Essays on the real and financial allocation of capital

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Submitted to the Department of Economics
in partial fulfillment of the requirements for the degree of

Doctor of Philosophy in Economics

at the

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

June 2006

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Abstract

This dissertation consists of three papers studying how firms allocate real and financial capital, and how taxes, the labor market and asymmetric information affect these allocation decisions. The first paper studies the response of business investment to taxes. I use the variation provided by recent reforms to the Mexican tax system, including the elimination of accelerated depreciation for investment outside the main metropolitan areas. I show that investment is very sensitive to tax changes (an elasticity of investment with respect to the user cost around -2.0), mainly due to the small open economy nature of Mexico: large responses of multinationals and large elasticity of imported assets. I also show that investment behavior is consistent with nonconvexities and irreversibilities. The results are robust to different specifications and instrumental variables approaches, and are not an artifact of tax evasion.

The second paper studies the link between payout and unionization. Signaling models suggest that dividends are used to convey information about future earnings to investors. However, if unions also receive these signals, managers will be less inclined to send the signal, preventing unions from using this information when bargaining for higher salaries. Using data from IRS 5500 Forms to measure firm unionization, I find dividends to be better predictors of future earnings in non-unionized firms. Results are robust to different specifications and time periods, as well as to an instrumental variables approach that uses state level right-to-work laws to address unionization endogeneity.

The third paper, joint with Antoinette Schoar, studies the presence and extent of Performance-Based Arbitrage (PBA) in the money manager industry. PBA (correlation between past performance and assets given by investors to arbitrageurs) prevents arbitrage from equalizing prices and fundamental values. We document the presence of PBA and show it might be profitable for investors. We show that PBA is stronger in periods of lower returns and higher volatility, and it is stronger in equity versus fixed income markets. However, we also show that PBA is weaker among managers that use arbitrage strategies, suggesting that although PBA exists, its effect on security prices might be small.

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Acknowledgments

This thesis would not have been possible without the constant advice and support from Jim Poterba. Jim has thought me many things throughout these four years at MIT that not only made me a better economist, but a better person. Together with Nancy, you made Manétt and me feel more welcome in Boston. Thanks for believing in me.

I also need to express my gratitude to Antoinette Schoar. Her insights improved my work considerably. Thank you for the opportunity to be your research assistant and be coauthors in Chapter 3 of this thesis. Thanks also to Jerry Hausman, who accepted to be my third recommender and also provided very helpful comments on my papers. I thank Mikhail Golosov, third member of my thesis committee, for approving the final version of this dissertation. I also had the chance to learn a lot by being teaching assistant for Victor Chernozhukov and Theodore Panayotou at MIT and the KSG-Harvard, respectively.

For comments on previous versions of this thesis, I thank María Fernanda Cervantes, Francisco Gallego, Frank Schneider, José Tessada, seminar participants at MIT, Instituto Tecnológico Autónomo de México (ITAM), Centro de Investigación y Docencia Económicas (CIDE), El Colegio de México (COLMEX), and Banco de México (Mexico's Central Bank). I also thank participants at MIT's Public Finance, Summer Applied Micro and Corporate Finance lunch seminars.

I thank Gerardo Leyva, Abigail Durán and Otoniel Soto from INEGI (Instituto Nacional de Estadística, Geografía e Informática) for approving on-site access to the database used in Chapter 1, and Alejandro Cano, Juan Gallegos and Juan M. Jiménez for technical support. I also thank Brian Becker and Joshua Rauh for providing the data used in Chapter 2.

I also acknowledge and appreciate the financial support from the Mexican Government through CONACYT (Consejo Nacional de Ciencia y Tecnología) and from the Fulbright-García Robles Program during my graduate studies.

Coming to MIT would have not been possible without the support from my recommenders: Pedro Aspe, Luis Videgaray, Alejandro Poiré, Carlos Sales and Sergio Sánchez. Thanks for encouraging me to pursue this goal and for your advice on how to get it done.

I thank all the people that made these four years in Cambridge a great experience: friends, classmates and professors. In particular: José Tessada (the chats, pool and card games made me feel more like home; thanks for your friendship and for sharing great moments with us), Arturo García de León, Franciso Gallego (and family), Frank Schneider, and Alejandro and Leslie Poiré (and their very helpful advice on parenting).

Thanks also to all those who back from home sent numerous emails and cared for us; my friends from high school and college, in particular, Ivan Escalante and Ricardo Ortega; my in-laws, thanks for having us at your home during (the sometimes very long) vacations.

I might say that the completion of this Ph.D. should not be considered my own work. This is just the final step of what my parents, Alberto and Guadalupe, started 28 years ago. Mom and dad, thank you for all your love and guidance throughout all these years. Thanks for making me who I am. I can hardly express with words how much I love you and thank you for all you have done and sacrificed for me.

To my siblings, Adrián, Flor and Alejandro. Thanks for being such a good example in my life and for your constant advice, help and support. I am really proud of being your brother and cannot wait for the four of us to be together again. To my sister in-law Gabriela and my nieces María Fernanda and Regina, thanks for all the video conferences; those laughs made my days.

Overall, I dedicate this thesis to my wife, Manétt. I hardly believe I would be writing this dissertation if I had not met you. You bring up the best of me, and make me want to be a better person day after day. During our first two years in the US at distance, you really guided me and helped me to achieve many things I did not think I was capable of. Thanks for your patience, for revising all my work and for always saying the right words to keep me trying. I cannot imagine living a life without you and, believe me, I will remember our married days in Cambridge as the happiest days of my life. I love you.

Finally, to my baby-boy, Artur. I hope you will read this dissertation in the future and be proud of your old man. But most importantly, I hope you read it and see that you can achieve anything you want in your life, just be patient and never give up. You have made your mom and me the happiest people in the whole world.

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Introduction

Economic science is about the efficient allocation of scarce resources. In this dissertation, I study how firms allocate real and financial capital across several potential uses and how this decision is affected by corporate taxation, the labor market and asymmetric information. Firms make many different decisions about the efficient allocation of resources. Examples of these decisions include investment in real assets; defining the amount of expenditures on research and development; the optimal management of cash flow; the optimal investment of pension assets; the optimal policy of earnings distribution to shareholders or reinvestment; the debt vs. equity decision as well as many others.

This thesis is composed of three essays. Each essay studies one of these multiple dimensions of the allocation decision. In particular, the first essay studies the effect that tax provisions have on firms' decisions to purchase tangible assets. The second essay studies how firm unionization affects firms' decisions to distribute earnings through dividends. Finally, the third essay studies how past performance affects firms' decisions to withdraw pension assets from the money manager previously chosen.

Overall, the results of this thesis present evidence of firm behavior that is consistent with neoclassical models of profit maximizing firms. Moreover, the results show that firms strategically choose where, how and when to allocate real and financial capital depending on macroeconomic and market conditions as well as the decisions of other economic agents, like the government, suppliers and competitors.

The main conclusion of this dissertation is that there is an important role of exogenous factors (such as taxation and asymmetric information) in the allocation decisions of real and financial assets, and that in some cases, these particular exogenous factors provide potentially valid instruments and identification in the empirical analysis.

The literature focusing on the interaction of firm investment and tax policy is not new. Previous to the mid 1990's, micro level empirical analysis were generally unable to find significant effects of taxes on investment.[1] However, a recent wave of empirical work provided evidence that taxes do affect investment, with an estimated elasticity of investment with respect to the user cost (a comprehensive measure of taxes, relative prices and interest rates) between -0.5 and -1.0.

Chapter 1 of this thesis provides new evidence on this subject. In this chapter, I study how rules for deducting the purchase of assets for tax purposes affect investment decisions. Given that the available empirical evidence for developing economies is scarce due to data limitations, by studying the Mexican case, I partially fill this gap in the literature.

Moreover, several features of the Mexican corporate tax system provided large cross sectional variation in the user cost of capital absent in US reforms. Furthermore, these tax changes are arguably exogenous to firm investment decisions, providing potentially valid instruments for the estimation. This exogeneity helps to deal with concerns about the possible simultaneous determination of the user cost and investment rate variables, or the existence of measurement error in the former.

Previous to 1999, Mexican tax rules allowed accelerated depreciation for investments made outside the three main metropolitan areas of the country (Mexico City, Guadalajara and Monterrey). This system was eliminated in 1999 to overcome a shortfall in government revenue caused by low international oil prices. I argue that this tax policy change is exogenous to firm investment decisions and provides potentially valid instruments for the cost of capital. The empirical analysis shows that the elasticity of investment with respect to the user cost is significantly greater than unity (and greater than comparable estimates for the US). This result is robust to different specifications and the use of instrumental variables, including dynamic panel models, with a preferred estimate of the elasticity of investment with respect to the user cost around -2.0.

The small open economy nature of the Mexican economy is shown to be a possible determinant of this large investment response to changes in the user cost of capital. I further analyze this hypothesis both from the demand and the supply side of capital. First, I show that the investment response of plants owned by multinational firms is large, compared to domestic plants. Moreover, addressing the possible price effect driven by an upward sloping supply of capital, I also show that the elasticity of imported assets is considerably larger than

[1] See literature reviews by Chirinko (1993) and Hassett and Hubbard (2002).

that of domestically purchased capital. The latter result provides evidence that domestic prices of capital goods might have decreased after tax incentives were removed, reducing the fall in domestic investment. However, investment adjustments in the international market (with fixed prices) were large.

Exploiting the detail asset information in the panel of plant level data used in this chapter, I also present a nonparametric analysis of the investment adjustment cost function. My results show that investment is discrete and consistent with the presence of nonconvex adjustment costs and irreversibilities, similar to those reported for the US. Specifically, plants that according to a neoclassical model should disinvest rarely do so, while plants with capital shortfalls do invest, and this response is increasing in the size of the capital shortfall. Given the large similarity of the estimated adjustment cost functions between Mexico and the US, I conclude that the difference in elasticities is not due to differences in these functions.

Arguably, if managers were able to include capital expenditures as operating expenses after investment incentives were removed, then the large elasticity could be just an artifact of misreporting. However, I show that the elasticity of investment in transportation equipment and land is also high. Since these assets are harder to misreport, this finding suggests that the large investment response is not due to misreporting or tax evasion.

Chapter 2 studies another topic about the allocation of financial capital: the interaction between payout policy and the labor market. In particular, I analyze the relationship between dividend payments and firm unionization. In a seminal contribution, Miller and Modigliani (1961) showed that under perfect capital markets, rational behavior and perfect certainty, dividend policy does not affect firm value. Given the historical tax disadvantage of dividend income compared to capital gains, a large part of the literature on financial economics in the past 40 years has been devoted to reconciliating this irrelevance result with the real corporate world, in which more than 400 billion dollars are paid as dividends.

One of the leading explanations for dividend payments is the so-called "dividend signaling hypothesis", which relies on the assumption of asymmetric information about the firm's true earnings potential between managers and investors. In this setting, managers pay dividends to convey information about their firm's earnings. One of the key elements of these models is that dividend payments imply some cost, and this cost makes possible the existence of a separating equilibrium in which managers of firms with better future earnings prospects pay higher dividends.

In Chapter 2, I present an extension of the dividend signaling model developed by Bhattacharya (1979) to include unions. Intuitively, even if managers have an incentive to convey information about future earnings to investors (and in that way to increase the price of the firm's shares), they also face the incentive not to do so since the signal can also be received by the union, which could bargain for higher salaries. The model predicts that dividends should be less used as a signal by highly unionized firms.

I test this prediction following the empirical literature that test whether dividends are predictors of future changes in earnings. The empirical evidence in the literature is still mixed: in general, researchers have found no relationship between future changes in earnings and current changes in dividends. In this paper, I improve the predictive power of dividends by using quarterly data, and show that changes in dividends are in fact related to future changes in earnings.

Moreover, this paper is the first to test the prediction that unionization affects dividend policy in a general setting. In particular, I test if dividends have less predictive power for future earnings in highly unionized firms by interacting the dividend change variable with a measure of firm level unionization (which comes from two different databases provided by Joshua Rauh and Brian Becker, respectively). Consistent with the model, I find that the predictive power of dividends is negatively related to the unionization of the firm. My results are robust to analyzing different time periods (1975-1980 and 1990-1998) and also robust to different specifications (scaling earnings using book equity or the value of assets).

The main concern with the least squares results is that unionization might be an endogenous variable in the model, i.e., it might be simultaneously determined with earnings and dividends in response to a shock that also affects these variables. For this reason, I instrument unionization using Right-to-Work Laws. These laws give workers the freedom not to join a union and avoid paying the fees. In this way, these laws are correlated with firm unionization but are potentially uncorrelated with the disturbance term of the regression. The results of the instrumental variables regressions show the same positive and significant effect of dividends (the signaling effect) and the same negative and statistically significant effect of the interaction between dividends and unionization (the unionization effect) in explaining future changes in earnings, thus providing strong support for my hypothesis.

Finally, the third chapter, coauthored with Antoinette Schoar, studies asset flows to money managers in the pension fund industry, and its relationship with managerial performance and investment strategies. Despite the large size of assets under management of institutional investors (over 7 trillion dollars), this industry has received little attention in the economics and finance literature, compared to the mutual fund industry. In this literature, the industry is characterized as plagued with agency problems which are blamed for the lack of value generation. The agency problems are driven by the different incentives that each participant faces: pension funds hire plans sponsors which then hire money managers, who are the actual investors in the equity and fixed income markets. Pension funds prefer to delegate all decisions, thereby avoiding blame for bad performance.

In this chapter we analyze the empirical relationship between asset flows and performance in this industry. In particular, we test for the presence and extent of Performance-Based Arbitrage (PBA). PBA was defined by Shleifer and Vishny (1997) as the condition under which assets that investors give to specialized arbitrageurs are positively related to their past performance. The importance of PBA is that it limits the ability of arbitrage to bring security prices to fundamental values, and in that way reduces the ability of arbitrage to achieve market efficiency. The pension fund industry represents a better approximation to the theoretical conditions for PBA than the mutual fund industry since money managers are probably engaged in more arbitrage activities than mutual fund managers, and assets withdrawn by institutional investors represent a bigger concern than assets withdrawn by individual investors.

Our results show that there is persistence in managerial performance, which is a necessary condition for PBA to be profitable, since it means that plan sponsors can actually predict future performance using past performance. Then, we show that returns are positively related to asset and account flows in the money manager industry, that is, we show the existence of performance-based arbitrage. We also show that manager replacement is also related to past performance. In accordance with other papers that test these relationships, we also find, that performance only explains a small fraction of asset and account flows, as indicated by the low R-squared of the regressions. The literature interprets this result as suggesting that asset flows are driven more by some manager characteristics that are easy to justify ex-post to the board than past performance (binary events like "beating" the market or even other non-performance variables, like services provided).

The main results of this essay are however those that test different predictions of PBA (when and in which markets it is stronger). We find that, as expected, PBA is stronger in periods of lower returns and higher volatility. We also find that PBA is stronger in equity markets than in fixed income markets. These results, combined with the existence of PBA, imply that there are limits to arbitrage in bringing security prices to fundamentals. However, we also find that assets of managers that use arbitrage strategies are less sensitive to both its own performance and to the performance of the benchmark portfolio. The latter result suggests that performance-based arbitrage is weaker among the true arbitrageurs. Thus, although PBA exists, its effect on security prices might be small.

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Chapter 1

Tax Incentives and Business Investment: New Evidence from Mexico

1.1 Introduction

There is a large number of studies estimating the elasticity of business investment with respect to the user cost of capital. A recent wave of empirical work since the early 1990s has used panel data and clever estimation techniques to generate a new consensus estimate of this elasticity between −0.5 and −1.0, implying that taxes, interest rates, and depreciation rules affect investment decisions.[1]

The study of the responsiveness of investment to the user cost in other countries provides a natural robustness check for the results found using US data.[2] However, the available empirical evidence for developing economies is scarce due to data limitations and the complex way in which income from capital is taxed in many of these countries. This paper tries to partially fill this gap in the literature. Using a confidential panel database of Mexican manufacturing establishments, I estimate the elasticity of investment with respect to the user cost. Correcting my estimates for possible endogeneity and measurement error using instrumental variables (IV), my results show that the elasticity is significantly greater than unity, with a preferred estimate around −2.0.

[1] See Chirinko (1993), Caballero (1999) and Hassett and Hubbard (2002) for reviews of the literature.

[2] See Cummins, Hassett, and Hubbard (1996) for a cross country analysis for 14 members of the OECD.

This large elasticity is partially a result of using large cross sectional variation in the user cost of capital.[3] Previous to 1999, Mexican depreciation rules included the option to expense the present discounted value (PDV) of all future depreciation allowances using a favorable discount rate. Notably, only investments undertaken outside the three main metropolitan areas (Mexico City, Guadalajara and Monterrey) applied for this preferential tax treatment. In 1999 this system was eliminated to overcome a shortfall in government revenue caused by lower international oil prices. This policy change is arguably exogenous to firm investment decisions providing potentially valid instruments (this provision implied an increase in the user cost of 34% outside these metropolitan areas, compared to an increase of 19% within these areas). The results of this paper are robust to different specifications and the use of IV strategies, including dynamic panel models.

The small open economy nature of the Mexican economy is shown to be another possible determinant of the large investment response. I show that the investment response of plants owned by multinational firms is large. My results suggest that investment by US, British, German and Swiss multinationals responded more to changes in the user cost than investment by other multinationals or domestic plants.

The small open economy nature is also recognized in the supply side of capital as a possible determinant of the high responsiveness of investment. Specifically, I show that the elasticity of imported assets is considerably larger than that of domestically purchased capital. This provides evidence of a response of domestic prices to tax incentives: managers adjusted more their investment in the international market (with fixed prices), while in the domestic market both prices and investment reacted.

The use of data at the establishment level also allows me to identify the discrete nature of investment, and show that investment is consistent with nonconvex adjustment costs and irreversibilities, similar to those reported in Caballero, Engel, and Haltiwanger (1995) for US manufacturing plants. Specifically, plants that according to a neoclassical model should disinvest rarely do so, while plants with capital shortfalls do invest, and this response is increasing in the size of the capital shortfall. This finding implies that the larger elasticity compared to US estimates is not caused by differences in the adjustment cost functions

[3]This large cross sectional variation comes from: Industry variation driven by economic depreciation rates; pure time series variation driven by interest rates; time series and industry level variation driven by changes in the ratio of prices of capital goods and output; and time series, industry and regional variation driven by the changes to the system of depreciation allowances.

between Mexico and the US.

Arguably, if after investment incentives were removed managers were able to include capital expenditures as operating expenses, then the large elasticity could be just an artifact of misreporting. However, I show that the elasticity of investment in transportation equipment and land is also high. Since these assets are harder to misreport, this finding suggests that the large investment response is not due to misreporting or tax evasion.

The paper is divided as follows. Section 1.2 presents the review of the literature, with particular emphasis on the study of investment incentives in Mexico. Section 1.3 describes the reforms to the Mexican corporate tax system. Section 1.4 briefly describes the database. Section 1.5 outlines the main empirical strategy and its results. Additional results aimed to explain the large estimated elasticities are presented in Section 1.6. Section 1.7 analyzes tax policy implications. Section 1.8 concludes. Finally, a detailed description of the database can be found in Appendix A-1.

1.2 Literature Review

1.2.1 Sensitivity of investment to the user cost

One decade ago, the empirical evidence suggested that taxes and interest rates have little effect on investment.[4] The estimated models implied implausibly large adjustment costs, in the range of one to five dollars per dollar of investment. However, several recent papers have been successful in explaining the reasons behind this result, and in some cases even correct the estimation techniques and show that investment is in fact sensitive to changes in the user cost of capital.

The small estimated elasticities can be explained, for example, by monopolistic competition in the capital goods market, which may cause prices and not quantities (investment) to react (Goolsbee (1998)). Moreover, there is a bias towards finding small effects of the user cost on investment if the common assumption of convex adjustment costs does not hold. Dixit and Pindyck (1994) argue that irreversibility might create ranges where investment does not react to changes in the user cost. Caballero et al. (1995) show that the pattern of investment is consistent with the presence of irreversibilities and nonconvexities, and estimate the long run elasticity of the capital stock with respect to its user cost to be close

[4] See surveys by Chirinko (1993), Caballero (1999) and Hassett and Hubbard (2002).

to -1.0, larger by an order of magnitude than those of the previous literature.[5]

Furthermore, one of the main explanations for the small empirical elasticities is measurement error in the user cost. Panel data at the asset, firm or plant level has been used to address this problem. For example, using a panel at the industry level, Goolsbee (2000) shows that the user cost variable has measurement error and that, after correcting the estimates using instrumental variables, the results show that taxes affect both prices and investment.

Using a panel of firm level data from COMPUSTAT, Cummins, Hassett, and Hubbard (1994) show that measurement error is present not only in the tax variables, but also in the measure of Tobin (1969) Q. Their IV estimate of the elasticity of investment with respect to the user cost lies between -0.5 and -1.0, close to the neoclassical prediction and equivalent to adjustment costs of only 10 cents per dollar of investment. More recently, Chirinko, Fazzari, and Meyer (1999) also use firm level variation in the cost of capital to estimate the elasticity of the capital stock with respect to its user cost. Their preferred IV estimate is close to -0.25.

An important fundamental concern with the empirical estimation is the difference between short and long run dynamics. House and Shapiro (2004) link this difference to firm expectations about future tax changes and show that for sufficiently forward looking investment in long lived assets, the elasticity to temporary changes in tax parameters is nearly infinite. These authors analyze the 2002 and 2003 changes to depreciation allowances and find that prices reacted very little while investment increased for the types of capital that qualified for bonus depreciation. In contrast, Desai and Goolsbee (2004) argue that depreciation rules were already close to full expensing, and thus these reforms produced only small percentage changes in the user cost, which explains the small effects on investment they find.

1.2.2 Investment incentives in Mexico

The economic analysis of tax investment incentives in developing countries requires consideration of some additional factors compared to developed economies. Auerbach (1995) provides a detailed discussion on this topic and concludes that the two main differences in the analysis are the consideration of the effects of investment incentives on Foreign Direct

[5] Doms and Dunne (1993) also show that plant level investment is composed of large and discrete episodes.

Investment (FDI), and the possible exogeneity of the required after-tax return on investment.[6]

Evidence on the effect of investment tax incentives in Mexico is scarce. Most of the analysis of investment that has been done at the aggregate or micro level has not considered the effects of taxes on investment.[7] For example, Gelos and Isgut (2001a,b) analyze the investment behavior of Mexican and Colombian manufacturing plants following the methodology of Caballero et al. (1995). They do not construct a measure of the user cost of capital, but only use one of its non-tax components (the relative prices of capital goods and output) in order to identify the adjustment function. Moreover, their relative price parameter does not vary across industries. Gelos and Isgut (2001b) find that investment patterns are consistent with the presence of irreversibilities but not nonconvexities. This contrasts with my results in Section 1.6.3, where I show that investment of Mexican manufacturing plants is consistent with both irreversibilities and nonconvexities.[8]

The general omission of tax considerations is striking given the fact that tax incentives for investment in Mexico have undergone large changes since 1950.[9] In fact, those changes motivated Feltenstein and Shah (1995) to develop a computable general equilibrium model to study the impact of taxes on investment in Mexico. Their calibrations show that taxes do affect investment and that for two reforms with the same revenue impact, reductions to the corporate income tax rate are more effective to incentive investment than investment tax credits.[10]

In a time series framework, Shah and Slemrod (1995) analyze the effects of taxation on the aggregate flow of FDI to Mexico during the 1960-1990 period. Their results suggest that the FDI flow is very sensitive to taxes. The estimated elasticities also imply that the tax effect on FDI in the form of new transfers from abroad is larger than the one on FDI in the form of retained earnings of multinationals. Also using a time series framework,

[6]See Hines and Gordon (2002) for a review of the theory and empirical results on international taxation and FDI.

[7]Notably, many papers that study the impact of cash flow, liquidity and financial liberalization on investment also omit the consideration of taxes. See Gelos and Werner (1999), Babatz and Conesa (1997), for example.

[8]The differences can be caused by the different time period of study (Gelos and Isgut (2001b) study plants during 1984-1994, while I use 1994-2002). The difference can also be caused by the different methodology to calculate both the capital stock and the user cost, as explained in Section 1.4 and in the Appendix A-1.

[9]See Feltenstein and Shah (1995) for a summary of the changes between 1950-1985.

[10]Decreasing the corporate tax rate from 42% in 1987 to 35% in 1988 would have yielded an increase in manufacturing investment of 4.9%, while a 10% investment tax credit in 1988 would have only increased it by 2.2%.

