand levels in non-tradable activities and the financial distress experienced by most non-financial firms, contributed to the paralysis of the Mexican financial system. Over the years, external sources of financing were sharply reduced, at least through the traditional channels of banking, money, and capital markets. Real outstanding debt granted by commercial banks to the non-financial private sector diminished by 72 percent between 1995 and the first semester of 2000. Likewise, the net flow of financing channeled through the Mexican

¹⁰ It is beyond the reach of the paper to empirically test the moral hazard theory stated in this section. The theoretical argument is simply laid out to give an explanation of some of the coefficient signs in the investment equation, which at the same time is consistent with the macroeconomic stylized facts presented here.

securities market fell from an annual average of US\$6.23 billion in 1991-1994, to US\$1.96 billion in 1996-1999, as described by Castañeda (2001a) in greater detail.

However, as the initial panic came to an end, the Mexican economy started to show promising signals of recovery. Not only did the economy rebound within a year, but it also grew steadily afterwards, averaging an annual rate slightly above 5 percent during 1996-2000. Moreover, other macroeconomic indicators improved: internal savings as a share of GDP increased from 14.7 percent in 1994 to 20.3 percent in 1999; the current account deficit was reduced from 7 percent of GDP in 1994 to 2.9 percent in 1999; inflation was curtailed from 52 percent in 1995 to less than 10 percent in 2000. From the demand side, the main engine of this non-inflationary growth was undoubtedly the export sector, which increased at impressive rates after trade liberalization. In addition, the positive effect of the rapid growth in exports was reinforced by the swift recovery of fixed investment.

The ratio of exports to GDP rose from 15.2 percent in 1993 to 32.7 percent in 1999. Nowadays, Mexico is the eighth largest exporter in the world and the second trading partner of the United States. The tradable sector was important to spur growth, not only because of the dynamism of the export demand, but also because fixed investment in this sector was heavily stimulated. The strength of fixed investment was increased by the initial sharp real depreciation, which drastically decreased the amount of US dollars paid per man/hour in 1995. While the annual average rate of export growth between 1996 and 1999 was close to 13 percent, fixed investment grew on average one percentage point higher.¹¹ Moreover, the recovery was spread to non-tradable activities and, as soon as 1997, the economy was experiencing the highest growth in two decades. Hence, the macroeconomic upturn is a striking phenomenon that deserves further explanation.

A plain export-led-growth argument does not seem to capture the whole story in a context of financial disarray. It is not enough to argue that demand side multiplier effects were able to pull the rest of the economy. Such an outstanding performance in the real sector cannot be possible without financial flows moving from the booming exporting sector to the non-tradable sector. Exporting firms, besides being the best candidates to obtain domestic financing, have

¹¹ Lederman, Méndez, Perry and Stiglitz (2000) show evidence that aggregate investment in Mexico during 1980-1999 was linked to the performance of the tradable sector. These authors find that the multiplier effect of the tradable output on growth of fixed investment is two times larger than the multiplier effect of the non-tradable output.

issued bonds and equity in international markets, supported by their dollar-denominated income flows.

Several analysts, like Lederman, Méndez, Perry and Stiglitz (2000) and Krueger and Tornell (1999), have argued that access to U.S. financial markets by Mexican firms producing tradable goods is a key factor in explaining the recovery after 1995. In the former study, it is shown that aggregate investment reacted during this period to US real interest rates. However, sustained aggregate growth required also that the surplus cash flow of booming firms be channeled to the rest of the economy. In other words, an increased demand for non-tradable goods could be met only if financing was available to the producer. In fact, data show a swift recovery of domestic sales of durable and non-durable goods during the period, creating not only a demand for working capital financing but for capital spending as well.

According to a survey of 500 firms carried out by Mexico's central bank for the 1998-2001 period, nowadays the financial structure of Mexican firms relies more on trade credit from suppliers, than on bank credit or any other source of external financing.¹² Consequently, a change in financial structure might well be an important ingredient in explaining a recovery.

It is well known that trade credit is commonly observed in countries when there are important asymmetric information problems that hamper the functioning of external capital markets. Biais and Gollier (1997), and Petersen and Rajan (1997) present a formal explanation of trade credit based on adverse selection considerations. However, trade credit is not the only missing link in the export-led-growth theory. In this paper, it is argued that the existence of business groups contributed to the formation of a strong internal capital market, thus making the speedy recovery of the Mexican economy possible.¹³

As in many developing economies, Mexico's industrial structure is characterized by networks of firms tightly controlled by closed groups of owners, usually members of the same

12 Some interesting findings from this survey are the following. (i) Suppliers' credit has been very large during 1998-2001, representing from 40 percent to 50 percent of total financing. (ii) Credit granted by commercial banks has been less than half the credit provided by suppliers since 1999. (iii) Credit from parent companies or some other companies in the group oscillated around 15 percent in the four years of the sample. (iv) Suppliers' credit is larger for non-exporting firms; for instance, it was 54.7% for non-exporting firms in 1999/I, which is eight points above the percentage observed among exporting firms. (v) The importance of suppliers' credit varies inversely with the size of the firm; for instance, 57.7 percent of the funding is for the smallest firms and 22.2 percent for the largest in 1999/I. (vi) Size is also a key determinant for having access to funds from foreign banks: the largest firms obtained 29.6 percent of their credit from this source in 1999/I, which is much larger than the 2.3 percent obtained by small firms. (vii) About 60percent of the surveyed firms have not received any bank credit in the last four years.

family. These business groups tend to be vertically integrated and widely diversified, as shown by Khanna (2000). This author analyzes the two sides of the debate on the presence of business groups in an economy: either groups substitute for missing outside institutions, and have positive implications for society at large, or produce exploitation and rent seeking by majority shareholders.¹⁴

Because of the lack of a well-functioning capital market, perhaps due to institutional links with the social and corporate governance arena, manager/owners prefer to set up large conglomerates, which tend to stabilize aggregate profits.¹⁵ Moreover, the largest shareholders of these networks typically own a financial group and/or a bank, which allows them to avoid being rationed out from the use of scarce savings.

In the empirical literature on unrelated business diversification of U.S. conglomerates, summarized in Lang and Stultz (1993) and Montgomery (1994), it is shown that the performance of affiliated firms (or divisions) is poorer than the one observed in independent firms in the same industries. However, there are theoretical reasons to expect an inverted relationship in emerging markets, as suggested by Khanna and Palepu (1997). The absence of intermediaries, the limited protection offered by property rights, and the weak enforcement of law, create large agency costs that handicap the functioning of a formal capital market. Thus, according to Leff (1976), and Khanna and Palepu (1998), firms are encouraged to build networks where an internal capital market arises. Through this internal market, groups diversified across unrelated business activities smooth out income flows, overcoming financial constraints for some of their affiliates.

The above argument suggests that, in the case of Mexico, business groups structure might have contributed to the economy's recovery, especially in cash-constrained firms with no direct access to international capital markets. The banking system's collapse, and the interruption of financing flows through the domestic financial system, was overcome by a change in the firms' capital structure. Many firms became more dependent on trade credit, and the business groups' internal capital markets created a financial cushion that kept the economy working. Through this internal capital market, cash-rich firms were able to channel cash flow to liquidity-constrained

13 Shin and Park (1999) show econometric results that do not reject the existence of an internal capital market for the Korean business groups known as "chaebols."

¹⁴ For a description of Mexican groups see Castañeda (1998,1999).

¹⁵ See Aoki (2001).

network affiliates. Obviously, in this setting, firms belonging to a business network, or those supplying to exporting firms, have better chances of surviving.

4.2. An Intuitive Story for Solving the Paradox

A tentative explanation for some of this paper's econometric results is that internal capital markets became very dynamic in Mexico after traditional financing was interrupted.¹⁶ This interpretation is consistent not only with the lack of sensitivity of investment to cash stock after 1994, but also with the fact that aggregate production was not permanently halted due to a lack of bank financing during the financial paralysis period. Thus, it is argued that resources coming from foreign sales, international issues of financial assets, repatriation of capital flight, and proceeds from the bailing-out of bank debts and the sales of companies were allocated through internal capital markets.