Pérez-López (2004) develops a forecast model for Mexican investment where he proxies the tax component of the user cost by including the ratio of income taxes (both personal and corporate) to GDP as an explanatory variable in his aggregate error correction model of investment. The coefficient of this term goes in the wrong direction although is not significantly different from zero.[11]

At the micro level, Schwartzman (1985) finds no support for the view that taxes affect investment in Mexico. He models the behavior of investment in a small open economy and suggests that real exchange rate fluctuations contributed to the large volatility of Mexican investment during 1975-1985 (through its effect on Q). Schwartzman (1985) estimates structural Q-model equations for investment in a panel of 20 Mexican firms. His results support the view that Q-model regressions explain the behavior of investment in Mexico, but also that taxes play a very secondary role in affecting investment. His tax-unadjusted regressions econometrically outperform the tax-adjusted regressions. The contrasting results reviewed in this section, pose the question of whether taxes affect investment in Mexico; answering this question is the goal of this paper.

1.3 The Mexican corporate tax system and its recent reforms

1.3.1 General overview of the corporate tax system

According to Gordon and Ley (1994), the Mexican and the US tax systems are relatively similar. "Both federal governments tax corporate income in virtually the same rate (34 percent in Mexico and 35 percent in the US), and both have a progressive personal tax with a maximum rate of 35 percent in Mexico and 39 percent in the US" (Gordon and Ley 1994, p. 436).

The differences come from the definition of taxable income.[12] The Mexican tax system is completely neutral with respect to inflation, while the US system is not. Also, there is full integration of the personal and corporate tax system in Mexico.[13] Finally, the Mexican

[11] Pérez-López (2004) attributes his finding to large measurement error in his average effective tax rate (the corporate and personal income taxes are fully integrated, so it is not possible to get the corporate share of revenue).

[12] Also, the US government relies more on the payroll tax while the Mexican government collects a substantial amount of funds through the Value Added Tax.

[13] Dividends from Mexican firms are tax-exempt as well as all capital gains realized in the Mexican Stock Exchange (Bolsa Mexicana de Valores). Therefore, I omit the discussion of the different predictions of the views of dividend taxation (see Poterba and Summers (1985)).

Constitution mandates firms to distribute 10% of pre-tax income to workers and employees each fiscal year. This profit sharing scheme increases the burden of corporate taxation.

It should be noted that investment tax credits are small and very specific in Mexico (targeted to agriculture mostly). Therefore, since the following analysis focuses on manufacturing establishments, I omit its consideration.

The corporate tax rate is a flat 34% (1994). Depreciation allowances are based on a straight line method of deductions for fixed assets. The specific percentage deduction for each asset is specified in the Income Tax Law (Ley del ISR). For machinery and equipment, this percentage also depends on the industry in which it is used. Table A-1.1 shows annual depreciation rates applicable to selected assets, and to machinery and equipment in selected industries.

By 1994, depreciation rules also included the option to immediately expense the PDV of future depreciation allowances using a fixed (and favorable) real discount rate of 5%.[14] For example, in the case of the purchase of a building, with annual depreciation deductions of 5% (20 years of straight line depreciation), the law allowed the option to immediately expense 62% of the acquisition cost, which is considerably higher than the 35% PDV of depreciation allowances when using the market real riskless rate.

Importantly for the following analysis, this Optional Accelerated Depreciation (OAD, or so called "Depreciación Inmediata"), was only applicable to investment expenditures undertaken outside the three main metropolitan areas of the country, i.e., Mexico City, Guadalajara and Monterrey. For many years, this system was used by the government to promote decentralization.[15]

1.3.2 Recent reforms to the corporate tax system

In the aftermath of the Tequila Crisis (1994-1995), the Mexican government approved some measures designed to increase economic activity, growth and investment. These measures included a decrease in the discount rate to calculate the OAD rate from 5% to 3%. This change considerably increased the value of depreciation allowances. In the previous example, it represented the immediate expense of 74% of the original investment instead of 62%.

By the end of 1998, the federal government presented to the Congress a series of reforms

[14] This favorable rate was 7.5% before 1991.

[15] These three metropolitan areas represent 38.1% of national manufacturing production and 22.8% of Mexican population.

designed to increase government revenue collections. The dependence of Federal Government revenue on oil, combined with low international oil prices made necessary to take some politically costly actions. Since the elimination of special regimes for the Value Added Tax did not get support in Congress, other measures were proposed, including some aimed at increasing the effective tax rate on corporations.

The approved law included an increase of the corporate tax rate to 35% and the elimination of the OAD system. The OAD was replaced with a system of differential taxation of retained earnings over distributed earnings. Specifically, retained earnings were taxed at 30% and distributed profits were subject to the full 35% tax rate while the 5%×(Taxable Income) tax liability was deferred until distribution.

During 2001, the federal government promoted the discussion of a fundamental tax reform. The discussion included the academia, tax advisors, corporations, and the government. At the end, failures in the political negotiations at the Congress resulted in a new tax law that was far from a fundamental reform. Nevertheless, the corporate tax rate was gradually decreased from 35% in 2002 to 32% in 2005 (1% each year). Moreover, the OAD system was reinstalled with a discount rate of 6% while the preferential treatment of retained earnings was abandoned. The OAD immediate expense in the approved system, however, was not allowed to be made in the year of acquisition, but until the next one.

The government noticed that the system of OAD was considerably less effective than the one in effect in 1998 (both because of the high discount rate and because of the deferral rule). The Income Tax Law was further modified in 2003 decreasing the discount rate to calculate the OAD to 3% and allowing the immediate expense to be done partially (one third) in the year of acquisition, and the rest (two thirds) in the following year. Moreover, for the fiscal year 2004 the deferral rule was two thirds in the first year and one third in the second; for fiscal year 2005 and beyond, it was possible to expense the full PDV in the same year of acquisition. Finally, in 2005 the corporate tax rate was again reduced 1% each year from 30% to 28% in 2007.

1.3.3 Time series behavior of tax parameters during 1994-2002

The top panel of Table 1.1 summarizes the tax rules applicable in each year. It is useful to consider its effects on the PDV of depreciation allowances, the cost of capital and the effective marginal tax rate. Section 1.4 and Appendix A-1 describe in detail the construction of these variables.

The present value of depreciation allowances was calculated using the standard formula:

$$z = \sum_{t=0}^{T} \frac{NDR \times V}{(1+\rho)^t}, \tag{1.1}$$

where, z: present value of depreciation allowances, ρ: real discount rate (for a plant in the OAD region, is the rate allowed by the government to calculate the accelerated depreciation; for a plant in the 3MMA region, is the riskless long term interest rate), NDR: is the Normal Depreciation Rate, i.e., the percentage of the purchase value of an asset that the government allows to deduct each year, V is the purchase value of an asset, and T is the number of years until full depreciation is achieved, according to NDR.

The cost of capital was estimated using the well known derivation in Jorgenson (1963):

$$COC = \frac{p^K}{p^Y} \times \frac{(r+\delta) \times (1-\Gamma)}{(1-\tau)}, \tag{1.2}$$

$$\Gamma = ITC + \tau z, \tag{1.3}$$

where, COC: user cost of capital, p^K: price of capital, p^Y: price of output, r: required rate on return (the riskless rate, ρ, plus a time varying risk premium), δ: economic depreciation rate, ITC: investment tax credits, and τ: corporate tax rate.

The effective tax rate (i.e., the hypothetical tax rate on pure economic income that yields the same cost of capital as the actual regime of depreciation allowances and corporate tax rate) was calculated as:

$$ETR = \frac{(r+\delta) \times (1-\Gamma) - (r+\delta) \times (1-\tau)}{(r+\delta) \times (1-\Gamma) - \delta \times (1-\tau)}, \tag{1.4}$$

where, ETR: Effective Tax Rate.[16]

The bottom panel of Table 1.1 presents, as an example, the time series behavior of these tax parameters for investment in machinery and equipment in the automobile parts industry. The table distinguishes between the values for plants located inside the main metropolitan areas (3MMA) and those that qualified for the OAD. As is evident from the

[16] The ETR is implicitly defined by:

$$r = (1 - ETR) \times (COC - \delta). \tag{1.5}$$

Solving for ETR derives in Equation 1.4.

table, the 1999 reform implied a differential increase in the user cost for the two regions.

1.4 Data

1.4.1 Encuesta Industrial Anual (EIA), 1994-2002

The Annual Industrial Survey (Encuesta Industrial Annual, or EIA) is conducted by the Mexican Statistical Agency, INEGI (Instituto Nacional de Estadística, Geografía e Informática), and is housed at its headquarters in Aguascalientes, Mexico. In this study I use the most recent panel: 1994-2002. INEGI follows a non-random sampling procedure to determine the group of manufacturing plants that would be surveyed. This procedure is described in INEGI (2005) and summarized in Appendix A-1.

The EIA panel consists of 7,171 manufacturing establishments in 205 6-digit industries, which excludes maquiladoras, basic petrochemical plants, refineries and also micro-industry plants (i.e., plants with less than 15 employees). A small random sample of new plants is added every year. The variables used in the empirical analysis include:

- Location: state and municipality.
- Industry: 9 (2-digit) "subsectores", 50 (4-digit) "ramas" and 205 (6-digit) "clases".
- Employment: total payroll.
- Profit Sharing: total payments to employees and workers due to the profit sharing scheme (10% of pre-tax income).
- Output: value of production.
- Assets: Asset values, purchases, sales, depreciation and write-offs. This information is broken down into five categories of asset types: Machinery and equipment, constructions and facilities, land, transportation equipment and other assets. Asset values and depreciation are reported at historic costs or gross book value.

1.4.2 Other plant level data sources

I also use aggregate information (at the 6-digit industry level) for asset values and depreciation (both at historic cost) from the previous panel of the EIA (1984-1994). This information was averaged over the years to estimate industry economic depreciation rates. These rates were used in the calculation of the user cost of capital. I imputed these rates at the 4-digit industry level in the 1994-2002 panel of plant level information.

INEGI officials allowed me to merge EIA data with information for assets values at market prices (or replacement costs) from the 1994 Industrial Census, for a subsample of 4,997 plants. The information was also broken down into five asset categories: machinery and equipment, constructions and facilities, land, transportation equipment, and other assets.

In 1994, the EIA was jointly surveyed with a Technology Database (Encuesta Nacional de Empleo, Salarios, Tecnología y Capacitación, ENESTYC). INEGI officials provided matched information regarding country of equity ownership for a subsample of 6,845 plants. The questionnaire asked the ownership percentage for the following countries: Mexico, USA, Germany, Canada, France, Netherlands, Japan, UK, and Switzerland.

1.4.3 Construction of variables

Different variables were constructed for the analysis. Given the available data on the EIA, it was not possible to estimate models at the firm level, but only at the plant level. The details are presented in Appendix A-1 at the end of the paper. Here, I just briefly summarize the process:

- Region: Plants were classified according to its location inside or outside the three main metropolitan areas (3MMA), since only those outside qualified for the accelerated depreciation.
- Capital stock (K): I use the perpetual inventory method, taking as the initial capital stock the market value of assets from the 1994 Industrial Census. Depreciation rates were estimated using gross book value depreciation and asset values as explained in the Data Appendix.[17]
- Gross Expenditures (GE): is the sum of all assets purchased either in the domestic market or imported from abroad.
- Net Expenditures (NE): equals gross expenditures minus economic depreciation.
- Retirements (R): is the value of sales of assets, reported at market value.
- Investment (I): is the sum of gross expenditures minus retirements.
- Cash Flow (CF): is estimated by multiplying the profit sharing amount by 10.[18]

[17] Previous studies that have used the EIA use the initial reported gross book value of assets as the initial capital stock in the perpetual inventory method. This procedure can yield misleading measures in short panels for two reasons. First, this method approximates the market value of assets by the book value of assets in the initial year, relying on the length of the panel to erode this bias. Second, the reported book value in the EIA is not net of depreciation, and thus might include assets already fully depreciated. The use of market value figures from the 1994 Census allows me to overcome these problems.

[18] As previously noted, Mexican Constitution mandates firms to distribute 10% of pre-tax profits. This is

- Cost of Capital (COC): it is estimated at the 4-digit industry level for the two different regions (3MMA or OAD) using Equation 1.2 and the following inputs:
  - The capital-output price ratio (p^K/p^Y): is the output deflator for each 2-digit industry divided by the price index for fixed capital accumulation.[19] It was set equal to 1 in 2002.
  - Corporate Tax Rate (τ): comes from Income Laws, and was adjusted to include the burden of the profit sharing rate.
  - Real required rate of return (r): was assumed equal to the real riskless interest rate, plus a time varying risk premium equal to the difference between the short term nominal interest rate on private and government bonds.[20]
  - Present discounted value of depreciation allowances (z): calculated based on Equation 1.1 using normal depreciation rates or the optional accelerated depreciation rates according to each plant location (OAD or 3MMA), from Income Tax Laws.
  - Economic depreciation (δ): estimated at the 6-digit industry level using data from the 1984-1994 EIA panel, and assigned at the 4-digit industry level for each plant in the 1994-2002 EIA panel.

1.4.4 Other minor sources

Other series needed for the analysis were derived from different sources. Price indices and different real and nominal interest rates were obtained from the Mexican Central Bank (Banco de México).

1.4.5 Summary statistics

Summary statistics for the most relevant variables are presented in Table 1.2. The top panel shows the mean, standard deviation, quartiles and number of observations for the cost of capital, the different investment and capital expenditure variables, and cash flow and output to capital ratios. The middle panel shows the means by subgroups of regions (3MMA

the same approach that Gelos and Werner (1999) followed to get a measure of cash flow.

[19]The first comes from the Mexican National Income and Product Accounts and the second from Banco de México.

[20]The real riskless rate is the rate on UDIBONOS (inflation indexed long term government bonds). The risk premium is the difference between the rate on private commercial paper and CETES (short term government bonds).

region or OAD region). For all variables the difference in the means is statistically different from zero. Finally, the bottom panel shows means for plants with majority ownership by Mexicans or foreigners.

1.5 Main empirical specification and results

In this section I analyze investment in machinery and equipment. Investment in other types of assets (i.e., constructions, land and transportation equipment) is considered in Section 1.6.4. As noted in Section 1.4, the unit of analysis is the manufacturing establishment (plants). Due to confidentiality reasons, and mainly due to the EIA questionnaire itself, it was not possible to merge information at the firm level. This has the drawback of not been able to estimate models with financial variables, i.e., Q-type models like Summers (1981). Before turning to the specific firm model used to derive the regressions, it is useful to consider a pure differences-in-differences approach.

1.5.1 Differences-in-differences regressions

Given the potential exogenous nature of the 1999 and 2002 reforms, I regress investment rates on a dummy equal to one in the years in which the Optional Accelerated Depreciation system was in effect (1994-1998 and 2002), a dummy equal to one if the plant is located outside the three main metropolitan areas (i.e. where the OAD system applies), and the interaction between the two:

$$\begin{aligned}\frac{I_{it}}{K_{it-1}} &= \alpha_i + \beta_1 OAD_{it}^{period} + \beta_2 OAD_{it}^{region} + \beta_3 (OAD_{it}^{period} \times OAD_{it}^{region}) \\ &\quad + \eta_t + \epsilon_{it}, \end{aligned} \tag{1.6}$$

where, I: investment, K: capital, OAD^{period}: equals one in 1994-1998 and 2002, OAD^{region}: equals one for plants outside the main metropolitan areas, α: plant fixed effects, η: year fixed effects (included when OAD^{period} is excluded), and ϵ: the disturbance term.

Table 1.3 presents the results of these regressions. The positive and significant coefficient on the interaction term suggests that plants in OAD regions reduced more their investments in the years in which the accelerated depreciation was eliminated compared to plants that did not qualify for this special tax treatment. The last four columns specifically exclude the Tequila Crisis (1994-1995). Note that the coefficient on the interaction term is robust to the inclusion of year fixed effects instead of the OAD^{period} dummy. Therefore, the results show that even without considering the large cross sectional variation in the user cost induced by the reforms, the effect of the reform on investment is large. The task of the next subsections is to use this variation and introduce a more elaborated model of firm behavior to estimate the elasticity of investment with respect to the user cost of capital.

1.5.2 Elasticity of investment with respect to its user cost

According to neoclassical theory, a firm maximizes its value by choosing the optimal capital stock (after optimally choosing variable inputs) that maximizes the stream of after tax profits, subject to the capital accumulation process equation:

$$\begin{aligned} \max V_s &= \sum_{s=t}^{\infty} \frac{(1-\tau_t)p_t^Y F_t(K_{t-1}) - p_t^K C(I_t, K_{t-1}) I_t (1-\Gamma_t)}{(1+r_t)^{-(s-t)}}, \\ s.t. \quad & K_t = (1-\delta_t)K_{t-1} + I_t, \end{aligned} \tag{1.7}$$

where, $F(\cdot)$: production function, $C(\cdot)$: capital adjustment cost function, and the rest of the variables are defined as above.

Auerbach and Hassett (1992) and Auerbach (1989) derive an analytical solution for investment of a profit maximizing firm under a constant growth trend, multiplicative shocks to the production function and adjustment costs that are linear in K and I. The solution characterizes investment as a partial adjustment process toward the desired capital stock, which depends on current and future expected values of the user cost. The main differences between the derivation in the aforementioned papers and previous implementations of the partial adjustment model (like Hall and Jorgenson (1967)) are: first, that the friction is derived endogenously from a formal model with adjustment costs instead of ad-hoc delivery lags; and second, that investment depends on current and future values of the user cost, instead of past values of this variable.

Equation 1.8 shows my econometric specification. As in Cummins et al. (1994), I depart from Auerbach and Hassett (1992) and assume that firms see tax changes as permanent, thus using only the current value of the cost of capital instead of current and future values.

Moreover, since in many applications I specifically use instrumental variables to control for endogeneity, the COC variable in my specifications has the current value of both tax and non-tax variables (and not a combination of current tax values and lagged values of non-tax variables like the model in Cummins et al. (1994)).

Following the literature on investment equations, I present results both with and without the inclusion of the cash flow to capital ratio. Even if a positive and significant coefficient on this term should not be interpreted as a sign of financial constraints (Kaplan and Zingales (1999)), it has proven to have explanatory power for investment.

$$\frac{I_{it}}{K_{it-1}} = \alpha_i + \beta COC_{it} + \gamma \frac{CF_{it}}{K_{it-1}} + \eta_t + \epsilon_{it}, \tag{1.8}$$

where, CF: cash flow and the rest of the variables are defined as above.

The top panel of Table 1.4 shows the results of estimating Equation 1.8 by OLS including plant and year fixed effects. The first two columns use the full sample period 1994-2002, while the next columns exclude the Tequila Crisis period. The standard errors are clustered at the "4-digit industry $\times$ region (3MMA or OAD)" level, since this is the level at which the COC variable is constructed.

Across all specifications, Hausman (1978) tests reject the hypothesis that fixed and random effects (not reported) coefficients are not systematically different, implying that random effect models are inconsistent. The results excluding the Tequila Crisis show a negative and significant relationship between the investment rate and the user cost. The results are robust to the inclusion or exclusion of the cash flow variable.

The elasticity of investment with respect to the user cost is derived from multiplying the coefficient β by the ratio of the means of the COC and I/K variables. The last row of the top panel displays these elasticities. Excluding the Tequila Crisis the elasticity lies around -1.5 for 1996-2002 and -1.6 for 1997-2002, considerably larger than those found for the US (with a similar methodology Cummins et al. (1994) found an elasticity of -0.6 for US firms).

To see the extent to which classical errors-in-variables or measurement error might be present, the bottom panel of Table 1.4 estimates the same Equation 1.8 by first differences (with the same clustering), instead of fixed effects. The two estimators have the same probability limit under the assumption that there are no errors-in-variables, and should only differ due to sampling error.[21] Classical errors-in-variables should bias the first differences estimator toward zero. The two estimators systematically differ when using the full 1994-2002 sample, but do not differ when I exclude the Tequila Crisis. The logic of this result is clear given two facts: First, the dramatic increase and volatility of interest rates during the crisis (Table 1.1) might introduce measurement error in the user cost. Second, from 1995 to 1996, changes in investment and changes in the user cost might present legislative endogeneity, i.e., the fact that policy makers tend to introduce investment incentives when investment is perceived to be "low" (as mentioned in Section 1.3.2, in 1996 the government increased the value of depreciation allowances trying to promote investment in the aftermath of the crisis).

Logarithmic and industry aggregate regressions

The fact that the elasticity is the product of the estimated coefficient and the ratio of the means of the user cost and the investment rate variables implies that a greater than unity elasticity might be an artifact of the ratio of the means (because of fat tails) and not really an effect of the coefficient. A valid solution to this problem would be to estimate the model in logarithms, since the coefficient then would be interpreted directly as the elasticity.

In this case, however, this basic approach can be misleading because the many zeros in the investment rate variable are replaced by missing values when taking logs. Moreover, Tobit panel models are inconsistent since they can only be estimated through random effects.[22] I address this issue by aggregating information to the "6-digit industry $\times$ region" level (in order to get rid of many of the zeros) and then run the model in logs. For these regressions, I cluster the standard errors at the 4-digit industry level.

The top panel of Table 1.5 displays both the results of the regressions in levels and logs at the plant level. Note that when taking logarithms 30% of observations are lost. The elasticity from the model in logs is less than that found in levels. This result was expected since, as shown in Section 1.6.3 investment is lumpy (many periods of inactivity are followed

[21] I also estimate cross sectional IV regressions as in Hausman and Griliches (1986). These regressions support the results of the analysis presented in Table 1.7, which uses a subset (only first differences) of these equations.

[22] As mentioned before, Hausman (1978) Tests reject the null that fixed and random effects models are not systematically different. Since under the null both models are consistent but under the alternative only the fixed effects model is, this is evidence that the random effects model is inconsistent.

by large adjustments), thus the lost observations can provide a lot of power to explain the large elasticities because they represent the extensive margin of the elasticity. The elasticity is still higher than unity and double the size of the US benchmark (which is calculated in levels).

At the aggregate 6-digit industry level only 6% of observations are lost when taking logs. The most important result from these regressions is that the elasticity is unaffected by the use of levels or logarithms. Regardless of the model, this elasticity is close to -1.3. Although smaller than the elasticity at the plant level, this number is still greater than unity, and more than double the size of the US benchmark. This table provides evidence that the large elasticity found in Table 1.4 is not an artifact of the ratio of the means.

1.5.3 Instrumental variables estimation

To make the estimation robust to endogenous determination of the user cost and investment rates (a common shock might affect interest rates and investment rates), I estimate three different models with instrumental variables. For the first set of IV regressions, I instrument the user cost with its lagged value together with current values of tax variables.[23] Specifically, the instruments in this regression are the first lag of the cost of capital and the current value of depreciation allowances (z).[24] The results of this estimation are shown in the top panel of Table 1.6.

The estimated elasticities for 1996-2002 and 1997-2002 differ in their magnitude. While estimations for 1994-2002 and 1996-2002 show elasticities around -1.8, this figure is around -2.5 for 1997-2002. Note also that when I exclude the Tequila Crisis, Hausman (1978) tests (performed on exactly the same sample) do not reject the hypothesis that the difference between the OLS and the IV coefficients is not systematically different. The two estimators have the same probability limit under the null hypothesis that the right hand side variables are exogenous.

Using z might still introduce some endogeneity since the discount rate to get the PDV of depreciation allowances in the 3MMA region depends on the current interest rate (only its riskless component). That is not true for OAD regions, where z is independent of the

[23] This is a common approach in the literature; see Hassett and Hubbard (2002).

[24] In other specifications where the cash flow to capital ratio is included (not reported), I also included this variable as endogenous and used its lag as an additional instrument. The results look similar to Table 1.6, however, the results for 1997-2002 are only marginally significant.

current interest rate. For this reason, the bottom panel shows the second IV strategy where instead of using z as an instrument, I use a dummy for plants that qualify for the optional accelerated depreciation in the years in which the system was in effect (i.e., the interaction between a dummy for the OAD region times a dummy for years 1994-1998 and 2002). Using the "reform$\times$region" dummy potentially eliminates the source of simultaneity of interest rates. The table shows that the results from this exercise are similar to those using z as the instrument. Note also that overidentification tests strongly reject the null, and the significance levels of these tests are greater by an order of magnitude compared to the top panel (as would be expected given the possible small endogeneity of z). In summary, Table 1.6 provides evidence of a strong response of investment to the user cost, and in particular to tax incentives, with a preferred IV estimate of -2.0 (columns (3) and (4) in the bottom panel).

Even if the exclusion restriction for the use of z or the "region$\times$reform" dummy as instruments does not hold, the panel nature of the database still allows me to estimate IV models using lagged levels of the right hand variable in models estimated in differences. Hausman and Griliches (1986) show that there can be many equations to estimate (first differences, second differences, etc.) with all non-coincident levels as instruments (or levels one or more periods apart depending on the assumptions about the serial correlation of measurement error).

Table 1.7 shows the estimation in first differences (in order to get rid of the unobservable plant effects), using non coincident lagged levels of the user cost as instruments. I estimate the model with the Generalized Method of Moments Dynamic Panel estimator developed by Arellano and Bond (1991), including one lag of the left hand side variable as another explanatory variable. The estimates of this model also show a negative and significant relationship between the user cost and investment, though the elasticities are less precisely estimated (between -1.0 and -2.0).

Overall, Tables 1.6 and 1.7 show that the results of Section 1.5.2 are robust to IV strategies and that the elasticity of investment with respect to the user cost is large compared to US standards, with a preferred IV estimate around -2.0.