At the beginning of the crisis, the depressed aggregate demand levels caused a severe moral hazard problem. Thus, individuals decided to stop investing through external markets in firms with a bleak perspective, mainly oriented to the domestic economy. At the same time, investors increased their lending to booming firms, which were mainly in the exporting sector. These firms not only used the financial resources for their productive activities but also to offer some financing themselves. The recipients of credit were bank-rationed firms that were financially sound and had network connections with the lender.

Consequently, cash-rich firms started to offer trade and direct credit to affiliates even in non-exporting sectors of the economy; this allowed the former firms to obtain valuable inputs for their regular production but also to make additional profits out of financial activities. External investors were aware of the existence of internal capital markets, yet they willingly lent money because the business group structure guaranteed the expected return. That is, parent firms reduced the opportunistic behavior of borrowing firms, and hence the initial moral hazard problem was attenuated.

This story is a possible explanation of why, in a context of financial disruption, certain sectors did not enter into a severe recession, and why the demand spill-over from a booming sector led to higher output despite the presence of a banking crisis. The essence of the

¹⁶ For an overview of the efficiency of internal capital markets and the nature of their agency costs, see Gertner, Scharfstein and Stein (1994) and Scharfstein and Stein (1997).

microeconomic argument is that although a firm's expected production may reach certain low level, investors may still have an incentive to keep lending to that firm as long as they can have certain control on the borrower's decisions, as is the case in network transactions. The previous argument is presented formally in Castañeda (2001b).

It is important to clarify two key elements in this line of reasoning: firstly, the nature of the affiliates' choice of financial structure before the crisis, and secondly, the incentives of outside investors to provide funding despite the diversion of resources through internal capital markets. With regard to the first element, in this story it is assumed that, under stable market conditions, network firms might select a rather loose governance structure to increase market pressure on divisions.

The latter strategy reduces transaction costs presented in large conglomerates with long hierarchies and centralized decision-making. Under a loose structure, affiliates operate as profit centers, with a large degree of leeway, in particular on financing issues. At the same time they endure the financial cost of being partially rationed in credit markets. In other words, affiliates under an autonomous structure not only need to rely more on their internal cash flow but they are also precluded from using extensively cross-financing with other network firms. For this to be a rational decision, it has to be the case that the benefit from the low transaction costs more than offsets the financial cost of being cash-constrained. Hence, in an investment equation model this strategy might produce certain sensitivity of investment to cash-stock, irrespectively of whether the economy is experiencing financial liberalization.

It can be assumed that as the economy entered into a more uncertain environment in 1995, the relative importance of these two costs was reversed. In the new macroeconomic scenario, network firms were more interested in coping with financial constraints, in spite of experiencing a loss in efficiency due to the introduction of a tight decision-making process. Under this setting, the cash-stock coefficient of an investment equation will tend to be close to zero, given the cross-financing taking place among the network's affiliates, irrespectively of whether there is a paralysis in external markets.

With respect to lending incentives, outside investors are aware that they do not have control rights in an arms-length relationship with the borrowing firm. Therefore, only under appropriate market conditions will they be willing to offer credit, namely only when the borrowing firm has the incentive to pay back the loan. However, even if this condition is not

present for certain firms, outsiders may still be willing to lend if a third party can guarantee repayment.

When the third party belongs to a network and has controlling rights in the cash-constrained affiliate firm, such as in the case of a parent company, outsiders' money might come in. On the one hand, the control exerted on the affiliate by the third party is possible in a business network where cross-shareholdings and interlocking of directorates prevail. On the other hand, when experiencing a high demand for its product, the third party has an incentive to pay back the borrowed funds, included those that were diverted through the internal capital market. In this fashion, the initial moral hazard problem of an arms-length transaction with a fragile borrower is removed by combining an arms-length transaction involving a cash-rich borrower, with a network transaction between such a borrower and a cash-constrained associate.

Although this story is obviously only a caricature of the Mexican experience, it brings together five important stylized facts of the country's recent macroeconomic paradox: (1) a drastic reduction in financing through domestic credit markets, in the context of a currency and banking crisis; (2) a booming foreign market that expands the demand for goods produced by some large firms; (3) international issues of financial assets by export firms; (4) increased relevance of suppliers' credit and internal capital markets; and (5) the rapid recovery of the Mexican economy since 1996, including the non-tradable sector. It is important to emphasize that this theory is not tested through the econometric models presented in the previous sections. It only offers a microfoundation that helps to explain some of the estimated results.

5. Conclusions

The econometric results presented in this paper coincide with previous findings in the literature that support the view that investment behavior is conditioned by the presence of asymmetric information in financial markets. In particular, the estimations for the 1993-1994 period are consistent with those studies in which the firm's liquidity is defined by whether or not it belongs to a business network. Firms listed on the Mexican Securities Market were classified as either "independent" or "associated" with extended business groups, as the available data allowed. The latter definition corresponds to those firms with at least two board members sitting in the board of at least one other firm.

The main results derived from the two regression models of the paper are the following: (i) independent firms' investment was limited by liquidity constraints only during the financial liberalization period; (ii) there was no statistical connection between cash stock and firms' investment during the financial paralysis period (1995-2000), either for independent or network firms; (iii) healthy firms with banking ties were not financially constrained during the financial liberalization period, yet the situation was reversed in 1995; (iv) pooled cash stock was a determinant of network firms' individual investment rate only in the early period of the sample; and (v) investment by export oriented firms exhibited a larger cash stock sensitivity than non-exporting firms during financial liberalization, but such relationship was statistically close to zero during financial paralysis for both types of firms.

In the analysis across firms, results (i) and (iv) suggest the existence of an internal capital market within each business group, where affiliate firms, despite being rationed out from the external capital market, can still have access to liquidity through the use of cross-financing. These resources are either a direct source of financing or they work like shared collateral, which allows cash-constrained members to get better credit conditions from external markets. Moreover, result (iii) indicates that the market when assigning financial resources discounted the connection between firms and troubled banks after the banking crisis of 1995. Finally, if the treasuries of export oriented firms are used to cross-finance non-exporting but affiliated firms, a preliminary explanation can also be offered for the unexpected result (v). The previous reasoning is valid in a context of limited access to foreign financing, which indeed was the case even for export-oriented firms in the first half of the 1990s.

In the analysis across periods, result (ii) shows, somehow paradoxically, that the banking paralysis was not a period of severe financial bottleneck, at least for listed and non-distressed firms. Supposedly, alternative means of financing, such as suppliers' credit, were used more intensively after 1994. That is, the finding is consistent with the presence of internal capital markets where borrowers and lenders have intertwined control rights; however, this explanation is not thoroughly validated by the econometrics presented here. Theoretically, the empirical evidence can be rationalized by a change in incentives once stable market conditions disappeared in 1995. Presumably, from this year to 2000, firms might have preferred to deal with the transactions costs of having a large hierarchical organization rather than being financially

constrained. This feature allowed moving from cash-constrained firms organized as autonomous profit centers to tightly-managed affiliates enjoying the benefits of internal capital markets.

In addition, and from a macroeconomic perspective, the existence of these internal capital markets is thought to be very helpful. They might have worked as financial buffers to avoid a prolonged recession and even contributed in the recovery of the economy, given that the banking system had stopped lending throughout the late 1990s. The Mexican episode represents a very interesting case of a positive externality of business networks.¹⁷

In the theoretical literature on comparative corporate governance, group structure is usually considered the result of market failures. In particular, the lack of intermediaries and endemic information asymmetries, are partially offset by the formation of business groups and internal capital markets, which reduce opportunistic behavior and makes economic activity possible. Consequently, the Mexican experience analyzed here provides a case where this type of governance structure could have fulfilled a crucial role in financial activities.

17 For an empirical analysis of groups' implications in Asia, see Claessens, Djankov, Fan and Lang (1999).

Appendix: Construction and Definition of Variables

It is important to clarify that since 1984 the financial information of firms listed on the BMV has been re-expressed to reflect the effects of inflation. Thus, fixed assets, inventories and depreciation are restated by determining current replacement costs. Moreover, under these accounting principles, a firm adjusts the value of the debt due to inflation, despite that new debt has not been granted. For this study, the firms' balance sheet, income, and cash flow statements for the sample period 1990-2000 are expressed in real terms using prices of 2000. In order to avoid seasonality complications, only the data for the fourth quarter was taken into account, hence the 176 firms of the unbalanced panel add up to 1460 year-firm observations.