1.5.4 Long run elasticity of the capital stock with respect to its user cost

The previous section describes the instantaneous reaction of investment to changes in the user cost. In this section, I also provide estimates of the long run elasticity of the stock of capital to changes in the user cost. For this purpose, I rely on delivery lags as in Chirinko et al. (1999). The specification consists of regressing the investment rate on present and lagged percentage changes of the user cost ($\Delta COC/COC$), present and lagged percentage changes of output ($\Delta Y/Y$), and present and lagged levels of the cash flow to capital ratio (CF/K):

$$\begin{aligned}\frac{I_{it}}{K_{it-1}} &= \alpha_i + \sum_{k=0}^{4} \beta_k (\frac{\Delta COC_{it-k}}{COC_{it-k-1}}) + \sum_{k=0}^{4} \gamma_k (\frac{\Delta Y_{it-k}}{Y_{it-k-1}}) \\ &\quad + \sum_{k=0}^{4} \psi_k (\frac{CF_{it-k}}{K_{it-k-1}}) + \eta_t + \epsilon_{it}. \end{aligned} \tag{1.9}$$

where, Y: output, and the rest of the variables are defined as above.

Chirinko et al. (1999) show that, under certain assumptions, the sum of the coefficients on the lagged changes in the user cost (β_k) can be interpreted as the elasticity of the capital stock with respect to the user cost. Table 1.8 shows the sums of these coefficients along with their clustered standard errors using plant and year fixed effects. The last two columns use the Dynamic Model estimator (Arellano and Bond (1991)), which includes one lag of the dependent variable, and use levels of the left and right hand side variables as instruments in the regression in first differences. The average of the elasticities in this table is -1.1.

These results are not inconsistent with the findings of Sections 1.5.2 and 1.5.3. In those sections, my estimates of the elasticity of investment to the user cost were two to four times larger than the benchmarks for the US reported by Hassett and Hubbard (2002). With a different methodology, Chirinko et al. (1999) find a long run elasticity of the capital stock around -0.25; I obtain elasticities that are around four times this benchmark.

1.5.5 Long run elasticity of the targeted investment with respect to its user cost

Finally, I also estimate the long run elasticity of the targeted capital stock or targeted investment with respect to its user cost. According to the analysis in Caballero et al.

(1995), this elasticity can be estimated under the assumption that deviations between the actual capital stock and the frictionless capital stock (the one that the firm would choose if there were no adjustment costs) are not persistent. Since the difference between the frictionless and the actual capital is a function of the capital output ratio and the user cost in the neoclassical model, the former assumption suggests estimating a cointegrated regression of the capital output ratio on the user cost, where the cointegration vector is in fact the long run elasticity of the capital stock with respect to the user cost:[25]

$$\ln\left(\frac{K_{it-1}}{Y_{it}}\right) = \alpha + \beta COC_{it} + \epsilon_{it}. \tag{1.10}$$

Table 1.9 shows the results of estimating this model (clustering standard errors at the plant level). To compare these results to those for the US (reported in Caballero et al. (1995)), I also allow for different elasticities (the coefficient β) for each 2-digit industry. In columns (2), (4) and (6), I also include lagged differences of the cost of capital to control for small sample biases, as suggested by Caballero (1994). Caballero et al. (1995) report coefficients for the different industries between 0.0 and -2.0, averaging -1.0. My preferred estimates (1996-2002 controlling for small sample bias, column (4)) show elasticities ranging from -1.7 to -4.7, with a pooled COC coefficient of -3.4, three and a half times higher than that for the US, again consistent with the results of Section 1.5.2.

1.6 Explaining the large elasticities: additional results

In this section, I explore additional results that might help to explain the large estimated elasticities found in Section 1.5. First, in Section 1.6.1 I consider the role of FDI on investment. The presence of multinational firms, with presumable more outside options for investment, might explain why investment is so responsive. Section 1.6.2 also presents indirect evidence on the reaction of prices to changes in tax incentives. Goolsbee (1998) shows that large price reactions reduce the response of investment in the US. If prices do not react in Mexico, this might also help to explain the large elasticities. Then, section 1.6.3 analyzes whether adjustment costs are convex. Convex adjustment costs might explain the difference between these large elasticities and those of the US (where adjustment costs have been found to be nonconvex). Finally, in Section 1.6.4 I explore another possible explanation

[25] See Section 1.6.3.

for the large elasticities: misreporting of capital expenditures. I look at the elasticities for different types of capital, in particular, investment in transportation equipment and land, which are potentially more difficult to misreport.

1.6.1 FDI and Investment Incentives

Table 1.2 shows that plants owned by multinational firms invest more, have higher cash flow to output ratios and smaller output to capital ratios. In this section I explore whether the response to changes in the user cost is also different from that of domestically owned plants.

To perform this exercise, I interact the user cost variable with dummies for the country with majority ownership for each plant. The results displayed in Table 1.10 show that US, British, German and Swiss multinationals reacted more than other multinationals, and also more than domestic firms. Notably, these countries have the largest ownership concentration among the sample, as can be seen in Column (4).

The differential response of multinational firms might be due to international taxation rules. According to the traditional theory of international taxation, there are two main systems to tax foreign income. The first system is called Territorial Taxation. In this system, profits that a multinational receives from operations in other countries are exempt from taxation in the country where the multinational is incorporated. In this system, for example, the profits generated by a plant owned by a German multinational and located in Mexico are taxed in Mexico but are exempt from taxation in Germany. Thus in this system, multinational firms face the same burden of taxation as domestic firms.

The other main system is called Worldwide Taxation. In this system, profits that a multinational receives from operations in other countries are included in a "worldwide" measure of income, which is the basis for taxes in the country of incorporation. In some cases, the government of the country of incorporation allows claiming tax credits on the taxes paid to foreign governments (with some possible limit). In this system, for example, the profits generated by a plant owned by a US multinational and located in Mexico are taxed in Mexico and they are also included as taxable income in the US. However, the multinational firm can claim tax credits to the Internal Revenue Service in the US for taxes paid to the Mexican government. In this set up, multinational firms might avoid facing the full burden of taxation in the host country.

Column (2) of Table 1.10 displays the general method of taxing foreign income in these nine countries (OECD (1991)). According to this classification, in Column (3) I present results of regressing the investment rate on interactions of the user cost variable and dummies for the different taxation systems. The counterintuitive result indicates that the response by multinationals incorporated in countries with territorial systems of taxation is slightly lower than those incorporated in countries with worldwide systems of taxation. However, a linear test of the hypothesis that the coefficients are equal is unable to reject the null. Once transformed to elasticities, the difference is even smaller. This finding implies that the reason behind the higher response of multinational firms does not rely on international taxation issues, but probably on more available options for investment.

The analysis of this subsection shows that the response of multinational firms is larger than that of domestically owned plants, which, together with the plausible assumption that multinational firms have more outside options for investment, partially explains the large elasticities found in Section 1.5.

1.6.2 Price response to changes in tax incentives

As noted in the literature review, there is evidence that prices react to changes in tax incentives, reducing its effect on investment. Thus, the large elasticities found in this paper might be due to price insensitiveness. To see if that is the case, I run separate regressions for capital expenditures in the domestic market and imports of capital goods.[26] Under perfect markets for international and domestic capital goods and no other imperfections in the financial markets, the elasticities of both imports and domestic purchases should be about the same. Moreover, the reforms to the Mexican tax system are unlikely to change the international prices of capital goods but, if the domestic capital goods market is not perfect, domestic prices might change. In that case the estimated elasticity of imports would be higher than that of domestically purchased assets.

Table 1.11 shows the results of these regressions.[27] The elasticity of imported investment triples that of domestically purchased capital goods (-0.9 versus -3.1). This table thus presents evidence of a possible domestic price response to changes in tax incentives. This finding suggests that the openness of the Mexican economy and its proximity to the US

[26]The results are the same if the model is estimated as a Seemingly Unrelated Equations Model (SUR).

[27]The user cost for imports of assets is adjusted for changes in the foreign exchange rate.

market of capital goods might explain the large elasticities, since prices in the international capital goods are fixed.

1.6.3 Nonparametric analysis of the adjustment cost function

The use of plant level data allows me to perform a detailed analysis of the investment process, in order to determine the nature of adjustment costs. The presence of convex adjustment costs could explain the large elasticities found in this paper, compared to non-convex adjustment costs as those found for the US. For this purpose, I construct a measure of the desired capital stock, following Caballero et al. (1995), by first imputing the frictionless capital stock to each firm, using Equation 1.11 (the former is the capital stock that the firm would choose if adjustment costs were temporarily removed, while the latter is the capital stock that the firm chooses when there are no adjustment costs at all).

$$\ln(K^*_{it}) - \ln(K_{it-1}) = \eta_{it}\Big(\ln(Y_{it}) - \ln(K_{it-1}) - \theta_i COC_{it}\Big), \tag{1.11}$$

where, K^*: frictionless capital (before adjustments take place).

To obtain K^*, some parameters need to be estimated. As in Caballero et al. (1995), θ_i is taken to be equal to the coefficient of the cointegrated regression in Table 1.9 (Column (4)); this is because deviations between actual and frictionless capital stock are assumed not to be persistent, which implies that there is a long run relationship between the variables in the right hand side of the equation that can be estimated by cointegration. The value for η_{it} is approximated as the cost share of machinery and equipment for each 2-digit industry, with data for input costs from the EIA.[28]

Once the frictionless stock of capital (K^*) has been determined, the desired capital stock (K^d) is assumed to be proportional to the frictionless capital, up to a plant specific constant. This constant is estimated as the average difference between the actual capital and the frictionless capital for the five observations in which the investment rate is closest to the median investment rate:

$$\ln(K^d_{it}) = \ln(K^*_{it-1}) - d_i, \tag{1.12}$$

where, d_i: plant specific constant.

[28] Appendix B of Caballero et al. (1995) shows the details in the derivation of this approximation.

With a measure of the desired capital stock at hand, it is then easy to explore the nature of adjustment costs. For example, I can analyze mandated investment (i.e., the investment that is necessary to close the gap between the actual capital stock and the desired capital stock). Furthermore, I can also explore the pattern of the average adjustment function (i.e., the ratio of actual investment to mandated investment).

Figure 1-1 shows histograms for the actual investment rate, the estimated shock and the mandated investment rate. Following Caballero et al. (1995) I standardize these measures by removing plant means and dividing by plant standard deviations. Note how actual investment is more skewed (thicker right tail) and has higher kurtosis (spike) than mandated investment. Mandated investment even displays negative excess kurtosis. This pattern is consistent with the presence of irreversibilities and nonconvexities in the capital accumulation process.

Using nonparametric estimation, I also show the relationship between investment and mandated investment in the top panel of Figure 1-2. Irreversibilities are evidenced by the small response of actual investment to negative mandated investment, i.e., resilience to disinvest. At large negative levels of mandated investment, actual investment is in fact flat. Moreover, consistent with nonconvex adjustment costs, the slope of the line in the positive side of mandated investment is increasing. Under convex adjustment costs, large investment episodes should be avoided and replaced by small and gradual adjustments. Nonconvex adjustment costs provide a rationale for higher proportional investment responses to higher mandated investment.

Further evidence can be derived from nonparametric estimation of the average adjustment function, which is shown in the bottom panel of Figure 1-2. Once again, note that the left hand side of the figure is almost flat, confirming that investment is irreversible: negative mandated investments are in general not followed by negative adjustments to the capital stock. The smoother line shows an S-pattern, as found by Caballero et al. (1995) for US plants. As noted in Section 1.2.2, my results contrast with those of Gelos and Isgut (2001b). These authors find irreversible but convex adjustment costs. The differences could be due to the different time period of study or the use of different capital stock and user cost variables, as noted in Section 1.4 and the Appendix A-1.[29]

[29] Gelos and Isgut (2001b) study 1984-1994. Also, they do not construct a measure of the cost of capital, but only use the relative prices of capital and output. Moreover, they use gross book value to measure the initial capital stock in their perpetual inventory method, while I was able to use the initial market value of

The evidence presented in this section rejects that adjustment costs are convex. In fact, the adjustment cost function resembles that for US manufacturing plants. Therefore, the explanation for elasticities larger than those of the US does not lie on convex adjustment costs.

1.6.4 Investment in other types of capital

The previous analysis considers only investment in machinery and equipment. One possible explanation for the large estimated elasticities can be that firms misreport capital expenditures. For example, in response to the 1999 reform, which increased the user cost for many plants, managers could have tried to report some capital expenditures as operating expenses (tax evasion). The likelihood that this might contaminate information on the EIA is small for two reasons. First, firms are not liable for tax purposes regarding the information reported on the survey. Second, in the validation process INEGI officials match investment information (flow of purchases of capital goods) to asset values (balance sheet), reducing the misreporting.

Even though the possibility of misreporting is low, I analyze the behavior of other types of capital to provide further evidence on a generalized response of investment to changes in the user cost. These other asset categories are: constructions and facilities, land and transportation equipment. It is important to note, however, that the tax depreciation rules for these other types of capital do not vary by industry, which in turn reduces the variation in the *COC* variable and might decrease the precision with which the coefficients of the regressions are estimated.

Table 1.12 shows the results of these regressions. In these regressions the unit of observation is each asset category in each plant, thus each regression includes "plant × asset" fixed effects. I cluster the standard errors in these regressions at the "4-digit industry × region × asset" level.

The first two columns show the results of pooling all types of capital together. The number of observations is not just the product of the number of plants times the number of periods times four since many plants present missing values for investment in these other types of capital. The results show an elasticity even higher than that of Table 1.4. This might be due to larger elasticities for some asset classes than for machinery and equipment.

assets from the 1994 Industrial Census.

Columns (3) and (4) show the coefficients separated by asset categories.

Note that all coefficients are negative and significant. The largest coefficient corresponds to transportation equipment. Land also presents a coefficient larger than that of machinery and equipment. Constructions and facilities has a coefficient smaller than machinery and equipment, but also negative and highly significant.

Since land, constructions and transportation equipment are harder to misreport for tax evasion, I conclude that the large elasticity found in Section 1.5 is not an artifact of tax evasion practices.

1.7 Policy implications

Worldwide tax policy discussions rarely omit the debate of the efficiency advantages of consumption taxes versus income taxes. Since most countries have in fact hybrid systems, tax reform discussions are overwhelmingly related to the optimal choice of instruments to gradually move to consumption taxes. The implications for tax policy of a large response of investment to changes in the user of cost, as the one found in this paper, are presumably important in this setting.

The results of this paper imply that fiscal policies designed to change the corporate tax rate, investment tax credits and depreciation allowances are effective in promoting investment. Moreover, the user cost not only varies due to changes in taxes, but also with changes in interest rates. The results of Sections 1.5 and 1.6 also imply that monetary policies aimed to change interest rates can have important consequences on manufacturing investment.

The validity of using these elasticities for tax policy analysis lies on the "structural" nature of the model from which they are derived. The specifications are robust to the inclusion of year fixed effects and, in many cases, linear tests (not reported) were unable to reject the null that the coefficients of the year effects are equal. Overall, this mitigates the possible critique that the estimated coefficients should not be used for policy implications.[30]

In this section, I discuss the magnitude of these responses. First, I predict the effect that the tax provisions for 2003, 2004 and 2005 can have on manufacturing investment in Mexico,[31] based on the estimated elasticities. Then, I compare these results with the

[30]See Lucas (1976).

[31]The reforms include the reduction in the discount rate to calculate OAD to 3%, and the reduction of

hypothetical introduction of a 10% Investment Tax Credit (ITC) in 2003 (together with the elimination of the OAD system). Finally, I estimate the impact of allowing full expensing of investment for all plants in 2003.

Table 1.13 presents the calibrations of these scenarios. Each row represents the period of analysis: either for the actual reforms approved by the Congress or for the ITC and full expensing scenarios. The first two columns show the weighted average level and percentage change in the user cost (weighted by the capital stock), respectively. The last two columns show the predicted level of the investment rate: Column (3) under the assumption of a conservative elasticity of -1.5 (OLS) and Column (4) under the assumption of my preferred IV estimated elasticity of -2.0.

In the top panel, the initial level of the investment rate is taken to be equal to the actual weighted (by capital stock) level of the investment rate in 2002 (around 9.0%). This very small investment rate might bias the policy results downwards. To get the level of investment in each year, I make calculations at the 4-digit industry level.[32] The predicted investment rates for 2005, under the approved reforms, are between 11.2% and 12.0%. The introduction of a 10% investment tax credit (repealing the OAD system) is predicted to increase investment rates to 12.4%-13.5% and full expensing to 12.7%-13.9%. Notably, the approved changes are nontrivial when compared to the ITC and full expensing scenarios, and are predicted to have an important effect on investment.

Assuming a level of the investment rate equal to the average for the period 1994-2002 (16.3%), the predicted changes are considerably larger in absolute value. The cumulative effect of the approved reforms gives a weighted average investment rate in 2005 of 20.3%-21.6%. A 10% ITC (repealing the OAD system) would have increased the weighted average investment rate to 22.3%-24.3%, compared to 22.9-25.2% in the full expensing scenario.

1.8 Conclusions

This paper provides additional evidence on the responsiveness of investment to changes in the user cost of capital. I use a panel database of Mexican manufacturing plants and take advantage of the large variation in the user cost provided by recent reforms to the Mexican

the corporate tax rate. See Section 1.3.2.

[32]Specifically, I multiply the investment rate in 2002 for each industry by one plus the product of the assumed elasticity and the change in the user cost for that industry. I obtain an aggregate measure by weighting industry investment rates using the capital stock in 2002.

corporate tax system in order to identify the elasticity of investment with respect to its user cost.

The results of this paper show that the elasticity of investment with respect to the user cost is larger than unity, with a preferred estimate of -2.0, implying that taxes affect investment decisions. These results are robust to different specifications, including estimating models of long run and short run investment dynamics. The results are also robust to different IV strategies, including instrumenting the user cost with current tax parameters or dummies for the reforms and the use of dynamic panel IV models.

Additional results show that the small open economy nature of the Mexican economy might explain the large elasticities. In particular, I show that plants owned by multinational firms respond more to changes in the user cost. Moreover, I show that even if domestic prices of capital goods reacted to changes in tax incentives, the openness of the Mexican economy and its proximity to the US market allow plants to adjust their imports of capital goods and respond to changes in the user cost. I also show that the pattern of investment is consistent with the presence of nonconvex adjustment costs, including irreversibilites, similar to those of US manufacturing plants. This implies that large investment responses are not explained by smoother adjustment processes compared to US firms. Finally, I present some evidence that the large elasticities are not the result of misreporting or tax evasion, since the elasticities of investment in transportation equipment and land (harder to misreport) are also high.

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A-1 Data appendix

A-1.1 Plant Level Data: EIA, 1994-2002

The Annual Industrial Survey (Encuesta Industrial Annual, or EIA) is conducted by the Mexican Statistical Agency, INEGI (Instituto Nacional de Estadística, Geografía e Informática), and is housed at its headquarters in Aguascalientes, Mexico. It began in 1963 and has been significantly improved over the years, increasing the sample size, industry representativity and improving the questionnaire. In this study I use the most recent panel: 1994-2002. I also combine this panel with aggregate information from the previous panel (1984-1994), as explained below in Section A-1.2. INEGI follows a non-random sampling procedure to determine the group of manufacturing plants that would be surveyed. This procedure, described in INEGI (2005), is based on the directory of plants of the XIV Industrial Census of 1994 and consists on the following steps:

1. Select the industries, among the 309 6-digit industries in the Mexican Classification System (CMAP), that contribute the most to total output.[33]
2. Select the plants with the largest output in each 6-digit industry, until each industry has at least 80% of total output.
3. Include all plants with more than 100 employees that were not selected by the previous criteria.
4. Include all plants in industries where production is highly concentrated.
5. Conversely, in industries where production is highly disaggregated, set the maximum number of selected plants to 100.

The result from this procedure is a sample of 7,171 manufacturing plants in 205 6-digit industries, which excludes maquiladoras, basic petrochemical plants, refineries and also micro-industry plants (plants with less than 15 employees). INEGI includes a small random sample of new plants each year; other plants are reclassified as necessary.

The variables used in the empirical analysis include:[34]

- Location: state and municipality.

[33]The CMAP (Clasificación Mexicana de Actividades y Productos) is compatible with the International Standard Industrial Classification (ISIC) at the 4-digit level. The classification consist of the following categories: 1-digit sectores (e.g. Manufacturing, 3); 2-digit subsectores (e.g. Food products, beverages and tobacco, 31); 4-digit ramas (e.g. Dairy products, 3112); and 6-digit clases (e.g. Processing, bottling and packing of milk, 311201).

[34]The following variable definitions are based on INEGI (2005).

- Industry: 9 (2-digit) "subsectores", 50 (4-digit) "ramas" and 205 (6-digit) "clases".
- Employment: total payroll.
- Profit Sharing: total payments to employees and workers due to the profit sharing scheme. The Mexican Constitution mandates firms to distribute 10% of pre-tax earnings to employees and workers each fiscal year. The figures in the EIA include actual payments during the year, regardless of its fiscal year.
- Output: value of production.
- Assets: The next set of variables, broken down for each of these five asset categories: Machinery and equipment;[35] constructions and facilities;[36] land; transportation equipment;[37] and, other assets.[38]
  - Value of assets: the valuation is made at acquisition (historic) cost, defined as the purchasing price plus transportation and installation costs and import duties; excludes interest.
  - Acquisition of new assets: includes the value of each fixed asset purchased and/or acquired through financial lease or received from other plants of the same firm during the year of study. Also includes expenses that improved currently used assets by increasing its useful life by more than one year, changing its nature or increasing its productivity. Information is broken down by whether the asset was bought in the domestic (new or used) market, or if it was directly imported from abroad.
  - Production of assets for plant own use: includes the value of all fixed assets produced by the plant for its own use, using plant materials and personnel. The valuation is done at market prices.
  - Sale of assets: is the amount effectively received for the sale of fixed assets owned by the plant during the year (excluding interest), regardless of whether they were originally bought from third parties or produced by the plant for own use.
  - Depreciation of assets: means the consumption of fixed capital or reduction in the value of fixed assets used in production during the year, due to physical

[35]Includes mechanic, electric and any other type of machinery and equipment, dies, molds, tools and laboratory equipment.

[36]Includes plants, warehouses, offices, stores, parking slots and facilities for water, electricity and steam conduction.

[37]Includes all automotive vehicles, ships, planes, carts, carriages, tractors and freight elevators.

[38]Includes office equipment and furniture, computers, original software and calculators; excludes intangible assets like patents.

damage or obsolescence.

- Write-off of assets: includes the value of all assets retired, scrapped or destroyed due to its inoperative status. This value is reported at historic costs and thus cannot be used in the calculation of retirements.[39]

A-1.2 Industry aggregate EIA Data, 1984-1994

Industry aggregate information on asset values and depreciation (both at historic prices) was also used (at the 6-digit level). This information was averaged over the years to estimate industry economic depreciation rates. This rates were used in the calculation of the cost of capital at the 4-digit level in the 1994-2002 panel of plant level information.

A-1.3 XIV Industrial Census of 1994

INEGI officials allowed to merge EIA data with information for total assets at market prices (also called replacement costs) from the 1994 Industrial Census for a subsample of 4,997 plants.[40] The information was also separated by machinery and equipment, constructions and facilities, land, transportation equipment, and other assets.

A-1.4 1994 ENESTYC

In 1994, the EIA was jointly surveyed with a Technology Database (Encuesta Nacional de Empleo, Salarios, Tecnología y Capacitación). INEGI officials provided matched information regarding country of equity ownership for each plant for a subsample of 6,845 plants. The questionnaire asked the ownership percentage for the following countries: Mexico, USA, Germany, Canada, France, Netherlands, Japan, UK, and Switzerland.

A-1.5 Construction of the OAD dummy: Region variable

Due to confidentiality reasons, officials at INEGI directly constructed the variable for whether a plant qualified for OAD. The Income Tax Law expressly states that, to qual-

[39]Given its inoperative status, the market value of these assets must be near zero, otherwise they could be sold to generate positive cash flow. In fact, the value is equal to zero at the following percentiles: machinery and equipment (76), constructions and facilities (95), land (97), transportation equipment (63), and other assets (78).

[40]The survey guidelines explain what the respondent should understand by replacement cost or market value. It is the sum of the acquisition cost, plus the value of all improvements and renovations, as well as the revaluation due to inflation, less the accumulated depreciation, i.e., the value of all allowances due to physical damage and obsolesce.

ify for this preferential tax treatment of investment, the investment must be made outside the three main metropolitan areas or 3MMA (Mexico City, Monterrey and Guadalajara).[41]

According to the tax authority, these jurisdictions are delimited at the municipal level.[42] I provided INEGI with the list of municipalities and they matched a dummy variable for whether the plant was in the 3MMA region, or if it was located elsewhere, and thus qualified for OAD.

A-1.6 Construction of capital stock variable

The EIA asks plants to report asset values and depreciation at historic cost. It also includes questions about the inflation adjustment of both values and depreciation (in order to have an estimate of the asset value at replacement costs). However, the information for these adjustments has never been used by the INEGI due to important failures to comply with validation of the data. Previous studies that have used the EIA create the capital stock series using the perpetual inventory method.[43] However, the perpetual inventory method can only generate reliable estimates if the panel is considerable long (many time periods) to erode the bias created by using book values of assets, instead of market values of assets, as the initial capital stock.

Moreover, the distinction between information at gross book value (also called historic cost) and information at net book value (also called Book Value) has been often ignored. The gross book value is the actual payment made at the time of purchase, without any adjustment (neither for inflation, nor depreciation). The net book value is equal to the purchase payments minus the value of depreciation allowances, but without inflation adjustments.

The information for asset values in the EIA is reported at gross book value or historic

[41] There exist other considerations that allow for this special tax treatment. For example, even if a plant is located inside the 3MMA the investment can still qualify for OAD if the plant in question and the technology implemented are both labor intensive.

[42] According to the Decree to reform the Income Tax Law. (Diario Oficial de la Federación, December 12th, 2004): The MA of Mexico City includes all jurisdictions of the D.F. and the following municipalities of the State of México: Atizapán de Zaragoza, Cuautitlán, Cuautitlán Izcalli, Chalco, Ecatepec de Morelos, Huixquilucan, Juchitepec, La Paz, Naucalpan de Juárez, Nezahualcóyotl, Ocoyoacac, Tenango del Aire, Tlalnepantla de Baz, Tultitlán, Valle de Chalco-Solidaridad and Xalatlaco. Guadalajara MA includes the following municipalities of the State of Jalisco: Guadalajara, Tlaquepaque, Tonalá and Zapopan. The MA of Monterrey includes the following municipalities in the State of Nuevo León: Monterrey, Cadereyta Jiménez, San Nicolás de los Garza, Apodaca, Guadalupe, San Pedro Garza García, Santa Catarina, General Escobedo, García and Juárez.

[43] For example, Verhoogen (2004), Gelos and Isgut (2001a,b), Gelos and Werner (1999), López-Córdova and Mesquita-Moreira (2003), Hernández-Laos and del Valle-Rivera (2000), Pérez-González (2005).

cost (no adjustment for depreciation), and thus if used as the initial capital stock in the perpetual inventory method induces a bias, since the stock can still include assets for which depreciation has reduced their value.

I overcome this problem by merging the data of the EIA with data from the XIV Industrial Census of 1994. In the census, the information for asset values is reported at market (replacement) values. That means that I can actually use the perpetual inventory method with the information of the EIA, but having as the initial capital stock a true market valuation of the assets in each plant.

Another common assumption of previous studies that use the EIA is to assume a fixed depreciation rate for different asset categories. However, since the capital stock is one of the most important variables in my analysis, this simplification can be very costly in terms of measurement error.

I take advantage of the fact that both asset prices and depreciation are reported in the EIA at historic cost. Thus, for each asset category in each year I created a plant specific depreciation rate by dividing the reported depreciation by the value of assets. Since the value of assets has not been adjusted for any depreciation nor inflation, and depreciation has not been adjusted for inflation, this depreciation rate is quite precise.

The actual computation for the capital stock is described in Equation A-1.1. Finally, before using any of the actual figures in the survey, all quantities were transformed to 2002 pesos using the average (annual) Producer Price Index for Investment in Fixed Assets, published by Banco de México. In the next equation, j defines each type of asset (machinery and equipment, constructions and facilities, land, transportation equipment and other assets), i defines each manufacturing plant, and t defines each year from 1994 to 2002.

$$\begin{aligned} K_{jit} &= MVA_{jit}, t = 1994, \\ K_{jit} &= (1 - \delta_{jit})K_{jit-1} + I_{jit}, t = 1995, ..., 2002, \end{aligned} \tag{A-1.1}$$

where K is the capital stock; MVA is the market value of assets (from the Industrial Census); I is investment (including retirements; its construction is explained in Section A-1.7); and δ is the depreciation rate (defined in equation A-1.2):

$$\delta_{jit} = \frac{D_{jit}}{A_{jit-1}}, \tag{A-1.2}$$

where, D is the total depreciation (at historic cost) and A is the historic cost value of the asset.

Finally, whenever equation A-1.1 generated a negative capital stock, that year K was set to zero, and continue the same recursion.

A-1.7 Construction of expenditures, investment and retirement variables

The following expenditure, investment and retirement variables are used in the empirical analysis:

$$GE_{jit} = new_{jit} + used_{jit} + import_{jit} + ownuse_{jit}, \tag{A-1.3}$$

where, GE is gross expenditures, *new* is acquisition of domestic new assets; *used* is acquisition of domestic used assets; *imports* imports of assets; and *ownuse* the value of assets produced by the plant for its own use.

$$NE_{jit} = GE_{jit} - \delta_{jit} K_{jit}, \tag{A-1.4}$$

where, NE is net expenditures.

$$R_{jit} = assetsales_{jit} \tag{A-1.5}$$

where, R is the value of retirements, *assetsales* is the value of the sale of assets.

$$I_{jit} = GE_{jit} - R_{jit}, \tag{A-1.6}$$

where, I is investment.

A-1.8 Construction of cash flow variable

Unfortunately, the data on EIA is available only at the manufacturing plant level, and cannot be properly aggregated at the firm level. Financial information is thus not available, and a measure of cash flow is absent in the questionnaire. However, since the profit sharing rate is calculated at the firm level, the reported profit sharing amount contains information on firm pre-tax income. I thus follow Gelos and Werner (1999) in multiplying the reported profit sharing by 10 to get an estimate of pre-tax cash flow.

A-1.9 Construction of cost of capital variable

The cost of capital variable was created using Income Tax Laws (Ley del Impuesto Sobre la Renta) for the years of study, and was assigned to each plant according to whether the Accelerated Depreciation Option was applicable. It was calculated separately for each of the asset categories and assigned to each plant at the 4-digit industry level. The exact procedure is outlined below.

1. Each plant was classified as located in one of two zones: 3MMA-region if inside one of the three major metropolitan areas where OAD was not allowed, and OAD-region, otherwise.
2. The cost of capital for each asset category in each plant and year was calculated using Equation 1.2. The inputs for this calculation come from the following sources. Table 1.1 shows the behavior of some of these parameters.
   - The capital-output price ratio was created using two sources: The numerator is the output deflator for each 2-digit industry from the Mexican National Income and Product Accounts. The denominator is the price index for fixed capital formation, as reported by Banco de México. The ratio was set equal to 1 in 2002.
   - The Corporate Tax Rate was directly obtained from the Income Tax Laws for various years, and was adjusted to include the burden of the profit sharing rate.[44]
   - The required rate of return was assumed equal to the real riskless interest rate (UDIBONOS),[45] plus a time varying risk premium equal to the difference between the short term interest rate on private commercial paper and the short term interest rate on government bonds (CETES).
   - The present value of depreciation allowances for each plant was calculated based on Equation 1.1 using the normal depreciation rates allowed for each type of asset

[44] An alternative Asset Tax was enacted in 1989 to prevent firms from tax evasion. This tax is totally deductible from the Corporate Income Tax, and thus functions as a minimum tax. This paper does not consider the impact this provision might have on investment rates.

[45] UDIBONOS are government bonds issued at a fixed real interest rate for 3, 5 and 10 years. They started in 1996; the rate for 1994 and 1995 was extrapolated using other nominal interest rates on government bonds.

in the Income Tax Law for plants in the 3MMA region. For plants in the OAD region, it was calculated using the maximum optional accelerated depreciation allowed. This procedure implicitly assumes that all plants that qualify for OAD actually choose this option. Table A-1.1 shows the depreciation rates for selected assets and industries applicable in 2002.

- Economic depreciation rates were estimated at the 6-digit industry level using aggregate information about asset values and depreciation (both at historic cost) from the previous EIA panel (1984-1994). These depreciation rates were assigned at the 4-digit industry codes to each plant in the EIA panel used in the study (1994-2002).

A-1.10 Treatment of extreme and missing values

Variables were winsorized at the 1% and 99% of the empirical distribution. Observations for which the capital stock was zero were eliminated. Plants with incomplete information were not included in the analysis, thus the panel is balanced.

Tables and Figures

Table 1.1: Corporate Tax Rates and Depreciation Allowances, 1993-2007

Year	Corporate Tax Rate*	OAD system**	Real interest rate***
1993	35%	Yes (5%)	10.83%
1994	34%	Yes (5%)	12.89%
1995	34%	Yes (5%)	18.72%
1996	34%	Yes (3%)	12.78%
1997	34%	Yes (3%)	8.67%
1998	34%	Yes (3%)	8.51%
1999	35%	No	10.29%
2000	35%	No	8.67%
2001	35%	No	8.12%
2002	35%	Yes (6%, w/deferral)	6.64%
2003	34%	Yes (3%, w/deferral)	5.38%
2004	33%	Yes (3%, w/deferral)	5.41%
2005	30%	Yes (3%)	5.74%
2006	29%	Yes (3%)	5.74%
2007	28%	Yes (3%)	5.74%

Example of tax parameters: Automobile parts industry

	z		ETR		COC	
Region	3MMA	OAD	3MMA	OAD	3MMA	OAD
1994	0.617	0.730	0.361	0.284	0.263	0.245
1995	0.608	0.730	0.330	0.253	0.259	0.240
1996	0.617	0.824	0.361	0.207	0.220	0.192
1997	0.672	0.824	0.372	0.242	0.190	0.172
1998	0.651	0.824	0.389	0.244	0.198	0.177
1999	0.616	0.616	0.397	0.397	0.243	0.243
2000	0.650	0.650	0.397	0.397	0.240	0.240
2001	0.663	0.663	0.397	0.397	0.243	0.243
2002	0.669	0.653	0.422	0.444	0.228	0.232

*In 1999-2001, the tax rate on Retained Earnings was 30%. The (5% × Taxable Income) tax liability was paid upon distribution. **The number in parenthesis is the discount rate applicable to calculate the PDV of depreciation allowances under the Optional Accelerated Depreciation system. See Section 1.3 for deferral rules in 2002-2004. ***See Section 1.4.3 for a description of the calculations. Source: Federal Income Tax Law (Ley del Impuesto Sobre la Renta) and author's calculations. z is the present value of future depreciation allowances, ETR is the effective tax rate and COC is the cost of capital. 3MMA stands for the region including the three main metropolitan areas. OAD stands for the region outside these metropolitan areas, where the accelerated depreciation applied.

Table 1.2: Summary Statistics, 1994-2002

	Mean	Std. Dev.	25%	50%	75%	N
COC	0.253	0.044	0.226	0.249	0.276	33,678
GE/K	0.168	0.378	0.000	0.032	0.159	33,678
NE/K	0.072	0.359	-0.081	-0.042	0.062	33,655
R/K	0.005	0.026	0.000	0.000	0.000	33,678
I/K	0.162	0.371	0.000	0.029	0.153	33,678
CF/K	0.623	1.838	0.000	0.043	0.422	32,443
Y/K	25.213	302.202	2.510	5.843	14.426	33,339

	3MMA (Means)	OAD (Means)	Difference 3MMA-OAD	Std. Err
COC	0.257	0.249	0.007***	0.000
GE/K	0.174	0.163	0.010**	0.004
NE/K	0.075	0.068	0.007*	0.004
R/K	0.006	0.005	0.001***	0.000
I/K	0.166	0.158	0.009**	0.004
CF/K	0.787	0.452	0.335***	0.020
Y/K	28.989	21.300	7.689**	3.310

	Multinationals (Means)	Domestic (Means)	Difference Mult.-Dom.	Std. Err
COC	0.254	0.253	0.001	0.001
GE/K	0.204	0.165	0.039***	0.007
NE/K	0.103	0.069	0.035***	0.007
R/K	0.005	0.005	0.000	0.000
I/K	0.199	0.158	0.041***	0.007
CF/K	0.884	0.595	0.289***	0.035
Y/K	18.363	25.936	-7.574	5.630

COC is the user cost of capital, GE and NE are gross and net capital expenditures, respectively; R are retirements, I is investment, Y is output, CF is cash flow and K is the capital stock. *,**,*** significant at 10%, 5% and 1%, respectively. 3MMA stands for the region including the three main metropolitan areas. OAD stands for the region outside these metropolitan areas, where the accelerated depreciation applied.

Table 1.3: Differences-in-Differences regressions
$\frac{I_{it}}{K_{it-1}} = \alpha_i + \beta_1 OAD_{it}^{period} + \beta_2 OAD_{it}^{region} + \beta_3 (OAD_{it}^{period} \times OAD_{it}^{region}) + \eta_t + \epsilon_{it}$

	(1)	(2)	(3)	(4)	(5)	(6)
	1994-2002		1996-2002		1997-2002	
OAD^{period}	0.026***		0.021***		0.017***	
	(0.006)		(0.006)		(0.006)	
OAD^{region}	-0.036	-0.01	-0.084**	-0.05	-0.063	-0.018
	(0.037)	(0.037)	(0.042)	(0.042)	(0.048)	(0.048)
$OAD^{period} \times OAD^{region}$	0.015*	0.015*	0.014*	0.015*	0.015*	0.016*
	(0.008)	(0.008)	(0.009)	(0.008)	(0.009)	(0.009)
Constant	0.158***	0.123***	0.182***	0.143***	0.171***	0.127***
	(0.019)	(0.019)	(0.021)	(0.022)	(0.024)	(0.024)
Observations	33,678	33,678	26,194	26,194	22,452	22,452
R-squared	0.161	0.17	0.202	0.211	0.224	0.236
Plant FE	Y	Y	Y	Y	Y	Y
Year FE	N	Y	N	Y	N	Y

I is investment, K is the capital stock . Robust standard errors in parentheses. All variables winsorized at the 1% and 99% of the empirical distribution. *,**,*** significant at 10%, 5% and 1%, respectively. 3MMA stands for the region including the three main metropolitan areas. OAD stands for the region outside these metropolitan areas, where the accelerated depreciation applied.

Table 1.4: Investment response to changes in the user cost
$\frac{I_{it}}{K_{it-1}} = \alpha_i + \beta COC_{it} + \gamma \frac{CF_{it}}{K_{it-1}} + \eta_t + \epsilon_{it}$

	(1)	(2)	(3)	(4)	(5)	(6)
	1994-2002		1996-2002		1997-2002	
COC	-0.265	-0.255	-1.021***	-0.986***	-1.074***	-1.028***
	(0.188)	(0.189)	(0.260)	(0.257)	(0.327)	(0.325)
CF/K		0.045***		0.049***		0.049***
		(0.005)		(0.005)		(0.005)
Constant	0.156***	0.154***	0.330***	0.333***	0.342***	0.343***
	(0.045)	(0.049)	(0.062)	(0.066)	(0.077)	(0.083)
Observations	33,678	32,443	26,194	24,959	22,452	21,217
R-squared	0.17	0.193	0.212	0.237	0.237	0.263
Plant FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Elasticity	-0.414	-0.398	-1.572	-1.518	-1.682	-1.610
	(1)	(2)	(3)	(4)	(5)	(6)
	1994-2002		1996-2002		1997-2002	
COC	0.148	0.181	-1.057**	-0.941**	-0.951**	-0.880**
	(0.256)	(0.250)	(0.434)	(0.457)	(0.428)	(0.442)
CF/K		0.056***		0.058***		0.055***
		(0.006)		(0.006)		(0.007)
Constant	-0.014***	-0.012***	-0.017***	-0.015***	-0.017***	-0.014***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)
Observations	29,936	27,842	22,452	20,358	18,710	16,720
R-squared	0.004	0.029	0.002	0.029	0.001	0.025
Plant FE	FD	FD	FD	FD	FD	FD
Year FE	Y	Y	Y	Y	Y	Y
Elasticity	0.231	0.283	-1.627	-1.449	-1.489	-1.378

I is investment, K is the capital stock , COC is the user cost of capital and CF is cash flow. Robust standard errors in parentheses (clustered at the "4-digit industry × region (3MMA or OAD)" level). FD: Model estimated in first differences. All variables winsorized at the 1% and 99% of the empirical distribution. *,**,*** significant at 10%, 5% and 1%, respectively. 3MMA stands for the region including the three main metropolitan areas. OAD stands for the region outside these metropolitan areas, where the accelerated depreciation applied.

Table 1.5: Logarithmic and industry aggregate regressions
$\ln(\frac{I_{it}}{K_{it-1}}) = \alpha_i + \beta \ln(COC_{it}) + \gamma \ln(\frac{CF_{it}}{K_{it-1}}) + \eta_t + \epsilon_{it}$

	(1)	(2)	(3)	(4)
	Plants: 1996-2002			
	Levels		Logs	
COC	-1.021***	-0.986***	-1.186***	-1.143**
	(0.260)	(0.257)	(0.430)	(0.463)
CF/K		0.049***		0.273***
		(0.005)		(0.025)
Constant	0.330***	0.333***	-4.582***	-4.242***
	(0.062)	(0.066)	(0.607)	(0.693)
Observations	26,194	24,959	18,227	11,476
R-squared	0.212	0.237	0.425	0.47
Plant FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Elasticity	-1.572	-1.518	-1.186	-1.143

	(1)	(2)	(3)	(4)
	Aggregate (6-digit industry level): 1996-2002			
	Levels		Logs	
COC	-0.848***	-0.820***	-1.284***	-1.264***
	(0.271)	(0.267)	(0.456)	(0.420)
CF/K		0.036**		0.141***
		(0.016)		(0.033)
Constant	0.357***	0.331***	-4.993***	-4.606***
	(0.059)	(0.072)	(0.681)	(0.628)
Observations	2,667	2,667	2,517	2,363
R-squared	0.291	0.294	0.428	0.445
Industry (6-digit) FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Elasticity	-1.303	-1.260	-1.284	-1.264

I is investment, K is the capital stock , COC is the user cost of capital and CF is cash flow. Robust standard errors in parentheses (clustered at the "4-digit industry × region (3MMA or OAD)" level in the top panel and at the 4-digit industry level in the bottom panel). In the bottom panel all quantities came from aggregates at the "6-digit industry × region" level. All variables winsorized at the 1% and 99% of the empirical distribution. *,**,*** significant at 10%, 5% and 1%, respectively. 3MMA stands for the region including the three main metropolitan areas. OAD stands for the region outside these metropolitan areas, where the accelerated depreciation applied.

Table 1.6: Instrumental variables estimation: investment response to changes in the user cost
$\frac{I_{it}}{K_{it-1}} = \alpha_i + \beta COC_{it} + \gamma \frac{CF_{it}}{K_{it-1}} + \eta_t + \epsilon_{it}$

	(1)	(2)	(3)	(4)	(5)	(6)
	Instruments: Lagged COC and current z					
	1994-2002		1996-2002		1997-2002	
COC	-1.179***	-1.184***	-1.188***	-1.174***	-1.650***	-1.648***
	(0.319)	(0.313)	(0.426)	(0.417)	(0.540)	(0.521)
CF/K		0.044***		0.049***		0.045***
		(0.004)		(0.005)		(0.006)
Constant	0.436***	0.349***	0.368***	0.379***	0.610***	0.499***
	(0.081)	(0.073)	(0.100)	(0.104)	(0.146)	(0.131)
Observations	29,936	28,701	22,452	21,217	18,710	17,579
Plant FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Hausman test (OLS)	0.002	0.005	0.998	0.995	0.288	0.391
Overid test	0.141	0.102	0.188	0.259	0.141	0.186
Elasticity	-1.841	-1.849	-1.829	-1.807	-2.584	-2.581
	(1)	(2)	(3)	(4)	(5)	(6)
	Instruments: Lagged COC and $(OAD^{period} \times OAD^{region})$					
	1994-2002		1996-2002		1997-2002	
COC	-1.391***	-1.403***	-1.323***	-1.277***	-1.941***	-1.886***
	(0.344)	(0.341)	(0.431)	(0.420)	(0.555)	(0.529)
CF/K		0.044***		0.049***		0.045***
		(0.004)		(0.005)		(0.006)
Constant	0.462***	0.399***	0.445***	0.368***	0.689***	0.558***
	(0.087)	(0.080)	(0.108)	(0.098)	(0.150)	(0.133)
Observations	29,936	28,701	22,452	21,217	18,710	17,579
Plant FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Hausman test (OLS)	0.000	0.001	0.930	0.973	0.035	0.130
Overid test	0.939	0.681	0.994	0.842	0.654	0.948
Elasticity	-2.172	-2.191	-2.037	-1.966	-3.039	-2.953

I is investment, K is the capital stock, COC is the user cost of capital and CF is cash flow. Robust standard errors in parentheses (clustered at the "4-digit industry × region (3MMA or OAD)" level). All variables winsorized at the 1% and 99% of the empirical distribution. *,**,*** significant at 10%, 5% and 1%, respectively. In the bottom panel, instruments are lagged cost of capital and a tax reform dummy (equal to 1 in years in which the OAD system was in effect, but only for those plants that qualified for this preferential treatment, i.e., located outside the main three metropolitan areas). 3MMA stands for the region including the three main metropolitan areas. OAD stands for the region outside these metropolitan areas, where the accelerated depreciation applied.

Table 1.7: Dynamic Panel IV Model: Response of investment to changes in the user cost $(\frac{I_{it}}{K_{it-1}} - \frac{I_{it-1}}{K_{it-2}}) = \alpha + \beta(COC_{it} - COC_{it-1}) + \gamma(\frac{CF_{it}}{K_{it-1}} - \frac{CF_{it-1}}{K_{it-2}}) + \eta_t + \epsilon_{it}$

	(1)	(2)	(3)	(4)	(5)	(6)
	1994-2002		1996-2002		1997-2002	
COC	-0.146	0.095	-0.782***	-0.668**	-1.267***	-1.147***
	(0.145)	(0.165)	(0.250)	(0.288)	(0.296)	(0.327)
CF/K		0.057***		0.058***		0.050***
		(0.006)		(0.008)		(0.008)
Constant	0.002	-0.005**	-0.017***	-0.014***	-0.022***	-0.020***
	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Observations	26,194	24,100	18,710	16,720	14,968	13,084
Plant FE	FD	FD	FD	FD	FD	FD
Year FE	Y	Y	Y	Y	Y	Y
AR1	0.000	0.000	0.000	0.000	0.000	0.000
AR2	0.507	0.341	0.609	0.701	0.182	0.445
Elasticity	-0.228	0.148	-1.204	-1.028	-1.984	-1.796

I is investment, K is the capital stock, COC is the user cost of capital and CF is cash flow. Robust standard errors in parentheses (clustered at the "4-digit industry × region (3MMA or OAD)" level). FD: Model estimated in first differences. All variables winsorized at the 1% and 99% of the empirical distribution. *,**,*** significant at 10%, 5% and 1%, respectively. The model is estimated in first differences using the Arellano-Bond dynamic panel estimator, including one lag of the dependent variable: the instruments are available lagged levels of the left and right hand side variables. 3MMA stands for the region including the three main metropolitan areas. OAD stands for the region outside these metropolitan areas, where the accelerated depreciation applied.

Table 1.8: Response of the capital stock to changes in the user cost, 1994-2002

$\frac{I_{it}}{K_{it-1}} = \alpha_i + \sum_{k=0}^{4} \beta_k (\frac{\Delta COC_{it-k}}{COC_{it-k-1}}) + \sum_{k=0}^{4} \gamma_k (\frac{\Delta Y_{it-k}}{Y_{it-k-1}}) + \sum_{k=0}^{4} \psi_k (\frac{CF_{it-k}}{K_{it-k-1}}) + \eta_t + \epsilon_{it}$

	(1)	(2)	(3)	(4)
	OLS		Dynamic Panel	
$\sum \Delta COC/COC$	-0.813*	-0.925	-1.065*	-1.655**
	(0.471)	(0.579)	(0.586)	(0.656)
$\sum \Delta Y/Y$	0.043	0.024	0.002	-0.043
	(0.040)	(0.047)	(0.036)	(0.041)
$\sum CF/K$		0.073***		0.093***
		(0.016)		(0.010)
Constant	0.155***	0.055*	-0.006	-0.009
	(0.020)	(0.030)	(0.014)	(0.015)
Observations	13,882	11,977	10,316	8,508
R-squared	0.332	0.377	na	na
Plant FE	Y	Y	FD	FD
Year FE	Y	Y	Y	Y
Elasticity	-0.813	-0.925	-1.065	-1.655

I is investment, K is the capital stock, COC is the user cost of capital, Y is output and CF is cash flow. Robust standard errors in parentheses (clustered at the "4-digit industry × region (3MMA or OAD)" level). All variables winsorized at the 1% and 99% of the empirical distribution. *,**,*** significant at 10%, 5% and 1%, respectively. In the last two columns, the model is estimated in first differences, using the Arellano-Bond dynamic panel estimator, including one lag of the dependent variable: the instruments are available lagged levels of the left and right hand side variables. 3MMA stands for the region including the three main metropolitan areas. OAD stands for the region outside these metropolitan areas, where the accelerated depreciation applied.