Table 4. Number of Firms in the Database by Time Period

Period of information	Complete Database	Refined database*
1990-1993	4	
1990-1994	7	
1990-1995	9	
1990-1996	6	
1990-1997	6	
1990-1999	1	
1990-2000	69	
1991-1993		10
1991-1994	1	17
1991-1995	2	11
1991-1996		1
1991-1998	1	2
1991-1999		1
1991-2000	11	4
1992-1994		4
1992-1995		3
1992-1996		1
1992-1998	1	1
1992-1999	1	
1992-2000	8	4
1993-1995		6
1993-1996	1	
1993-1999	3	
1993-2000	11	4
1994-1996		1
1994-1997		1
1994-1999		1
1994-2000	3	1
1995-1999		1
1995-2000	10	2
1996-1998		5
1996-1999	2	
1996-2000	16	13
1997-1999		5
1997-2000	3	20
1998-2000		11
Total unbalanced panel	176	130

Notes to Table 4:

*Database where the investment rate is below 0.75 and above zero.

A firm belongs to the database when it has at least three observations; moreover, the firm is counted twice when there are missing values in between the time series

Definition of Variables:

I_{it} = Gross investment = $K_{it} - K_{i,t-1} + DEP_{it}$, where DEP_{it} is annual depreciation

K_{it} = Net capital stock -net fixed assets-

Y_{it} = Production (or NS_{it} = net sales)

FR_{it} = Financial restrictions variables (CF_{it} , CS_{it})

CF_{it} = Cash flow (or CS_{it} = Cash stock)

AFR_{it} = Group level financial restriction (CSO_{it} , CFO_{it})

CSO_{it} = Pooled cash stock

CFO_{it} = Pooled cash flow

KO_{it} = Pooled capital stock

EXP_{it} = Exports to sales ratio = X_{it}/NS_{it} , where X_{it} is foreign sales

DU_{it} = Dummy variables to partition the sample according to liquidity constraints: (G_{it} , B_{it} , T_{it} , E_{it})

G_{it} = Dummy for group membership

B_{it} = Dummy for banking linkages

T_{it} = Time Dummy for financial paralysis period

E_{it} = Dummy for highly-exporting firms

Variables Construction from Primary Sources:

Codes: (SIVA, Infosel))

K_{it} = Net capital stock: net assets in plant, equipment and real estate, valued at current replacement cost (S12, 1150)

NS_{it} = Net sales (R01, 1238)

Y_{it} = Production: Net sales minus decrease in inventories (RO1–C19, 1238-1312)

X_{it} = Net foreign sales (R22, 1262)

DEP_{it} = Depreciation: depreciation and amortization of year t (C13,1305)

CS_{it} = Cash stock: cash and temporary investments (S03,1141)

CF_{it} = Cash Flow: cash generated from operations (C05, 1293). This is equal to net income plus capital amortization and depreciation, plus increase in pension reserves, minus the increase in receivables, minus the increase in inventories, plus the increase in payables, plus the increase in mercantile credit.

CSO_{it} = Pooled cash stock is built with the summation of the cash stock of the other firms that belong to the same business group.

CFO_{it} = Pooled cash flow is built with the summation of the cash flow of the other firms that belong to the same business group.

KO_{it} = Pooled capital stock is built with the summation of the net fixed assets of the other firms that belong to the same business group.

G_{it} = Dummy for group membership: assigns a value of one if the firm belongs to a business group and a value of zero otherwise.

Criteria for group membership: A group is formed with the firms that have at least two board members sitting in all the firms' boards, whatever their position.

B_{it} = Dummy for banking linkages: assigns a value of one if the firm has a banking linkage and a value of zero otherwise

Criteria for banking linkages: A firm is linked with a bank if at least one of its board members sits on the board of a bank.

E_{it} = Dummy variable for highly-exporting firms: assigns a value of one if the firm has more than 50% of sales in foreign markets in that particular year and a value of zero otherwise.

D_{it} = Time dummy for financial paralysis period: assigns a value of one for 1995 and onwards and a value of zero otherwise.

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