Table 1.9: Long run response of the targeted capital stock to changes in the user cost, 1994-2002
$\ln\left(\frac{K_{it-1}}{Y_{it}}\right) = \alpha + \beta COC_{it} + \epsilon_{it}$

	(1)	(2)	(3)	(4)	(5)	(6)
	1994-2002		1996-2002		1997-2002	
$COC\times$ Industry31	-3.430***	-3.433***	-3.129***	-3.984***	-2.670***	-3.606***
	(0.623)	(0.811)	(0.720)	(0.994)	(0.782)	(1.071)
$COC\times$ Industry32	-3.888***	-4.362***	-3.499***	-4.697***	-2.957***	-4.633***
	(0.744)	(0.939)	(0.825)	(1.116)	(0.884)	(1.180)
$COC\times$ Industry33	-4.019***	-4.086***	-3.746***	-4.216***	-3.450***	-4.007***
	(0.828)	(1.056)	(0.943)	(1.243)	(1.036)	(1.355)
$COC\times$ Industry34	-2.675***	-3.172***	-2.286***	-3.407***	-1.891**	-2.883**
	(0.782)	(0.968)	(0.859)	(1.150)	(0.919)	(1.241)
$COC\times$ Industry35	-2.533***	-2.561***	-2.203***	-2.863***	-1.768**	-2.110*
	(0.641)	(0.825)	(0.731)	(1.009)	(0.796)	(1.105)
$COC\times$ Industry36	-1.114	-1.279	-0.798	-1.687	-0.542	-1.516
	(0.786)	(1.017)	(0.903)	(1.229)	(0.987)	(1.337)
$COC\times$ Industry37	-0.587	-1.722	-0.003	-2.386*	0.6	-2.183
	(0.980)	(1.158)	(1.041)	(1.314)	(1.081)	(1.364)
$COC\times$ Industry38	-2.993***	-4.094***	-2.560***	-4.711***	-2.045**	-4.912***
	(0.789)	(1.011)	(0.871)	(1.204)	(0.930)	(1.256)
ΔCOC		12.523***		12.586***		19.447***
		(1.158)		(1.260)		(2.324)
$L1\Delta COC$		7.253***		11.944***		15.606***
		(0.688)		(1.147)		(1.549)
$L2\Delta COC$		4.863***		11.714***		12.592***
		(0.483)		(1.133)		(1.271)
Constant	-1.007***	-0.571***	-1.091***	-0.311	-1.197***	-1.101***
	(0.157)	(0.220)	(0.178)	(0.268)	(0.193)	(0.276)
Observations	32,126	21,212	24,835	13,994	21,212	10,414
R-squared	0.038	0.04	0.035	0.039	0.032	0.037
Plant FE	N	N	N	N	N	N
Year FE	Y	Y	Y	Y	Y	Y
COC (pooled)	-3.836***	-2.944***	-3.892***	-3.397***	-3.600***	-4.542***
	(0.525)	(0.673)	(0.622)	(0.773)	(0.673)	(0.929)
Elasticity (pooled)	-3.836	-2.944	-3.892	-3.397	-3.600	-4.542

K is the capital stock, Y is output and COC is the user cost of capital. Robust standard errors in parentheses (clustered at the plant level). All variables winsorized at the 1% and 99% of the empirical distribution. *,**,*** significant at 10%, 5% and 1%, respectively. Industry codes: 31 - Food, beverages and tobacco; 32 - Textiles and leather products; 33 - Wood industries and products; 34 - Paper, printing and publishing industries; 35 - Chemicals, petroleum, coal, rubber and plastic; 36 - Nonmetalic minerals; 37 - Basic metal industries; 38 - Machinery and equipment, and other metal products.

Table 1.10: Investment response to changes in the user cost by Country of Majority Ownership
$\frac{I_{it}}{K_{it-1}} = \alpha_i + \sum_{l=1}^{11} \beta_l (COC_{lit} \times CountryOwnDummy_{il}) + \gamma \frac{CF_{it}}{K_{it-1}} + \eta_t + \epsilon_{it}$

	(1) 1996-2002	(2) Tax System	(3) 1996-2002	(4) Avg. Ownership
$COC\times$ Mexico	-0.985***	W-W	-0.980***	88.4%
	(0.263)	(35%)	(0.263)	
$COC\times$ United States	-1.462**	W-W		6.3%
	(0.578)	(39.3%)		
$COC\times$ United Kingdom	-2.059*	W-W		0.4%
	(1.229)	(30%)		
$COC\times$ Japan	-0.086	W-W		0.4%
	(0.768)	(40.9%)		
$COC\times$ Germany	-1.920***	Terr.		1.1%
	(0.745)	(38.9%)		
$COC\times$ Switzerland	-1.632***	Terr.		0.6%
	(0.619)	(24.4%)		
$COC\times$ France	0.297	Terr.		0.5%
	(1.426)	(35.4%)		
$COC\times$ Netherlands	0.645	Terr.		0.5%
	(1.324)	(34.5%)		
$COC\times$ Canada	-0.962	Terr.		0.3%
	(1.790)	(38.6%)		
$COC\times$ Worldwide Tax			-1.357***	
			(0.511)	
$COC\times$ Territorial Tax			-1.052**	
			(0.525)	
CF/K	0.049***		0.049***	
	(0.005)		(0.005)	
Constant	0.306***		0.305***	
	(0.061)		(0.061)	
Observations	23,779		23,779	
R-squared	0.237		0.237	
Plant FE	Y		Y	
Year FE	Y		Y	

In Column (2), W-W and Terr refer to Worldwide and Territorial taxation of foreign income, respectively; the number in parenthesis is the top statutory corporate tax rate effective in 2002, including state and local taxes (OECD (1991)). Column (4) shows the average ownership percentage across the sample of plants. I is investment, K is the capital stock, COC is the user cost of capital CF is cash flow. Robust standard errors in parentheses (clustered at the "4-digit industry $\times$ region (3MMA or OAD)" level). All variables winsorized at the 1% and 99% of the empirical distribution. *,**,*** significant at 10%, 5% and 1%, respectively. 3MMA stands for the region including the three main metropolitan areas. OAD stands for the region outside these metropolitan areas, where the accelerated depreciation applied.

Table 1.11: Evidence on the reaction of the price of capital goods to changes in the user cost

$\frac{Variable_{it}}{K_{it-1}} = \alpha_i + \beta COC_{it} + \gamma \frac{CF_{it}}{K_{it-1}} + \eta_t + \epsilon_{it}$

	(1)	(2)	(3)	(4)	(5)	(6)
		1994-2002			1996-2002	
	All K	Domestic	Imported	All K	Domestic	Imported
COC	-0.236	0.075	-0.378***	-1.022***	-0.402**	-0.546***
	(0.194)	(0.135)	(0.091)	(0.259)	(0.185)	(0.122)
CF/K	0.046***	0.030***	0.006***	0.049***	0.033***	0.007***
	(0.005)	(0.003)	(0.001)	(0.005)	(0.003)	(0.002)
Constant	0.154***	0.05	0.116***	0.346***	0.165***	0.157***
	(0.050)	(0.035)	(0.021)	(0.067)	(0.047)	(0.029)
Observations	32,443	32,443	32,443	24,959	24,959	24,959
R-squared	0.197	0.207	0.223	0.24	0.248	0.267
Plant FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Elasticity	-0.355	0.172	-2.121	-1.517	-0.899	-3.058

I is investment, K is the capital stock, COC is the user cost of capital and CF is cash flow. Robust standard errors in parentheses (clustered at the "4-digit industry × region (3MMA or OAD)" level). All variables winsorized at the 1% and 99% of the empirical distribution. *,**,*** significant at 10%, 5% and 1%, respectively. 3MMA stands for the region including the three main metropolitan areas. OAD stands for the region outside these metropolitan areas, where the accelerated depreciation applied. The user cost for imported capital is adjusted to consider changes in the foreign exchange rate.

Figure 1-1: Standardized Actual and Mandated Investment Rates

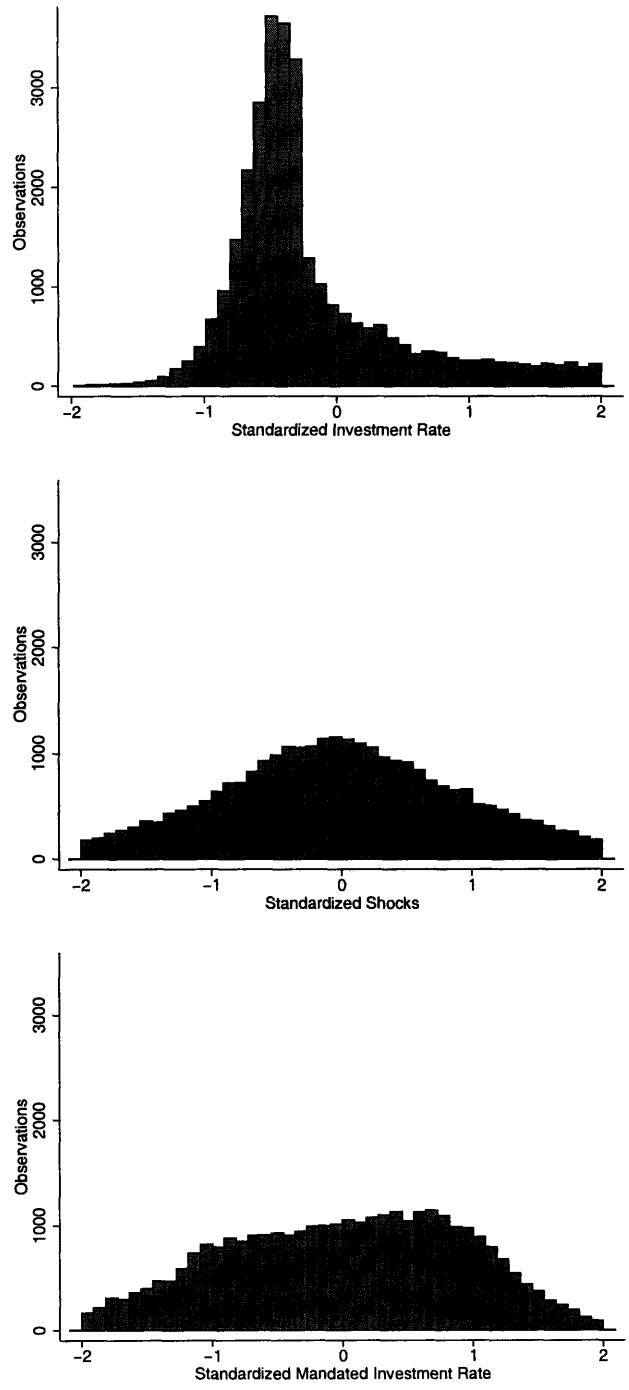
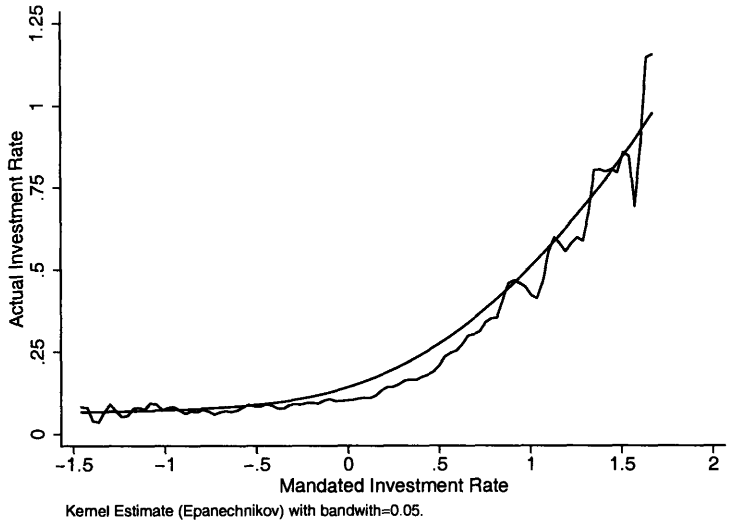


Figure 1-2: Actual and Mandated Investment Rates and the Average Adjustment Function



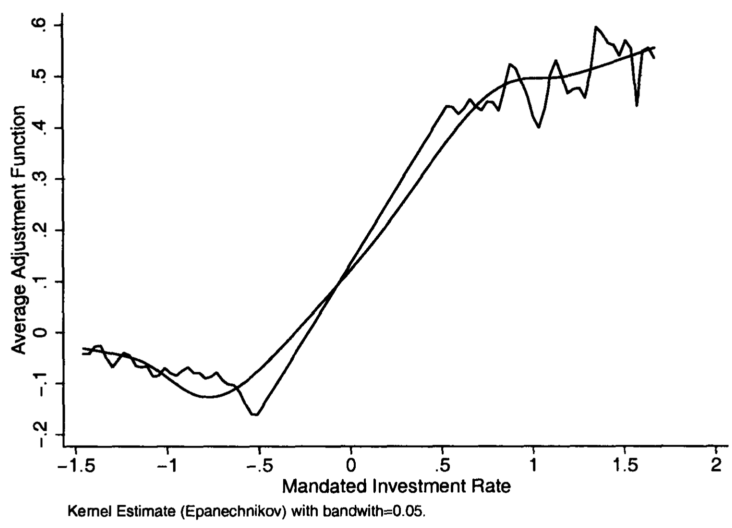


Table 1.12: Investment response to changes in the user cost by asset type
$\frac{I_{ijt}}{K_{ijt-1}} = \alpha_{ij} + \beta COC_{ijt} + \gamma \frac{CF_{ijt}}{K_{ijt-1}} + \eta_t + \epsilon_{ijt}$

	(1)	(2)	(3)	(4)
	1996-2002			
	Pooled		Separated	
COC	-1.701***	-1.771***		
	(0.246)	(0.252)		
COC (Mach. & Eq.)			-1.405***	-1.467***
			-0.218	-0.223
COC (Constructions)			-0.925***	-1.021***
			-0.279	-0.275
COC (Land)			-1.816***	-1.981***
			-0.316	-0.326
COC (Transp. Eq.)			-2.297***	-2.351***
			-0.338	-0.348
CF/K		0.003***		0.003***
		0.000		0.000
Constant	0.493***	0.548***	0.499***	0.552***
	(0.056)	(0.062)	(0.055)	(0.060)
Observations	72,765	69,362	72,765	69,362
R-squared	0.196	0.212	0.196	0.213
Plant×Asset FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Elasticity (Mach. & Eq.)	-2.619	-2.419	-2.163	-2.259

I is investment, K is the capital stock, COC is the user cost of capital and CF is cash flow. Robust standard errors in parentheses (clustered at the "4-digit industry × region (3MMA or OAD) × asset" level). All variables winsorized at the 1% and 99% of the empirical distribution. *,**,*** significant at 10%, 5% and 1%, respectively. 3MMA stands for the region including the three main metropolitan areas. OAD stands for the region outside these metropolitan areas, where the accelerated depreciation applied.

Table 1.13: Implications for Tax Policy

	(1)	(2)	(3)	(4)
	Using 2002 I/K			
			Elasticity	
			-1.5	-2.0
	COC	$\Delta COC/COC$	I/K	
Approved Tax changes:				
2002	0.231	Base	0.0904	0.0904
2003	0.198	-0.141	0.1093	0.1156
2004	0.196	-0.013	0.1115	0.1187
2005	0.195	-0.004	0.1122	0.1197
10% ITC (2003)	0.174	-0.246	0.1240	0.1352
Full Expensing (2003)	0.168	-0.273	0.1266	0.1387
	(1)	(2)	(3)	(4)
	Using average 1994-2002 I/K			
			Elasticity	
			-1.5	-2.0
	COC	$\Delta COC/COC$	I/K	
Approved Tax changes:				
2002	0.231	Base	0.1630	0.1630
2003	0.198	-0.141	0.1974	0.2088
2004	0.196	-0.013	0.2013	0.2144
2005	0.195	-0.004	0.2027	0.2164
10% ITC (2003)	0.174	-0.246	0.2232	0.2433
Full Expensing (2003)	0.168	-0.273	0.2294	0.2516

I is investment. K is the capital stock, COC is the user cost of capital. All numbers are derived from calculations at the 4-digit industry level and separately for each region (3MMA or OAD). The aggregation is done using as weights the capital stock in 2002 in each 4-digit industry. 3MMA stands for the region including the three main metropolitan areas. OAD stands for the region outside these metropolitan areas, where the accelerated depreciation applied.

Table A-1.1: Depreciation rates for selected assets and industries, 2002

Asset	NDR	OAD
Constructions	0.05	0.57
Railroad tracks	0.05	0.57
Railroad cars and locomotives	0.06	0.62
Office furniture and equipment	0.10	
Boats	0.06	0.62
Airplanes	0.10	
Automobiles, buses and trucks	0.25	
Personal computers, servers, printers, etc.	0.30	0.88
Dices, dies, molds, matrices and toolbox	0.35	0.89
Telephone communication towers and cables	0.05	0.57
Radio systems	0.08	0.69
Telephone transmission equipment	0.10	0.74
Satellite equipment on space	0.08	0.69
Satellite on land equipment	0.10	0.74
Industry	**NDR**	**OAD**
Generation, conduction and distribution of electricity; grain milling, sugar production, oil manufacturing and marine transportation	0.05	0.57
Basic metal production, tobacco manufacturing and production of derivatives of coal	0.06	0.62
Manufacturing of paper; extraction and processing of petroleum and natural gas	0.07	0.66
Manufacturing of motor vehicles and parts, railroads and ships, machinery, professional and scientific instruments; elaboration of nutritional products and beverages	0.08	0.69
Manufacturing of leather, chemical and petrochemical, plastic and rubber products; printing and graphical publishing	0.09	0.71
Electrical transportation	0.10	0.74
Manufacturing of textile products	0.11	0.75
Mining industry, construction of airships, load and passengers motor transportation	0.12	0.77
Aerial transportation and communication services	0.16	0.81
Restaurants	0.20	0.84
Construction; agricultural, cattle, forestry and fishing activities	0.25	0.87
Research and development	0.35	0.89
Manufacturing and assembling of magnetic components and hard disks	0.50	0.92
Production of natural gas and pollution control	1.00	
All other activities	0.10	0.74

Source: Federal Income Tax Laws (Ley del Impuesto Sobre la Renta). NDR: Normal Depreciation Rate (Straight Line Method). OADR: Optional Accelerated Depreciation Rate (First year only).

Chapter 2

Dividend Signaling and Unions

2.1 Introduction

This paper is part of the literature on the dividend signaling hypothesis, according to which managers possess superior information about the earnings capacity of the firm than investors do and, therefore, can use dividends to convey information to the market about their firm's future stream of earnings.[1] A key element of this literature is that these dividend payments are costly, and so this cost makes possible the existence of a separating equilibrium in which managers of firms with better future earnings prospects pay higher dividends.

Even if managers have an incentive to convey information about future earnings to investors (and in that way increase the price of firm's shares), they also face the incentive not to do so since the signal can also be received by the union, which could bargain for higher salaries. In this paper, I present an extension of the dividend signaling model developed by Bhattacharya (1979) to include unions, and obtained the result that dividends are used less as a signal by highly unionized firms.

According to Allen and Michaely (2002), asymmetric information (signaling) models of dividends result in two major empirical predictions: First, unanticipated changes in dividends should be accompanied by stock price changes in the same direction. Second, dividend changes should be followed by changes in earnings in the same direction. Previous empirical tests have supported the first prediction: in general, dividend increases are taken as good news by the market, and decreases as bad news.[2]

[1]Bhattacharya (1979), Bernheim and Wantz (1995), Bernheim (1991), John and Williams (1985), Williams (1988). See Allen and Michaely (2002) for a comprehensive literature review on Payout Policy.

[2]See for example Pettit (1972), Aharony and Swary (1980), Haely and Papelu (1988), Grullon, Michaely,

However, the empirical evidence for the second prediction is still mixed. In general, researchers have found no relationship between future changes in earnings and current changes in dividends. For example, in some earlier work Watts (1973), Haely and Papelu (1988), Brickley (1983) showed small and insignificant effects, in some cases even in the wrong direction. More recently, Benartzi, Michaely, and Thaler (1997) show that dividends are more related to past and present earnings than to future earnings. In contrast, Nissim and Ziv (2001) find a positive relationship between future earnings and current dividend changes.[3]

In this paper, I improve the predictive power of dividends by using quarterly data, thus supporting the results of Nissim and Ziv (2001). Moreover, this paper is the first to test the prediction that unionization affects dividend policy in a general setting.[4] In particular, I test the prediction that dividends have less predictive power for future earnings in highly unionized firms. Consistent with the model presented in Section 2.3, I find that the predictive power of dividends is negatively related to the unionization of the firm. The results are economically as well as statistically significant, and robust to different specifications.

The rest of the paper is organized as follows: Section 2.2 presents a review of the relevant literature. Section 2.3 presents the theoretical model and its prediction. Section 2.4 describes the empirical strategy and Section 2.5 presents the results of the econometric analysis. Finally, Section 2.6 concludes.

2.2 Literature Review

In a seminal contribution, Miller and Modigliani (1961) demonstrated that, under certain specific conditions, the dividend policy of a firm does not affect its value. This dividend irrelevance result is based on the existence of perfect capital markets, rational behavior and perfect certainty.[5] A large part of the literature on Financial Economics in the past 40 years has been devoted to explain the effects of relaxing some of these assumptions and

and Swaminathan (2002).

[3]Nevertheless, in a more recent working paper, Benartzi, Grullon, Michaely, and Thaler (2004) demonstrate that the effect found by Nissim and Ziv (2001) vanishes when using a non-linear mean reversion model for earnings, like the model proposed by Fama and French (2000)

[4]DeAngelo and DeAngelo (1991) analyze the relationship between executive compensation, income reporting and dividend payments around union renegotiations for a handful of financially distressed firms in the Steel Industry during the 1980s.

[5]The exact definition of each of these concepts can be found in Miller and Modigliani (1961) p. 412.

reconciliate the result of Miller and Modigliani (1961) with the real corporate world, in which more than 400 billion dollars are paid as dividends.

Explaining this large amount of dividend payments is even harder given the historical tax disadvantageous treatment to which dividend income was subjected as compared to capital gains, previous to the enactment of the Job Growth Taxpayer Relief Reconciliation Act (JGTRRA) in 2003.

Allen and Michaely (2002) suggest a classification of these research efforts based on five possible imperfections that managers might consider when deciding about their dividend payments: taxes, asymmetric information, incomplete contracts, institutional constraints and transaction cost.

In the next pages, I will concentrate on Asymmetric information models, in which, by definition, one party (the manager) has superior information (about the quality of the firm) than the rest of the agents in the model.

2.2.1 Asymmetric Information (Signaling) Models of Dividends

Asymmetric information models of dividend payments have generally been Signaling Models. In these models, it is assumed that managers know more about the true value of the firm (stream of earnings) than investors do. Managers of undervalued firms are thus eager to convey information about the quality of the firm to investors, using all the tools (signals) available to them. For these signals to be credible, they need to represent a higher cost for firms with poor earnings than to firms that actually have very optimistic earnings forecasts.

Bhattacharya (1979) presents the first dividend signaling model, in which dividends reduce the amount of free cash flow available to the firm, thus increasing the probability that the firm will need outside financing to cover all the projects it wants to undertake. He assumes the existence of an exogenous transaction cost of outside financing that makes dividends costly for firms. In the resulting equilibrium, firms with better earnings prospects are those that increase dividends the most, and this relationship is monotonic.

Similarly, Miller and Rock (1985) assume that paying dividends is costly because it prevents firms from attaining their optimal investment levels. This distortion of optimal investment unambiguously reduces the value of the firm. Thus, in equilibrium, more profitable firms are the ones paying more dividends, and the relation is also monotonic. Moreover, the firm with the minimum level of earnings is the only one that does not need to signal its type (it is fully revealed in equilibrium) and consequently is the only one paying zero dividends.

Other signaling models (Bernheim (1991), Bernheim and Wantz (1995), John and Williams (1985), Williams (1988)) take the disadvantageous tax treatment of dividends, relative to capital gains, as the explicit cost of dividends.[6] The advantage of these models is that there is no need to assume an exogenous cost of outside financing; however, they face the challenge of explaining why payout is not made by share repurchases instead of dividends.[7]

2.2.2 Empirical Test of the Signaling Hypothesis

The literature documenting empirical tests of the Signaling Hypothesis is extensive; the most important contributions are reviewed in this subsection. The literature consists primarily of studies that use dividends to explain future changes in profitability.

In a seminal contribution, Watts (1973) was the first to test directly the relationship between future changes in profitability and current and past dividend policy. He uses Compustat files from 1947 to 1966 for a total of 310 firms with complete information for the period and run firm by firm time series estimations. The average and median coefficients, although positive, are small and insignificantly different from zero in most of his specifications. He thus argues that there must be other reasons besides signaling for the positive reaction of stock prices to dividends.

Later, the work of Brickley (1983) and Haely and Papelu (1988) provided support for the signaling hypothesis. Brickley (1983) analyzes the behavior of stock prices, earnings and dividends around dividend announcements and compares the relationship between these variables for special dividends versus regular dividends. He finds that regular dividend increases convey the most positive information to the market. Haely and Papelu (1988) also test directly whether current dividends have a positive relationship with future earnings. Their test benefits from the fact that they use dividend initiations and omissions only, and so they find strong effects. These authors find that firms that initiate (omit) dividends payments have positive (negative) earnings changes both before and after the dividend policy change.

[6] Before JGTRRA, dividends faced a top marginal tax rate of 38.6 percent, while capital gains faced a top statutory rate of 20 percent. JGTRRA equalized both tax rates at 15 percent. See Poterba (2004).

[7] The substitution hypothesis, i.e., how share repurchases have been progressively substituting for dividends in the past two decades is one area of extensive research. See for example, Grullon and Michaely (2002).

More recently, a significant step towards our understanding of dividend signaling was made by Benartzi et al. (1997). This paper represents the first attempt to test the predictive power of dividends for explaining future changes in profitability using a more representative database (more than one thousand firms and several years, 1990-1997). The conclusion of this paper is, however, that dividends are more related to present and past changes in profitability than to future changes in profitability, thus challenging the dividend signaling hypothesis.

Using a similar database, Nissim and Ziv (2001) get very different conclusions. They use a linear mean reversion model of earnings and scale dividend payments differently than Benartzi et al. (1997) and find that dividends are related to both future changes in earnings levels and future changes in profitability.

Trying to get the final word on this debate, in a more recent working paper, Benartzi et al. (2004) show that the effect found by Nissim and Ziv (2001) vanishes once a non-linear mean reversion model for earnings is used.

2.2.3 Link Between Payout Policy and the Labor Market

Previous literature has not paid attention to the relationship between payout policy and labor market conditions. DeAngelo and DeAngelo (1991) analyze union negotiations and corporate policy for the steel industry during the 1980s. The paper studies how executive compensation, financial reporting, and dividend rates varied as seven major firms in the industry faced severe financial problems during the first half of the 1980s. According to the evidence presented in the paper, these seven firms reduced their work force by three hundred thousand workers. Most importantly, they find that during union renegotiations, firms reported lower income (controlling for cash flows) and reduced executive compensation. Finally, they also find that dividend reductions were targeted to match union renegotiations. The reasoning behind this behavior, the authors argue, is that dividend reductions are a credible signal of financial distress, which allows managers to reduce the pressure to increase wages during wage renegotiations.

Gertner, Gibbons, and Scharfstein (1988) study the equilibrium of signaling games with more than one audience. In their model, the signal is the corporate structure of the firm (the decision to issue equity or debt). The second audience is an uninformed competitor firm.

In their model, the existence of a second audience influences the payoffs of the firm. In this sense, the payoff structure is endogenous. Gertner et al. (1988) include the second audience by designing a game with two stages. In the first stage, the firm sends a signal to investors by choosing to issue debt or equity. In the second stage, the firm plays a Cournot game with the competitor firm. The competitor firm, however, also receives the signal sent to investors in the first period.

The main result of the paper is that the most likely outcome is a pooling equilibrium. This result is in sharp contrast to one-audience models of corporate structure, where the separating equilibrium is the most likely outcome, like the model of Myers and Majluf (1984). Gertner et al. (1988) suggest that the model can be easily generalized to other signals (like dividends) and other second audiences (like unions). However, the prediction of a pooling equilibrium is not realistic for dividends (a pooling equilibrium would yield zero dividend payments).

There is also extensive literature that studies the effects of unionization on leverage (for example Sarig (1998), Bronars and Deere (1991)). A contemporaneous work in this area by Matsa (2006) studies how liquidity and suppliers' market power can interact to affect the optimal debt policy of a firm. His results show that as predicted, firms use financial leverage to influence collective bargaining negotiations. However, his results also show that dividends are not used for this purpose (contrasting the result of DeAngelo and DeAngelo (1991)). This finding that dividends are not used as a commitment device (as free cash flow theories suggest) provides more support for the dividend signaling hypothesis and is consistent with my results, in which the interaction of unionization and dividend policy is shown to come from signaling effects.

2.3 Modified Bhattacharya (1979) Dividend Signaling Model

The following is an extension of the dividend signaling model presented in Bhattacharya (1979), allowing for the existence of a union that controls part of firm's earnings. The model is almost identical to the one presented in Bhattacharya (1979) and for this reason, I only include the most important equations.

2.3.1 Assumptions

The model assumptions are the same as in the cited paper: in each period each firm has a different earnings potential t, known by managers at the beginning of the period, but not by investors. The realization of future earnings is a random variable X which, for simplicity, is assumed to be uniformly distributed over the interval $[0, t]$, i.e., $X \sim U[0, t]$.

To abstract from the effects of diversification to hold and sell securities, the model assumes that all valuations are risk neutral. Also, each firm has enough investment opportunities for any cash flow level. This means that investment is always at its optimal level. This assumption yields a different signaling equilibrium than the model presented in Miller and Rock (1985).

Although agency issues have considerably gained importance in payout policy models, the model does not consider any agency problems: managers are assumed to care only about shareholders utility. Dividends are taxed at a rate τ. For simplicity I assume no tax on capital gains.[8]

Investment can be done using two sources of funds. The first, and cheapest, is internal cash flow. Bhattacharya (1979) assumes the existence of an exogenous cost of external financing, β. I follow this assumption as well.[9]

I extend the model of Bhattacharya (1979) by including one additional parameter, δ, which represents the fraction of firm's profits taken by the union in each period. The specific bargaining power of the union might be different in each firm; for this reason, I allow different firms to have different values of δ. I call the amount taken by the union, δX, "wages".

2.3.2 The role of dividends as a signal

The role of dividends as a signal is easy to develop in this setting. Managers can signal the true value of t, by promising to pay dividends D. The signal works because only those managers with high enough expected earnings will be able to minimize the risk of using costly outside financing and at the same time pay dividends.

[8]These assumptions correspond to the pre-JGTRRA period. This is consistent with the period used in the empirical analysis.

[9]One of the main concerns that the literature has had about Bhattacharya (1979) model is the exogeneity of the cost of outside financing. In this paper, I will not try to address this issue. I will just say that several asymmetric information issues might cause this cost, like Myers and Majluf (1984).

Formally, I assume that if there is enough cash flow to pay dividends plus wages ($D+\delta X$), then no other cost is incurred. In fact, if cash flow exceeds dividends and wages, the amount of costly outside financing is reduced by this difference. So, if $(1-\delta)X > D$, investors get the dividend D, and gain $(1-\delta)X - D$ from less costly outside financing. The union gets δX.

In contrast, if cash flow is insufficient to cover promised dividends and wages, then investors pay the cost of outside financing. So, if $(1-\delta)X < D$, investors get $(1-\delta)X$ and lose the cost of financing the shortfall: $\beta((1-\delta)X - D)$. The union still gets δX.

Note that the union is not taking any action or decision in this setting, but it simply takes wages from the firm. Although the model can be generalized to other settings where the union acts rationally, the main intuition can be derived from this simplistic version. I also derived more general versions of the model and obtained the same qualitative results.

2.3.3 Maximizing Behavior

In order to determine the equilibrium conditions of the model, I first solve for the maximizing behavior of managers. As noted above, the model assumes that managers care about the utility of investors. Equation 2.1 shows the utility function of investors, which is the sum of four terms. The first term is the value of the shares in the next period (as a function of D). The second term is the value of the after-tax promised dividend. The third and fourth terms are the expected values (under the distribution of X) of the gain when the cash flow is greater than dividends plus wages and the loss in costly outside financing when cash flow is lower than dividends plus wages, respectively:

$$\begin{aligned} I(D) &= \frac{1}{1+r}\Big(V(D) + (1-\tau)D + \int_{\frac{D}{1-\delta}}^{\infty} \big((1-\delta)X - D\big) f(x)dx \\ &\quad + \int_{-\infty}^{\frac{D}{1-\delta}} (1+\beta)\big((1-\delta)X - D\big) f(x)dx\Big). \end{aligned} \tag{2.1}$$

Under the assumption that X is uniformly distributed, Equation 2.1 can be reduced to Equation 2.2:

$$I(D) = \frac{1}{1+r}\Big(V(D) - \tau D + \frac{t(1-\delta)}{2} - \frac{\beta D^2}{2t(1-\delta)}\Big). \tag{2.2}$$

The utility function of investors is maximized by managers, who know the true value of t and choose dividends. Then, the First Order Condition of the maximization of Equation

2.2 with respect to D yields:

$$V'(D^*) = \tau + \frac{\beta D^*}{t(1-\delta)}. \tag{2.3}$$

2.3.4 Equilibrium

The equilibrium condition assumes rational behavior and beliefs of all agents, including implicitly the capital market. Therefore, as in Bhattacharya (1979), the equilibrium function $V(D)$, must be "equal to the true value of future cash flows for the project whose cash flows are signaled with dividend D."[10] Assuming stationary dividends, the equilibrium condition is therefore:

$$V(D^*(t)) = \frac{1}{r}\left(\frac{t(1-\delta)}{2} - \tau D^*(t) - \frac{\beta D^*(t)^2}{2t(1-\delta)}\right). \tag{2.4}$$

Totally differentiating the equilibrium condition, Equation 2.4, and substituting for Equation 2.3, we get a First Order Ordinary Differential Equation in $D(t)$:

$$\begin{aligned}\left(\tau + \frac{\beta D}{t(1-\delta)}\right)\frac{dD}{dt} &= \frac{1}{r}\left(\frac{(1-\delta)}{2} - \tau\frac{dD}{dt} - \frac{\beta D}{t(1-\delta)}\frac{dD}{dt}\right.\\ &\quad \left.+\frac{\beta D^2}{2t^2(1-\delta)}\right).\end{aligned} \tag{2.5}$$

As in many applications, the solution to this first order ODE can be found by assuming a linear solution of the form $D(t) = At$, where A is a known constant. The factorization used in Equation 2.5 gives clear indication that a linear solution is correct. This endogenous parameter A measures the sensitivity of dividends to the earnings potential, i.e., the slope of the signaling function.

The particular solution for the constant A is shown in Equation 2.6. Note how A depends on the different parameters of the model: the interest rate (r), the cost of outside financing (β), the fraction of earnings taken by the union (δ), and the tax rate on dividends (τ).

$$A = \frac{(1-\delta)(1+r)}{\beta(1+2r)}\left(\sqrt{\tau^2 + \frac{\beta(1+2r)}{(1+r)}} - \tau\right). \tag{2.6}$$

[10] Bhattacharya (1979), p. 264.

2.3.5 Empirical Prediction

Using Equation 2.6, it is straightforward to show that the derivative of A with respect to δ is negative.

$$\frac{\partial A}{\partial \delta} < 0. \tag{2.7}$$

In the model, δ can be interpreted as the power of the union in each particular firm. Therefore, the model predicts that the sensitivity of dividends to earnings is inversely related to the bargaining power of the union. This theoretical prediction leads to a very natural empirical test: *Whether dividends have less predictive power for explaining future changes in earnings in unionized firms.*

Section 2.4 describes in detail how this test is conducted, the main specification, the database used and some robustness checks.

2.4 Empirical Strategy

2.4.1 Database

Firm Unionization (Becker and Olson)

This database consists of firm level unionization data for 675 firms for the year 1977. This database is derived from a unique feature of the 1977 IRS Forms 5500. The US Department of Labor matched a union code to a sample of more than 1,000 pension plans. Becker and Olson aggregate over firms to get the number of total and unionized employees in each of the firms in the sample. From this sample of firms, I was able to match only 675 to the CRSP-COMPUSTAT Merged Database. This database has been used in other studies like Becker and Olson (1989) and Becker and Olson (1992). I define firm unionization as the percentage of firm employees that are unionized.

Collectively Bargained Pension Plans (Rauh)

This database consists of all the pension plans that fill up an IRS 5500 Form. The database is collected directly from the 5500 Forms and is publicly available from the US Department of Labor. When matched to the CRSP-COMPUSTAT Merged Database, I obtain 15,035 firm-year observations, with an average of 712 firms between 1990-1998.

For this sample of firms, I define firm unionization as the percentage of active employees for whom their pension plan was collectively bargained divided by the total number of active employees covered by these plans for the whole period.

Quarterly CRSP-COMPUSTAT Merged Database

I retrieved financial information for firms in either of the aforementioned databases from CRSP-COMPUSTAT Merged Files. For the firms matched to the database of Becker and Olson (1989), I use quarterly financial information for the period 1975Q1 to 1980Q4.

For the firms matched to the database of Rauh (2006), I use information from 1990Q1 to 1998Q4, which is the period for which the data is available. Table 2.1 presents summary statistics for the most important variables used in the empirical analysis.

2.4.2 Main specification

The main specification is similar to those used in the literature testing the power of dividends as predictors of future earnings (Benartzi et al. (1997), Nissim and Ziv (2001), Benartzi et al. (2004)). In this specification, the future change in earnings (scaled either by the value of assets or by book equity) is regressed on the current value of the percentage change in dividends, controlling for profitability as well as other characteristics of the firm.

Furthermore, I also include firm unionization and the interaction between changes in dividends and firm unionization in the regressions. The interaction variable is important to test the union effect of dividend payments. The model presented in Section 2.3 predicts that this coefficient should be negative, i.e., the predictive power of dividends should be lower for highly unionized firms.

$$\begin{aligned} \frac{(E_{it+1} - E_{it})}{A_{it}} &= \beta_0 + \beta_1 \Delta\% DIV_{it} + \beta_2 (U_i \times \Delta\% DIV_{it}) \\ &\quad + \beta_3 \frac{E_{it}}{A_{it}} + \beta_4 X_{it} + \alpha_i + \eta_t + \epsilon_{it}, \end{aligned} \tag{2.8}$$

where, E_{it}: Earnings; A_{it}: Assets; $\Delta\% D_{it}$: Percentage change in dividends; U_i: Firm Unionization; X_{it}: Matrix of controls (change in assets, change in sales, Market-to-book value, and market value percentile). I also perform regressions scaling by book equity (B_{it}), instead of assets.

2.5 Results

2.5.1 OLS results, 1975-1980

Table 2.2 presents the first set of results. Here, the future change in earnings scaled by the value of assets is explained by current changes in dividends for 1975-1980. The results support the dividend signaling hypothesis, i.e., the coefficient of the change in dividends is positive and significant. The result is robust to the inclusion of controls. The table also shows the separate effect of dividend increases (ΔDIV_{it}^{+}) and decreases (ΔDIV_{it}^{-}). Note that the results are basically driven by dividend decreases.

The most important result however is that of the interaction term $U_{it} \times \Delta DIV_{it}$. The coefficient is negative and statistically very significant, but only for dividend decreases. This finding confirms the hypothesis of the theoretical model. This result is also robust to the inclusion of controls.

Next, in Table 2.3, I also present results scaling the earnings change by book equity. The results also support the signaling hypothesis. The coefficient on the dividend change is positive and statistically significant. Moreover, the interaction term is also negative and statistically significant in the first two columns, where dividend decreases and increases are pooled, although the effect still seems to be driven by dividend decreases. These results confirm the hypothesis that unionization has an effect on payout policy.

The use of quarterly data is one of the reasons for the difference between these findings and those of previous studies, which relied on annual data (i.e., missing the variation that occurs at more frequent intervals).

2.5.2 Instrumental variables approach to unionization

A common critique to the results shown in the previous tables is that unionization might be endogenous in the model. I overcome this problem by using instrumental variables. Specifically, I use Right-to-Work Laws to instrument for unionization. These laws, which give workers the freedom not to join a union and avoid paying the fees, might explain firm unionization but are probably uncorrelated with the disturbance term of the regression.[11] One drawback of the use of this variable, however, is that I was not able to assign it at

[11]For example, in Non-Right-to-Work Law States, unions can require union membership. For details on Right-to-Work Laws and its effects on unionization see Farber (1984).

the plant level, but only to the state of incorporation of the firm. This aggregation can be misleading.

Table 2.4 presents the results of these regressions scaling earnings changes by the value of assets. In the model, firm unionization and the interaction between unionization and the percentage change in dividends are instrumented with a Right-to-Work Law dummy and the interaction between this dummy and the percentage change in dividends.

The signaling effect is strong and not only significant for dividend decreases but also for dividend increases. Moreover, the interaction effect is negative and significant, even for dividend increases. This table confirms that unionization is important in determining dividend policy.

The first stage of this set of regressions is shown in Table 2.5. Overall, Right-to-Work Laws explain firm level unionization accurately.

Scaling the earnings variable with book equity does not change the conclusions of Table 2.4. This is shown in Table 2.6; the first stage is displayed in Table 2.7.

The coefficients are greater than in the OLS case, and highly significant. All these results support the signaling and the unionization hypothesis, and are robust to the inclusion of controls.

2.5.3 Results for 1990-1998

Given that I was able to construct two databases for different time periods, a natural robustness check is testing whether the results vary between periods and databases.

Table 2.8 shows the OLS regressions for this period. Overall, the results are less precise than those for the 1975-1980 period, which was expected since the power of unions in the US has decreased substantially during the last two decades. Nevertheless, the signaling effect is present, and the interaction effect is also significant in some of the cases.

2.6 Conclusions

In this paper I show that unionization has an effect on the determination of dividend policy for US firms. The results support the dividend signaling hypothesis, according to which managers use dividends to convey information about future earnings to investors. Moreover, I find strong evidence that managers take into account the bargaining power of its union before signaling future earnings through dividends. In particular, using information from IRS 5500 Forms to measure unionization at the firm level, I find that the power of dividends as predictors of future earnings is higher for non-unionized firms than for highly unionized firms. These empirical results are consistent with the model presented here, which is an extension of the dividend signaling model developed by Bhattacharya (1979). Moreover, I use the variation at the state level in the adoption of Right-to-Work Laws to overcome the possible endogeneity of unionization with an instrumental variables approach. The results are robust to different specifications and time periods.

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Tables

Table 2.1: Summary Statistics

	Mean	Std. Dev.	25%	Median	75%	N
$\Delta\%DIV_{it}$	0.039	0.324	0.000	0.000	0.000	13,256
$\Delta\%DIV_{it}^{+}$	0.211	0.633	0.100	0.143	0.250	2,974
$\Delta\%DIV_{it}^{-}$	-0.381	0.375	-0.667	-0.286	0.000	302
$\frac{(E_{it+1}-E_{it})}{A_{it}}$	0.001	0.017	-0.004	0.001	0.005	14,129
U_i	0.304	0.308	0.000	0.211	0.566	16,346
E_{it}/B_{it}	0.032	0.081	0.022	0.035	0.047	15,943
E_{it}/A_{it}	0.017	0.017	0.010	0.017	0.025	15,094
Market Value$_{it}$	1,103	3,002	130	319	941	14,350
MtoB Equity$_{it}$	1.19	0.89	0.66	0.96	1.48	15,209

E_{it} is earnings, A_{it} is assets, $\Delta\%D_{it}$ is the percentage change in dividends ($\Delta\%DIV_{it}^{+}$ denotes only positive changes and $\Delta\%DIV_{it}^{-}$ only negative changes), U_i is firm unionization and B_{it} is book equity.

Table 2.2: OLS regressions scaling by value of assets, 1975-1980

$$\frac{(E_{it+1}-E_{it})}{A_{it}} = \beta_0 + \beta_1\Delta\%DIV_{it} + \beta_2(U_i \times \Delta\%DIV_{it}) + \beta_3\frac{E_{it}}{A_{it}} + \beta_4 X_{it} + \alpha_i + \eta_t + \epsilon_{it}$$

	(1)	(2)	(3)	(4)
$\Delta\%DIV_{it}$	0.004***	0.003***		
	(0.001)	(0.001)		
$\Delta\%DIV_{it}^{+}$			0.001	0.000
			(0.001)	(0.001)
$\Delta\%DIV_{it}^{-}$			0.013***	0.012***
			(0.002)	(0.002)
$\Delta\%DIV_{it} \times U_i$	-0.002	-0.001		
	(0.003)	(0.003)		
$\Delta\%DIV_{it}^{+} \times U_i$			0.003	0.004
			(0.003)	(0.003)
$\Delta\%DIV_{it}^{-} \times U_i$			-0.018***	-0.016***
			(0.005)	(0.005)
E_{it}/A_{it}	-0.885***	-0.992***	-0.888***	-0.995***
	(0.011)	(0.014)	(0.011)	(0.014)
Observations	11,942	10,889	11,942	10,889
Number of firms	649	644	649	644
R-squared	0.386	0.421	0.387	0.422
Firm and Time FE	Y	Y	Y	Y
Controls	N	Y	N	Y

E_{it} is earnings, A_{it} is assets, $\Delta\%D_{it}$ is the percentage change in dividends ($\Delta\%DIV_{it}^{+}$ denotes only positive changes and $\Delta\%DIV_{it}^{-}$ only negative changes) and U_i is firm unionization. Controls include change in assets, change in sales, Market-to-book value, and market value percentile. Robust standard errors in parentheses. *,**,*** significant at 10%, 5% and 1%, respectively.

Table 2.3: OLS regressions scaling by book equity, 1975-1980

$$\frac{(E_{it+1}-E_{it})}{B_{it}} = \beta_0 + \beta_1\Delta\%DIV_{it} + \beta_2(U_i \times \Delta\%DIV_{it}) + \beta_3\frac{E_{it}}{B_{it}} + \beta_4 X_{it} + \alpha_i + \eta_t + \epsilon_{it}$$

	(1)	(2)	(3)	(4)
$\Delta\%DIV_{it}$	0.010***	0.008***		
	(0.002)	(0.002)		
$\Delta\%DIV_{it}^{+}$			0.003	0.001
			(0.002)	(0.002)
$\Delta\%DIV_{it}^{-}$			0.036***	0.035***
			(0.005)	(0.005)
$\Delta\%DIV_{it} \times U_i$	-0.019***	-0.018***		
	(0.005)	(0.005)		
$\Delta\%DIV_{it}^{+} \times U_i$			0.004	0.004
			(0.006)	(0.007)
$\Delta\%DIV_{it}^{-} \times U_i$			-0.079***	-0.072***
			(0.010)	(0.010)
E_{it}/B_{it}	-0.877***	-0.958***	-0.879***	-0.961***
	(0.010)	(0.012)	(0.010)	(0.012)
Observations	12,358	10,889	12,358	10,889
Number of firms	652	644	652	644
R-squared	0.404	0.452	0.407	0.454
Firm and Time FE	Y	Y	Y	Y
Controls	N	Y	N	Y

E_{it} is earnings, B_{it} is book equity, $\Delta\%D_{it}$ is the percentage change in dividends ($\Delta\%DIV_{it}^{+}$ denotes only positive changes and $\Delta\%DIV_{it}^{-}$ only negative changes) and U_i is firm unionization. Controls include change in assets, change in sales, Market-to-book value, and market value percentile. Robust standard errors in parentheses. *,**,*** significant at 10%, 5% and 1%, respectively.

Table 2.4: IV regressions (Right-to-Work Laws) scaling by value of assets, 1975-1980

$$\frac{(E_{it+1}-E_{it})}{A_{it}} = \beta_0 + \beta_1\Delta\%DIV_{it} + \beta_2(U_i \times \Delta\%DIV_{it}) + \beta_3\frac{E_{it}}{A_{it}} + \beta_4 X_{it} + \alpha_i + \eta_t + \epsilon_{it}$$

	(1)	(2)	(3)	(4)
$\Delta\%DIV_{it}$	0.014***	0.010**		
	(0.004)	(0.004)		
$\Delta\%DIV_{it}^{+}$			0.014**	0.011*
			(0.006)	(0.006)
$\Delta\%DIV_{it}^{-}$			0.019***	0.012**
			(0.006)	(0.006)
$\Delta\%DIV_{it} \times U_i$	-0.041***	-0.032**		
	(0.015)	(0.016)		
$\Delta\%DIV_{it}^{+} \times U_i$			-0.050**	-0.043*
			(0.025)	(0.025)
$\Delta\%DIV_{it}^{-} \times U_i$			-0.033*	-0.017
			(0.017)	(0.018)
E_{it}/A_{it}	-0.882***	-0.990***	-0.886***	-0.994***
	(0.011)	(0.014)	(0.011)	(0.014)
Observations	11,942	10,889	11,942	10,889
Number of firms	649	644	649	644
Firm and Time FE	Y	Y	Y	Y
Controls	N	Y	N	Y

E_{it} is earnings, A_{it} is assets, $\Delta\%D_{it}$ is the percentage change in dividends ($\Delta\%DIV_{it}^{+}$ denotes only positive changes and $\Delta\%DIV_{it}^{-}$ only negative changes) and U_i is firm unionization. Controls include change in assets, change in sales, Market-to-book value, and market value percentile. Robust standard errors in parentheses. *,**,*** significant at 10%, 5% and 1%, respectively.

Table 2.5: IV first stage (Right-to-Work Laws) scaling by value of assets, 1975-1980
$(U_i \times \Delta\%DIV_{it}) = \beta_0 + \beta_1 \Delta\%DIV_{it} + \beta_2(RTWL_{it} \times \Delta\%DIV_{it}) + \beta_3 \frac{E_{it}}{A_{it}} + \beta_4 X_{it} + \alpha_i + \eta_t + \epsilon_{it}$

	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta\%DIV_{it}$	0.298***	0.293***				
	(0.003)	(0.003)				
$\Delta\%DIV^{+}_{it}$			0.257***	-0.001	0.255***	-0.002
			(0.003)	(0.002)	(0.003)	(0.002)
$\Delta\%DIV^{-}_{it}$			0.005	0.404***	0.003	0.395***
			(0.005)	(0.003)	(0.005)	(0.004)
$RTWL_{it}$	-0.009	-0.010	-0.008	-0.001	-0.010	-0.001
	(0.009)	(0.010)	(0.007)	(0.005)	(0.008)	(0.005)
$\Delta\%DIV_{it} \times RTWL_{it}$	-0.114***	-0.111***				
	(0.006)	(0.006)				
$\Delta\%DIV^{+}_{it} \times RTWL_{it}$			-0.080***	0.002	-0.080***	0.003
			(0.006)	(0.004)	(0.006)	(0.004)
$\Delta\%DIV^{-}_{it} \times RTWL_{it}$			-0.001	-0.205***	0.001	-0.198***
			(0.010)	(0.006)	(0.010)	(0.007)
E_{it}/A_{it}	0.122***	0.123**	0.048	0.011	0.043	0.016
	(0.040)	(0.049)	(0.032)	(0.021)	(0.039)	(0.027)
Observations	12,597	11,526	12,597	12,597	11,526	11,526
Number of firms	654	651	654	654	651	651
R-squared	0.451	0.447	0.410	0.566	0.411	0.551
Firm and Time FE	Y	Y	Y	Y	Y	Y
Controls	N	Y	N	Y	N	Y

Dependent variable in columns (1) and (2) is $\Delta\%DIV \times U_i$; in columns (3) and (5) is $\Delta\%DIV^{+} \times U_i$; in columns (4) and (6) is $\Delta\%DIV^{-} \times U_i$. Variable definitions specified in Equation 2.8. Robust standard errors in parentheses.*,**,*** significant at 10%, 5% and 1%, respectively.

Table 2.6: IV regressions (Right-to-Work Laws) scaling by book equity, 1975-1980

$$\frac{(E_{it+1}-E_{it})}{B_{it}} = \beta_0 + \beta_1 \Delta\%DIV_{it} + \beta_2(U_i \times \Delta\%DIV_{it}) + \beta_3 \frac{E_{it}}{B_{it}} + \beta_4 X_{it} + \alpha_i + \eta_t + \epsilon_{it}$$

	(1)	(2)	(3)	(4)
$\Delta\%DIV_{it}$	0.036***	0.026***		
	(0.009)	(0.008)		
$\Delta\%DIV_{it}^{+}$			0.039***	0.026**
			(0.014)	(0.012)
$\Delta\%DIV_{it}^{-}$			0.042***	0.032**
			(0.013)	(0.013)
$\Delta\%DIV_{it} \times U_i$	-0.119***	-0.088***		
	(0.034)	(0.033)		
$\Delta\%DIV_{it}^{+} \times U_i$			-0.153**	-0.107**
			(0.061)	(0.051)
$\Delta\%DIV_{it}^{-} \times U_i$			-0.093***	-0.063*
			(0.036)	(0.037)
E_{it}/B_{it}	-0.872***	-0.955***	-0.876***	-0.960***
	(0.011)	(0.012)	(0.011)	(0.012)
Observations	12,358	10,889	12,358	10,889
Number of firms	652	644	652	644
Firm and Time FE	Y	Y	Y	Y
Controls	N	Y	N	Y

E_{it} is earnings, B_{it} is book equity, $\Delta\%D_{it}$ is the percentage change in dividends ($\Delta\%DIV_{it}^{+}$ denotes only positive changes and $\Delta\%DIV_{it}^{-}$ only negative changes) and U_i is firm unionization. Controls include change in assets, change in sales, Market-to-book value, and market value percentile. Robust standard errors in parentheses. *,**,*** significant at 10%, 5% and 1%, respectively.

Table 2.7: IV first stage (Right-to-Work Laws) scaling by book equity, 1975-1980
$(U_i \times \Delta\%DIV_{it}) = \beta_0 + \beta_1 \Delta\%DIV_{it} + \beta_2(RTWL_{it} \times \Delta\%DIV_{it}) + \beta_3 \frac{E_{it}}{B_{it}} + \beta_4 X_{it} + \alpha_i + \eta_t + \epsilon_{it}$

	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta\%DIV_{it}$	0.295***	0.292***				
	(0.003)	(0.003)				
$\Delta\%DIV^{+}_{it}$			0.255***	-0.001	0.255***	-0.002
			(0.003)	(0.002)	(0.003)	(0.002)
$\Delta\%DIV^{-}_{it}$			0.004	0.397***	0.002	0.394***
			(0.005)	(0.003)	(0.005)	(0.004)
$RTWL_{it}$	-0.009	-0.010	-0.009	0.000	-0.010	-0.001
	(0.009)	(0.010)	(0.007)	(0.005)	(0.008)	(0.005)
$\Delta\%DIV_{it} \times RTWL_{it}$	-0.104***	-0.111***				
	(0.006)	(0.006)				
$\Delta\%DIV^{+}_{it} \times RTWL_{it}$			-0.068***	0.002	-0.080***	0.002
			(0.006)	(0.004)	(0.006)	(0.004)
$\Delta\%DIV^{-}_{it} \times RTWL_{it}$			-0.001	-0.199***	0.001	-0.198***
			(0.010)	(0.006)	(0.010)	(0.007)
E_{it}/B_{it}	0.076***	0.093***	0.025*	0.023**	0.019	0.039***
	(0.017)	(0.021)	(0.014)	(0.009)	(0.017)	(0.012)
Observations	13,016	11,526	13,016	13,016	11,526	11,526
Number of firms	657	651	657	657	651	651
R-squared	0.449	0.448	0.407	0.565	0.411	0.551
Firm and Time FE	Y	Y	Y	Y	Y	Y
Controls	N	Y	N	Y	N	Y

Dependent variable in columns (1) and (2) is $\Delta\%DIV \times U_i$; in columns (3) and (5) is $\Delta\%DIV^{+} \times U_i$; in columns (4) and (6) is $\Delta\%DIV^{-} \times U_i$. Variable definitions specified in Equation 2.8. Robust standard errors in parentheses.*,**,*** significant at 10%, 5% and 1%, respectively.

Table 2.8: OLS regressions, 1990-1998

$$\frac{(E_{it+1}-E_{it})}{Z_{it}} = \beta_0 + \beta_1 \Delta\%DIV_{it} + \beta_2(U_i \times \Delta\%DIV_{it}) + \beta_3 \frac{E_{it}}{Z_{it}} + \beta_4 X_{it} + \alpha_i + \eta_t + \epsilon_{it}$$

	(1)	(2)	(3)	(4)
$\Delta\%DIV_{it}^{+}$	0.002**	0.002**	0.001	0.005
	(0.001)	(0.001)	(0.015)	(0.009)
$\Delta\%DIV_{it}^{-}$	0.008***	0.008***	0.009	0.031*
	(0.002)	(0.002)	(0.028)	(0.017)
$\Delta\%DIV_{it}^{+} \times U_i$	0.003	0.001	0.002	-0.010
	(0.003)	(0.003)	(0.055)	(0.036)
$\Delta\%DIV_{it}^{-} \times U_i$	-0.014**	-0.012**	-0.050	-0.041
	(0.006)	(0.005)	(0.091)	(0.057)
E_{it}/Z_{it}	-0.917***	-0.935***	-0.371***	-0.469***
	(0.007)	(0.007)	(0.008)	(0.005)
Observations	21,577	21,179	21,577	21,179
Number of firms	851	851	851	851
R-squared	0.451	0.488	0.108	0.683
Firm and Time FE	Y	Y	Y	Y
Controls	N	Y	N	Y

In Columns (1) and (2) is $Z_{it} = A_{it}$; in Columns (3) and (4) is $Z_{it} = B_{it}$. E_{it} is earnings, A_{it} is assets, B_{it} is book equity, $\Delta\%D_{it}$ is the percentage change in dividends ($\Delta\%DIV_{it}^{+}$ denotes only positive changes and $\Delta\%DIV_{it}^{-}$ only negative changes) and U_i is firm unionization. Controls include change in assets, change in sales, Market-to-book value, and market value percentile. Robust standard errors in parentheses. *,**,*** significant at 10%, 5% and 1%, respectively.

Chapter 3

Investment strategies and limits to arbitrage

By Antoinette Schoar and Arturo Ramírez-Verdugo

3.1 Introduction

Despite the large size of assets under management of institutional investors (over 7 trillion dollars), this industry has received little attention in the economics and finance literature, compared to the mutual fund industry. Notable exemptions are Lakonishok, Shleifer, and Vishny (1992), Del-Guercio and Tkac (2002), Goyal and Wahal (2004) and Heisler, Knittel, Neuman, and Stewart (2004). In this literature, the industry is characterized as plagued with agency problems which are blamed for the lack of value generation. The agency problems are driven by the different incentives that each participant faces: pension funds hire plans sponsors which then hire money managers, who are the actual investors in the equity and fixed income market. Pension funds prefer to delegate all decisions, thereby avoiding blame for bad performance.

In this paper we analyze the empirical relationship between asset flows and performance in this industry. In particular, we test for the presence and extent of Performance-Based Arbitrage (PBA). PBA was defined by Shleifer and Vishny (1997) as the condition under which assets that investors give to specialized arbitrageurs are positively related to their past performance. The importance of PBA is that it limits the ability of arbitrage to bring security prices to fundamental values, and in that way reduces the ability of arbitrage to achieve market efficiency. The pension fund industry represents a better approximation to the theoretical conditions for PBA than the mutual fund industry since money managers are probably engaged in more arbitrage activities than mutual fund managers, and assets withdrawn by institutional investors represent a bigger concern than assets withdrawn by individual investors.

Our results show that there is persistence in managerial performance, which is a necessary condition for PBA to be profitable, since it means that plan sponsors can actually predict future performance using past performance. Then, we show that returns are positively related to asset and account flows in the money manager industry, that is, we show the existence of performance-based arbitrage. We also show that manager replacement is also related to past performance. In accordance with other papers that test these relationships, we also find, that performance only explains a small fraction of asset and account flows, as indicated by the low R-squared of the regressions. The literature interprets this result as suggesting that asset flows are driven more by some manager characteristics that are easy to justify ex-post to the board than past performance (binary events like "beating" the market or even other non-performance variables, like services provided).

The main results of this paper are however those that test different predictions of PBA (when and in which markets it is stronger). We find that, as expected, PBA is stronger in periods of lower returns and higher volatility. We also find that PBA is stronger in equity markets than in fixed income markets. These results, combined with the existence of PBA, imply that there are limits to arbitrage in bringing security prices to fundamentals. However, we also find that assets of managers that use arbitrage strategies are less sensitive to both its own performance and to the performance of the benchmark portfolio. The latter result suggests that performance-based arbitrage is weaker among the true arbitrageurs. Thus, although PBA exists, its effect on security prices might be small.

The paper is divided as follows. Section 3.2 presents a brief review of the relevant literature, with specific emphasis on the asset flows-performance relationship in the pension fund industry. Section 3.3 describes the database, followed by the results in Section 3.4. Finally, Section 3.5 concludes.

3.2 Literature review

As noted before, the money manager industry has received little research attention. The institutional details of this industry, surveyed by Lakonishok et al. (1992), generate many agency problems. This agency problems are driven by the different incentives that each participant faces: pension funds hire plans sponsors which then hire money managers, who are the actual investors in the equity and fixed income markets. Pension funds prefer to delegate all decisions in order to avoid been blamed for bad performance. Lakonishok et al. (1992) argue that these managers subtract (rather than add) value relative to passive investment strategies. Even if the low observed consistency of performance could allow a plan sponsor to transfer funds to better managers, it is not clear that it would be able to generate returns in excess of the market return.

3.2.1 Performance-based arbitrage

In their seminal work, Shleifer and Vishny (1997) define Performance-Based Arbitrage (PBA) as the condition under which investor's aggregate supply of funds to the arbitrageurs in a particular segment is an increasing function of arbitrageurs' gross return. These authors note that, unlike models where arbitrage involves no risk and where arbitrageurs can access an unlimited amount of capital, if specialized arbitrageurs invest the capital of outside investors and these investors evaluate the ability of each arbitrageur based on past performance, arbitrageurs can become most constrained when they have the best opportunities (when the mispricing they have bet against gets even worse).

The importance of PBA is that it may not be fully effective in bringing security prices to fundamental values, especially in extreme circumstances, thus limiting the power of arbitrage in achieving market efficiency. Although not formally modeled, Shleifer and Vishny (1997) also suggest that the presence of risk adverse arbitrageurs (together with arbitrageurs been Bayesians with imprecise posteriors about the true distribution of returns) would make them more cautious at the moment to put their initial trades. In this way, expectations of future asset withdrawals might have a similar effect to the withdrawals themselves in limiting arbitrage.

There are some other market conditions under which PBA should be more important in limiting the role of arbitrage to close the gap between prices and fundamental values. For example, when price movements are extreme or when there are agency problems. These authors also mention some other market conditions that would reduce the importance of PBA. For example, if there is a lag in the response of assets under management to performance, if arbitrageurs are diversified, if there are explicit contractual restrictions on withdrawals or if there is heterogeneity across arbitrageurs.[1]

In this paper we investigate some empirical implications of PBA mentioned by Shleifer and Vishny (1997). We follow their intuition that PBA might explain why some markets seem to have more arbitrage activity than others. Broadly defined, professional arbitrage activity is concentrated in a few markets, like the bond and the foreign exchange markets. Shleifer and Vishny (1997) mention that this might be explained by the ability to do arbitrage (for example, in the bond market there is fundamentally no risk in doing arbitrage, and thus there are potentially more arbitrageurs involved). Moreover, they also argue that the difference between prices and fundamental values also attracts arbitrageurs, since the benefits from arbitrage can be large (for example, when central banks attempt to maintain non-market exchange rates). These authors also note that risk averse arbitrageurs might avoid extremely volatile markets.

3.2.2 Evidence on the performance-flow relationship

Comparing the performance-flow relationship between pension and mutual fund industries

Del-Guercio and Tkac (2002) study the differential relationship of asset flows and returns between the mutual fund and the pension fund industries. They note that the scarce literature on pension funds relative to mutual funds can be caused by data accessibility, but argue that these important investors represent $7.3 trillion in tax-exempt assets, more than the $5.2 trillion assets in the mutual funds.

The pension fund database used by Del-Guercio and Tkac (2002) comes from the M-Search database, compiled and distributed by Mobius, Inc. The original M-search sample has information for 1,320 manager firms offering more than 4,500 products from 1985 to 1994. The final sample, however, contains information for only 562 products in 388 firms, for a total of 2,462 product-year observations.

Del-Guercio and Tkac (2002) regress asset flows on Jensen's alpha, lagged excess return and tracking error. They also include some controls like fund age, size, lagged asset flow, and "year×style" interaction dummies.

[1] "PBA supposes that all arbitrageurs have the same sensitivity of funds under management to performance, and that all invest in the mispriced asset from the beginning. In fact arbitrageurs differ. Some may have access to resources independent of past performance, and as a result might be able to invest more when prices diverge further from fundamentals", Shleifer and Vishny (1997, pp. 48-49).

The results of their regressions imply that pension manager flows are positively correlated to risk-adjusted performance measures such as Jensen's alpha (in contrast with mutual funds where the relationship is stronger for unadjusted returns), and negatively related to tracking error. Additional results test the different sensitivities to positive and negative returns and a dummy for outperforming the S&P500 Index.

They also find that asset flows are related to some manager characteristics that are more easily justified ex-post to a trustee committee. For example, they show that what matters is whether the manager "beats" the market, but not the actual excess return. Furthermore, they show that non-performance variables explain large part of the asset flows, while performance only explains 2%.

Using piecewise linear regressions, these authors show that the shape of the flow-performance relationship is also different between the mutual fund and pension fund industries. The mutual fund relationship is convex (i.e., there is no flow response to poor performance but there is an increasing response to good performance), while the pension fund relationship is almost linear. Finally, Del-Guercio and Tkac (2002) find that the high degree of autocorrelation of flows in the mutual fund industry is not present in the pension fund industry.

Studying selection and termination of managers through asset and account changes

Heisler et al. (2004) study hiring and firing of money managers in the pension fund industry by indirectly looking at changes in assets and number of accounts managed by each fund. They argue that although an exact measure of this firing/hiring decision is unavailable (would require knowledge of the exact portfolio holdings of each plan sponsor), assets and accounts are a good proxy.

They use the PSN Investment Manager Database compiled by Effron Enterprises Inc., with historical information for over 7,000 investment products. In their main sample they only include active domestic equity funds (60% of the entire database). They regress asset and account flows on past return, a measure of return consistency and some other product attributes, including product fixed effects.

The measures of assets and accounts flows used in the analysis include: level change; percentage change: change in assets relative to all funds "on the move" within the industry in each year and a similar variable for accounts. For robustness purposes, Heisler et al. (2004) use total returns and four different ways to calculate excess returns relative to some benchmark. Return consistency is measured as tracking error. Heisler et al. (2004) also use categorical variables to describe the path of excess performance over one, three and five years. Product attributes included in the analysis are: first appearance in the database, size and lagged flows.[2]

The results of these regressions show that asset and account flows are only partially explained by product performance and attributes (as measured by the low R-squared around 0.04). As Del-Guercio and Tkac (2002), Heisler et al. (2004) also argue that this finding suggest that flows are based more on qualitative considerations, like subjective measures of managerial skills and customer services.

Despite this result, the regressions show that products that consistently produce positive (negative) excess returns gain more (fewer) assets. The regressions show that what matters is the consistency with which managers deliver positive or negative active returns relative to the S&P500 Index, regardless of the magnitude of these returns. Moreover, one of the key results is that the S&P500 Index plays a key role in the evaluations for asset flows than other specific style benchmarks. However, these other style benchmarks indeed have an effect on account flows.

Their tables also show that plan sponsors exhibit a tendency to favor products with smaller asset bases and longer track records. Asset flows are also shown to be positive serially correlated, while accounts present negative serial correlation. Heisler et al. (2004) argue that the similarity of the results between the regressions using asset flows and account flows reduces the concern about the potential bias due to the presence of large plan sponsors.

Performance before and after hiring and firing decisions

Goyal and Wahal (2004) study the performance of managers around firing and hiring decisions by plan sponsors. Their database comes from various sources. They first get information on hiring decisions from Mercer Investment Consulting. This information is completed using the IISearches database (managed by Institutional Investors). Finally, they complete the sample with information from trade publications.

The hiring sample has 9,581 decisions by 3,715 plan sponsors between 1994 and 2003,

[2]Note that lagged flows together with product fixed effects induce a bias in the coefficients of order 1/T.

and represents $730 billion. Goyal and Wahal (2004) use excess returns one, two and three years before and after the decision. They find average pre-hiring returns of 14.1% compared to 1.6% post-hiring returns. Moreover, they find that post-hiring returns are negatively related to pre-hiring returns.

The firing sample is composed of 902 events involving 505 plan sponsors between 1996 and 2003, and represents $110 billion; 32% firing events are related to performance, 12% to organizational reasons and 12% to asset reallocations. The average pre-firing return is -1.4% compared to a 5.5% post-firing return. Furthermore, this differential is larger for firing decisions related to performance than the others (-5.4% vs. 6.3%). The "round-trip" (matched firing and hiring) sample has 655 events. On average, post-firing returns are positive and post-hiring returns are not distinguishable from zero.

Using transition matrices Goyal and Wahal (2004) find considerable performance persistence over a one year horizon (best quartile persistence of 34%). Persistence declines over longer horizons for domestic equity investment mandates but increases for fixed income mandates.

3.3 Data

The database for this paper comes from two main sources. The first is the PSN Database from Informa Investment Solutions, Inc. and the second is the Nelson Directory. The flow-performance analysis uses only the PSN Database, which is then completed using the Nelson Database for the analysis of hiring and firing decisions.

3.3.1 PSN Database

The main purpose of this database is to inform plan sponsors about their available choices for investment. Performance information is available on a quarterly basis since 1979. After 1999, this information is available in a monthly basis. We use total annual returns in the analysis, as well as annual excess returns with respect to self reported specific benchmarks or excess returns with respect to general indices. In particular we use the Standard and Poor's 500 Index for equity products and the Lehman Brothers Aggregate Bond Index for fixed income products. Table 3.1 shows the mean and standard deviation for the returns and excess returns for the different years of analysis. As expected, there is large variation in annual rates of return across years and within years.

The full PSN sample includes more than 8,000 products managed by 1,500 firms (a total of 87,221 product year observations). The distribution of products with respect to their main mandate is 58% for US Equity, 26% for US Fixed Income, while International Equity and International Fixed Income represent 13% and 3%, respectively. The rates of return broken down by mandate are displayed in Table 3.2. PSN classifies each product into one of their "universes" (e.g. Equity Large Capitalization, International Emerging Markets or Municipal Fixed Income). The distribution of products based on this PSN classification is shown in Table 3.3.

Other variables used in the analysis include the self-reported use of an arbitrage style investment strategy. We consider this variable to be a measure of the extent to which the manager is involved in arbitrage activities. The variable is available for both equity and fixed income products. For the 5,831 products with information for returns, asset flows and arbitrage strategy, the distribution of the arbitrage variable is shown in Table 3.4. It should be noted that this variable is static and corresponds only to 2004.

We also use the self-reported use of a contrarian style investment strategy as another proxy for the extent to which the manager is involved in arbitrage activities. Note, however, that this variable is only available for equity products. Table 3.4 also shows the distribution of this variable among the different categories.

3.3.2 Nelson Database

Since manager information is only available for the last year in the PSN Database (2004), we merged this database with the Nelson Directory, which includes the name, position and main functions of the principal manager of each product in each year (1997-2004).

The merging process generates 3,520 unique products matched between Nelson and PSN. Around 1,900 were automatically matched (the firm and product names were the same in both databases), while 1,596 were matched manually.

We classify each product-year observation into five different categories. These categories and the number of observations included in each cell are shown in Table 3.5.

The first category includes product-year observations for which the name of the manager in periods t and $t-1$ is the same. We call this situation the "no change situation". The other four categories include situations in which the managers in period t and $t-1$ are different. The second category includes product-year observations when the manager at t was in the firm at period $t-1$ in other position and the person who was the manager in period $t-1$ also stays at the firm in another position in t. We call this situation an "internal reallocation". The third, category includes observations when the new manager was not in the firm in period $t-1$ and the old manager leaves the firm after the replacement. We call this situation "Leaves the firm + external replacement". The fourth category includes observations when the new manager was in the firm in period $t-1$ but the old manager leaves the firm after the replacement. We call this situation "Leaves the firm + internal replacement". Finally, the fifth category includes observations when the new manager was not in the firm in period $t-1$ and the old manager does not leave the firm after the replacement. We call this situation "Move within the firm + external replacement".

3.4 Results

3.4.1 Persistence of returns

To study persistence of returns, we first classify the returns of each manager in a quartile for each year. We also calculate quartiles for two and three year cumulative returns, and construct transition matrices with non-coincident information.

The top panel of Table 3.6 shows the transition matrices for one, two and three year cumulative returns. In each matrix, each column sums to 1. The matrix for $k=1$ shows that 31% of managers in the lowest return quartile stayed there for the next year (compared to a 25% if there were no persistence). The persistence seems stronger at the highest quartile (35%) and across the diagonal. Note that the most difficult transition is from the second quartile to the fourth and viceversa (14% and 15%, respectively).

The transition matrix for two-year cumulative total returns ($k=2$) looks very similar. Note, however, that there are selection biases that are not accounted for, since to be included in this sample, products must have information for at least four consecutive years. Therefore, the sample drops from 79,260 to 63,950 product-year observations. Finally, the bottom matrix in the top panel shows persistence for three-year cumulative returns ($k=3$). The need for 6 consecutive years of information reduces the sample to 50,000 observations. Persistence at this longer horizon seems, on average, as high as for the shorter horizons.

If instead of looking at total returns we look at excess returns over self-reported product specific benchmarks, the results look very similar, as shown in the middle panel of the same Table. Also note that persistence is still high at longer horizons. Finally, the bottom panel shows transition matrices for excess returns calculated over the S&P500 Index for equity products and the Lehman Brothers Aggregate Bond Index for fixed income products. In this case, persistence looks stronger at shorter horizons but decreases at longer horizons. However, on average, we can still argue that the bottom panel shows about the same persistence than that of total returns of excess returns over self-reported benchmarks.

Persistence of returns is a necessary condition for performance-based arbitrage to be profitable. Thus, we further investigate persistence using regression analysis. In Table 3.7, we regress yearly returns (total and excess) on past returns with and without the inclusion of year fixed effects:[3]

$$R_{it,t+k} = \alpha + \beta R_{it,t-k} + \eta_t + \epsilon_{it}, \tag{3.1}$$

where, R is total or excess return, η are time fixed effects, and ϵ is the disturbance term.

Note how the inclusion of year fixed effects in general flips the sign of the past return variable. The inclusion of year dummies makes returns positive serially correlated (evidencing the existence of persistence). Notably, persistence decreases with the time horizon. We also find mean reversion for three-year cumulative returns when using the S&P500 and the LBAGB indices to calculate excess returns. The previous tables show that, although small, there is statistically significant persistence of returns in the money manager industry.

3.4.2 Asset/accounts flows and performance

We proceed to test directly the presence of performance based arbitrage by measuring the sensitivity of asset flows to performance. As is common in the literature, we also find a positive and significant relationship between asset flows and performance. Instead of assuming that the coefficient on the own return and market return should be the same (i.e., use excess returns in the regression), we include separately both product and market returns:

[3]These regressions cannot include product fixed effects, since the coefficients would be biased.

$$\frac{A_{it} - A_{it-1}}{A_{it-1}} = \alpha_i + \beta R_{it} + \gamma MktR_{it} + \eta_t + \epsilon_{it}, \tag{3.2}$$

where, A is assets or accounts, R is total return, $MktR$ is the market return, α are product fixed effects, η are time fixed effects, and ϵ is the disturbance term.

The top panel of Table 3.8 shows regressions where the percentage change in assets is regressed on product and market returns, the latter measured as each product self reported specific benchmark. The first column shows the results using both asset increases and decreases to get a net change in assets under management (excluding the automatic increase in asset holdings due to the change in the value of the position). The second and third columns show the results broken down for assets gained and assets lost. As expected, there is a positive and significant relationship between product return and assets gained and a negative and significant relationship between return and assets lost. Moreover, and also as expected, the market return is negatively related to assets gained and positively related to assets lost.

If we use changes (gained, lost and net) in accounts instead of assets (Columns (4), (5) and (6) of Table 3.8), the results look very similar. Note that across the top panel of the table, and as showed in the literature, R-squared are low (explaining about 2% of the variation in the left-hand side variable). The last column of the table presents fixed effects linear probability models of a dummy variable that indicates if a product ran out of business regressed on product and market return. As expected, product return has a negative and significant effect on running out of business, while market return has the opposite effect.

The bottom panel of Table 3.8 shows the same regressions but using the S&P500 and the LBAGB indices to calculate excess returns. Note that the market return variable is still of the expected sign but loses statistical significance. This result can be interpreted as plan sponsors looking at product specific benchmarks instead of general indices when deciding to invest or withdraw assets, in contrast with evidence presented in Heisler et al. (2004). Given this result, for the rest of the paper we concentrate on excess returns relative to each product self-reported performance benchmark.[4]

In Table 3.8, we also present linear tests of the hypothesis that the difference between

[4]Results for excess returns using general indices show the same pattern, but standard errors are considerably larger.

the product return and market return coefficients (in absolute value) is not statistically different from zero. In almost all specifications we reject the null hypothesis, except in the last two columns of the top panel. This finding validates our approach to include both variables separately and not one single measure of excess returns.

Table 3.9 shows the differential sensitivity for positive and negative returns (both product and market returns). In general, we can conclude that both positive and negative product returns have an effect on asset and account flows. Although the coefficients on negative terms are generally larger, linear tests of the hypothesis that the coefficients on positive and negative returns are equal are almost always unable to reject the null (both for product and market returns).

The results of this section show that plan sponsors do take into consideration performance when investing more assets or withdrawing from previous mandates in the money manager industry. Although this is not the only factor that affects flows (as shown in the literature and evidenced by the low R-squared), PBA might prevent arbitrage activities from bringing security prices to fundamental values.

3.4.3 Asset/accounts flows and performance for different markets and periods

Shleifer and Vishny (1997) mention that PBA might be more pronounced in some situations. We test this prediction in two ways. First, we present yearly regressions of asset flows on performance in Table 3.10. In general, it is evident that PBA is more pronounced when returns are lower and more volatile (in terms of standard deviation). Thus, asset flows are more sensitive to returns just when arbitrageurs would be most needed to bring security prices back to fundamental values. This table presents evidence that there are potential limits to arbitrage in the money manager industry.

We also interact the main regression with dummies for the basic four markets in our data: Domestic Equity, Domestic Fixed Income, International Equity and International Fixed Income. Table 3.11 presents the results of these regressions. Note that PBA is present in equity markets, but absent in fixed income markets. Given that professional arbitrage activity is more concentrated in the fixed income market than in the equity market (see Table 3.4), our results suggest that there are potential limits to arbitrage in the equity market, while arbitrage is not limited in the fixed income market. This result might, as noted by Shleifer and Vishny (1997), explain part of the equity premium puzzle.

3.4.4 Asset/accounts flows, performance and arbitrage strategies

Shleifer and Vishny (1997) also mention that one of the potential situations in which PBA is less pronounced is when arbitrageurs are heterogenous with respect to the sensitivity of their funds to performance. In Table 3.12, we interact the product and market return variables with a dummy for whether the product reported it used arbitrage investment strategies. The dummy takes the value of one if the manager answered very important, important or used; and zero if he answered not important or not used.

Note that there are only a few instances where the coefficients of the interaction terms are significantly different from zero. However, in these instances the coefficients have the inverse sign of the non-interacted return variables. That means that the asset flows of the managers that use more arbitrage strategies are less sensitive to performance: PBA is weaker among arbitrageurs.

If we assume that arbitrage activity is better proxied by the use of contrarian strategies in the subsample of equity products, Table 3.13 shows that the interaction variables are highly significant. A possible explanation is that investors, knowing that some of the managers follow a contrarian strategy, are more willing to accept variations in their returns before forcing to liquidate their positions. The findings in this section imply that, although PBA exists, it is weaker among arbitrageurs, thus its effect on security prices might be small.

3.4.5 Hiring and Firing and performance

The last exercise we present uses our merged PSN-Nelson database (described in Section 3.3.2). Instead of looking at the intensive margin (account and asset flows), in this section we study the extensive margin (replacing the fund manager). The decision to replace the manager is not, however, in the hands of plan sponsors, but on the principal manager of the firm. Given this feature, the empirical results in this section might be interpreted as looking at how agency problems within the firms (money managers) interact with PBA. Table 3.14 presents the results of regressing a dummy for whether the fund manager has been replaced on product and market returns. In Column (1), as expected, the coefficient on product return is negative and the coefficient on market return is positive: neither of these results is, however, statistically different from zero. Allowing for fixed effects probit or logit models in

Columns (2) and (3) (instead of a fixed effects linear probability model) does not increase the statistical significance. If we increase the sample size by using general indices (S&P500 or LBAGB) to calculate the market return (Columns (4-6)), we get statistically significant coefficients for the product return. The market return variable is not significantly different from zero, and is considerably smaller than the one using product self-reported specific benchmark. We argue that these results imply that the lack of statistical significance in Columns (1-3) is due to sample size, and that product specific benchmarks, instead of general indices, are still the relevant benchmark. Overall, this table suggests that although smaller, the extensive margin also presents evidence of the existence of PBA.

3.5 Conclusions

In this paper we analyze the empirical behavior of the money manager industry. In particular, we test for the presence and extent of Performance-Based Arbitrage (PBA), i.e., that assets under management that investors give to specialized arbitrageurs are positively related to their past performance. Shleifer and Vishny (1997) argue that PBA limits the ability of arbitrage to achieve market efficiency. We explore some empirical implications of PBA. First, we find that there is persistence in manager returns, a necessary condition for PBA to be profitable. Then, we show that returns are positively correlated with asset and account flows in the money manager industry. We also show that manager replacement is also correlated with past performance. Moreover, we find that PBA is stronger in periods of lower returns and higher volatility and that it is stronger in equity markets than in fixed income markets. These results imply that PBA might in fact affect pricing. However, we also find that assets of managers that use arbitrage strategies are less sensitive to both its own performance and to the performance of the benchmark portfolio. The latter finding suggests that PBA is weaker among arbitrageurs, and that although PBA exists, its effect on security prices might be small.

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Tables

Table 3.1: Returns by year

	R				$R - MktR^a$		
	Mean	Std. Dev.	Obs.		Mean	Std. Dev.	Obs.
1979	0.194	0.133	363	1979	0.052	0.091	137
1980	0.241	0.157	496	1980	0.015	0.104	257
1981	0.065	0.076	621	1981	0.070	0.083	320
1982	0.278	0.099	738	1982	0.053	0.098	379
1983	0.199	0.101	861	1983	0.020	0.078	450
1984	0.082	0.074	1,010	1984	0.010	0.065	522
1985	0.297	0.102	1,207	1985	0.010	0.068	611
1986	0.205	0.123	1,463	1986	0.016	0.067	725
1987	0.061	0.096	1,769	1987	0.021	0.074	913
1988	0.150	0.085	2,158	1988	0.004	0.064	1,088
1989	0.216	0.109	2,524	1989	0.000	0.081	1,268
1990	0.017	0.097	2,960	1990	0.038	0.087	1,493
1991	0.266	0.149	3,409	1991	0.021	0.110	1,744
1992	0.092	0.085	3,808	1992	0.017	0.069	1,958
1993	0.159	0.124	4,330	1993	0.015	0.078	2,252
1994	0.006	0.061	4,727	1994	0.015	0.057	2,473
1995	0.243	0.121	5,121	1995	-0.005	0.080	2,703
1996	0.154	0.106	5,469	1996	0.015	0.070	2,952
1997	0.196	0.149	5,696	1997	0.005	0.097	3,324
1998	0.120	0.149	5,879	1998	-0.020	0.110	3,448
1999	0.200	0.229	6,004	1999	0.026	0.163	3,535
2000	0.020	0.157	5,975	2000	0.045	0.133	3,549
2001	-0.006	0.135	5,987	2001	0.043	0.106	3,584
2002	-0.096	0.144	5,789	2002	0.009	0.071	3,471
2003	0.291	0.187	5,476	2003	0.017	0.099	3,286
2004	0.126	0.084	3,381	2004	0.003	0.052	2,151

Variables were winsorized at the 1% and 99% of the empirical distribution. R is product return and $MktR$ is the market return. $MktR^a$ takes each product performance benchmark's return as the market return, while $MktR^b$ takes the return on the S&P500 Index for equity products and the Lehman Brothers Aggregate Bond Index for fixed income products as the market return.

Table 3.2: Returns by investment mandate

	Mean	Std. Dev.	Obs.
Domestic Equity:			
R	0.148	0.188	50,273
$R - MktR^a$	0.020	0.109	36,825
$R - MktR^b$	0.014	0.137	50,273
Domestic Fixed Income:			
R	0.084	0.066	22,731
$R - MktR^a$	0.001	0.039	10,819
$R - MktR^b$	0.000	0.046	22,731
International Equity:			
R	0.122	0.250	11,194
$R - MktR^a$	0.032	0.140	858
$R - MktR^b$	-0.004	0.207	11,194
International Fixed Income:			
R	0.106	0.120	3,023
$R - MktR^a$	-0.034	0.158	91
$R - MktR^b$	0.025	0.116	3,023
Total:			
R	0.126	0.175	87,221
$R - MktR^a$	0.016	0.099	48,593
$R - MktR^b$	0.009	0.132	87,221

Variables were winsorized at the 1% and 99% of the empirical distribution. R is product return and $MktR$ is the market return. $MktR^a$ takes each product performance benchmark's return as the market return, while $MktR^b$ takes the return on the S&P500 Index for equity products and the Lehman Brothers Aggregate Bond Index for fixed income products as the market return.

Table 3.3: Returns by PSN product classification

	R			R	
	Mean	Obs.		Mean	Obs.
Large Cap	0.139	6,124	AllVariable Maturity	0.092	1,046
Mid Cap	0.160	1,524	Domestic Balance	0.125	9,617
Small Cap	0.170	2,328	International Fixed Income	0.116	1,066
REITReal Estate	0.180	235	EAFE	0.121	1,007
Large Cap Growth	0.145	1,395	Intl Emerging Markets	0.130	475
Large Cap Value	0.150	1,696	International Equity	0.118	2,703
Large Cap Core	0.133	877	Global Equity	0.127	2,071
Mid Cap Growth	0.146	480	Global Fixed Income	0.095	1,350
Mid Cap Value	0.170	354	GlobalIntl Balanced	0.113	607
Mid Cap Core	0.148	156	Japanesse Equity	0.052	192
Small Cap Growth	0.162	709	European Equity	0.141	286
Small Cap Value	0.183	687	Domestic Growth	0.161	3,270
Small Cap Core	0.189	282	Domestic Value	0.159	2,981
All Cap Growth	0.160	288	Domestic Core	0.145	1,535
All Cap Value	0.165	444	Domestic Equity	0.151	12,137
All Cap Core	0.142	195	Domestic Fixed Income	0.086	7,756
Micro Cap	0.200	188	Intl Large Cap	0.107	978
All Cap	0.157	2,004	Intl Small Cap	0.162	148
Less than 1 Yr Maturity	0.062	496	Domestic GARP	0.139	767
Short Term Fixed Income	0.069	847	Core Plus Fixed Income	0.088	307
Intermediate Fixed Income	0.082	1,378	Intl Equity ex Emerging Mkts	0.123	2,187
Long Term Fixed Income	0.095	406	Corporate Bond Managers	0.092	299
High Yield Fixed Income	0.109	625	Government Bond Managers	0.077	483
Municipal Fixed Income	0.067	597	Fixed Income ex High Yield	0.083	6,774
Core Fixed Income	0.083	1,463	International Value	0.131	613
Mortgage Backed	0.082	254	International Growth	0.132	534

Variables were winsorized at the 1% and 99% of the empirical distribution. R is product return and $MktR$ is the market return. $MktR^a$ takes each product performance benchmark's return as the market return, while $MktR^b$ takes the return on the S&P500 Index for equity products and the Lehman Brothers Aggregate Bond Index for fixed income products as the market return.

Table 3.4: Arbitrage and contrarian variables

	Arbitrage (Equity)		Arbitrage (Fixed Inc.)		Contrarian (Equity)	
	Obs.	Frac.	Obs.	Frac.	Obs.	Frac.
Very Important	79	0.004	136	0.013	1,191	0.056
Important	99	0.005	223	0.022	2,245	0.105
Not Important	674	0.032	851	0.083	2,931	0.137
Utilized	264	0.012	497	0.048	4,426	0.207
Not Utilized	20,218	0.948	8,545	0.833	10,541	0.494
Total	21,334	1.000	10,252	1.000	21,334	1.000

Variables were winsorized at the 1% and 99% of the empirical distribution.

Table 3.5: Firing and hiring sample

	R Mean	R Std. Dev.	R Obs.
No change	0.092	0.207	5,339
Change (all categories)	0.088	0.207	759
Internal Reallocation	0.127	0.215	56
Leaves the firm + External replacement	0.111	0.226	297
Leaves the firm + Internal replacement	0.023	0.203	55
Move within firm + External replacement	0.072	0.207	351
Total	0.092	0.208	6,098

Variables were winsorized at the 1% and 99% of the empirical distribution. R is product return.

Table 3.6: Persistence Tables

		$Q1_{t,t-k}$	$Q2_{t,t-k}$	$Q3_{t,t-k}$	$Q4_{t,t-k}$
		Quartiles in terms of R			
$k=1:$	$Q1_{t+k,t}$	0.31	0.25	0.19	0.26
	$Q2_{t+k,t}$	0.27	0.35	0.24	0.15
	$Q3_{t+k,t}$	0.20	0.26	0.30	0.24
	$Q4_{t+k,t}$	0.22	0.14	0.27	0.35
$k=2:$	$Q1_{t+k,t}$	0.33	0.25	0.18	0.26
	$Q2_{t+k,t}$	0.25	0.32	0.28	0.17
	$Q3_{t+k,t}$	0.19	0.24	0.31	0.27
	$Q4_{t+k,t}$	0.23	0.19	0.23	0.30
$k=3:$	$Q1_{t+k,t}$	0.36	0.21	0.18	0.26
	$Q2_{t+k,t}$	0.24	0.31	0.30	0.20
	$Q3_{t+k,t}$	0.20	0.30	0.28	0.25
	$Q4_{t+k,t}$	0.21	0.18	0.24	0.30
		Quartiles in terms of $R - MktR^a$			
$k=1:$	$Q1_{t+k,t}$	0.33	0.17	0.20	0.30
	$Q2_{t+k,t}$	0.17	0.40	0.30	0.15
	$Q3_{t+k,t}$	0.20	0.30	0.32	0.19
	$Q4_{t+k,t}$	0.29	0.14	0.18	0.36
$k=2:$	$Q1_{t+k,t}$	0.32	0.18	0.22	0.31
	$Q2_{t+k,t}$	0.18	0.40	0.31	0.14
	$Q3_{t+k,t}$	0.21	0.29	0.29	0.20
	$Q4_{t+k,t}$	0.29	0.13	0.18	0.35
$k=3:$	$Q1_{t+k,t}$	0.30	0.19	0.24	0.32
	$Q2_{t+k,t}$	0.18	0.41	0.33	0.14
	$Q3_{t+k,t}$	0.23	0.28	0.28	0.21
	$Q4_{t+k,t}$	0.29	0.12	0.15	0.33
		Quartiles in terms of $R - MktR^b$			
$k=1:$	$Q1_{t+k,t}$	0.37	0.23	0.18	0.23
	$Q2_{t+k,t}$	0.19	0.37	0.26	0.19
	$Q3_{t+k,t}$	0.17	0.24	0.36	0.23
	$Q4_{t+k,t}$	0.27	0.16	0.20	0.35
$k=2:$	$Q1_{t+k,t}$	0.32	0.25	0.18	0.27
	$Q2_{t+k,t}$	0.21	0.32	0.30	0.19
	$Q3_{t+k,t}$	0.20	0.26	0.32	0.23
	$Q4_{t+k,t}$	0.27	0.17	0.19	0.31
$k=3:$	$Q1_{t+k,t}$	0.29	0.24	0.22	0.28
	$Q2_{t+k,t}$	0.23	0.26	0.31	0.24
	$Q3_{t+k,t}$	0.20	0.30	0.30	0.21
	$Q4_{t+k,t}$	0.28	0.20	0.17	0.27

Variables were winsorized at the 1% and 99% of the empirical distribution. R is product return and $MktR$ is the market return. $MktR^a$ takes each product performance benchmark's return as the market return, while $MktR^b$ takes the return on the S&P500 Index for equity products and the Lehman Brothers Aggregate Bond Index for fixed income products as the market return.

Table 3.7: Persistence regressions
$R_{it,t+k} = \alpha + \beta R_{it,t-k} + \eta_t + \epsilon_{it}$

	(1)	(2)	(3)	(4)	(5)	(6)
	Returns ($R_{t,t+k}$)					
	$k = 1$		$k = 2$		$k = 3$	
$R_{t,t-k}$	-0.032***	0.052***	-0.010*	0.015***	-0.048***	0.028***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.007)	(0.006)
Constant	0.127***	0.233***	0.252***	0.516***	0.408***	0.617***
	(0.001)	(0.008)	(0.002)	(0.007)	(0.003)	(0.010)
Observations	79,260	79,260	63,950	63,950	50,000	50,000
R-squared	0.001	0.391	0.000	0.338	0.002	0.341
Product FE	N	N	N	N	N	N
Time FE	N	Y	N	Y	N	Y
	(1)	(2)	(3)	(4)	(5)	(6)
	Excess returns $(R - MktR^a)_{t,t+k}$					
	$k = 1$		$k = 2$		$k = 3$	
$(R - MktR^a)_{t,t-k}$	0.071***	0.061***	0.023***	0.027***	0.025***	0.037***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.009)	(0.009)
Constant	0.013***	0.066***	0.028***	0.090***	0.041***	0.026***
	0.000	(0.005)	(0.001)	(0.011)	(0.001)	(0.010)
Observations	43,970	43,970	35,386	35,386	27,649	27,649
R-squared	0.005	0.036	0.001	0.039	0.001	0.045
Product FE	N	N	N	N	N	N
Time FE	N	Y	N	Y	N	Y
	(1)	(2)	(3)	(4)	(5)	(6)
	Excess returns $(R - MktR^b)_{t,t+k}$					
	$k = 1$		$k = 2$		$k = 3$	
$(R - MktR^b)_{t,t-k}$	0.129***	0.086***	0.031***	-0.014**	-0.117***	-0.088***
	(0.005)	(0.005)	(0.006)	(0.006)	(0.009)	(0.009)
Constant	0.007***	-0.012*	0.012***	0.037***	0.012***	0.039***
	0.000	(0.006)	(0.001)	(0.006)	(0.001)	(0.008)
Observations	79,260	79,260	63,950	63,950	50,000	50,000
R-squared	0.017	0.151	0.001	0.174	0.011	0.196
Product FE	N	N	N	N	N	N
Time FE	N	Y	N	Y	N	Y

Robust standard errors in parenthesis. *, **, *** significant at 10%, 5% and 1%, respectively. Variables were winsorized at the 1% and 99% of the empirical distribution. R is product return and $MktR$ is the market return. $MktR^a$ takes each product performance benchmark's return as the market return, while $MktR^b$ takes the return on the S&P500 Index for equity products and the Lehman Brothers Aggregate Bond Index for fixed income products as the market return.

Table 3.8: Flow-performance regressions
$\frac{A_{it}-A_{it-1}}{A_{it-1}} = \alpha_i + \beta R_{it} + \gamma MktR_{it} + \eta_t + \epsilon_{it}$

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Asset Change			Accounts Change			Termi-
	Net	Gained	Lost	Net	Gained	Lost	nation
R	0.335***	0.448***	-0.004	0.274***	0.294***	-0.056***	-0.029***
	(0.071)	(0.081)	(0.012)	(0.048)	(0.049)	(0.012)	(0.004)
$MktR^a$	-0.189**	-0.246**	0.031**	-0.206***	-0.234***	0.048***	0.030***
	(0.086)	(0.099)	(0.015)	(0.058)	(0.059)	(0.015)	(0.005)
Constant	0.635***	1.028***	0.103***	0.500***	0.871***	0.145***	-0.006
	(0.075)	(0.062)	(0.012)	(0.048)	(0.036)	(0.012)	(0.007)
Obs.	18,284	19,854	18,816	17,964	19,808	18,745	48,593
Products	3,269	3,407	3,362	3,280	3,442	3,386	4,555
R-squared	0.017	0.028	0.004	0.033	0.051	0.008	0.015
Test	0.009	0.002	0.004	0.070	0.123	0.434	0.749
Prod. FE	Y	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y	Y

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Asset Change			Accounts Change			Termi-
	Net	Gained	Lost	Net	Gained	Lost	nation
R	0.216***	0.297***	0.017**	0.104***	0.116***	-0.016**	-0.015***
	(0.042)	(0.047)	(0.007)	(0.027)	(0.028)	(0.007)	(0.003)
$MktR^b$	-0.037	-0.024	0	-0.039	-0.062	-0.006	0.006
	(0.065)	(0.074)	(0.011)	(0.042)	(0.043)	(0.011)	(0.004)
Constant	0.460***	0.756***	0.090***	0.498***	0.858***	0.140***	-0.007
	(0.082)	(0.063)	(0.012)	(0.050)	(0.028)	(0.013)	(0.004)
Obs.	29,741	32,410	30,757	29,112	32,254	30,563	87,221
Products	5,501	5,779	5,675	5,509	5,839	5,713	7,961
R-squared	0.014	0.024	0.003	0.027	0.045	0.005	0.017
Test	0.001	0.000	0.073	0.069	0.145	0.023	0.026
Prod. FE	Y	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y	Y

Robust standard errors in parenthesis. *, **, *** significant at 10%, 5% and 1%, respectively. Variables were winsorized at the 1% and 99% of the empirical distribution. R is product return and $MktR$ is the market return. $MktR^a$ takes each product performance benchmark's return as the market return, while $MktR^b$ takes the return on the S&P500 Index for equity products and the Lehman Brothers Aggregate Bond Index for fixed income products as the market return. The rows named Test show the P-values of testing the hypothesis that the coefficients $R = -MktR$.

Table 3.9: Flow-performance regressions $\frac{A_{it}-A_{it-1}}{A_{it-1}} = \alpha_i + \beta_1 R_{it}^{+} + \beta_2 R_{it}^{-} + \gamma_1 MktR_{it}^{+} + \gamma_2 MktR_{it}^{-} + \eta_t + \epsilon_{it}$

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Asset Change			Accounts Change			Termi-nation
	Net	Gained	Lost	Net	Gained	Lost	
R^{+}	0.332***	0.424***	-0.027*	0.221***	0.262***	-0.055***	-0.027***
	(0.089)	(0.101)	(0.015)	(0.060)	(0.061)	(0.015)	(0.005)
R^{-}	0.366**	0.542**	0.066**	0.445***	0.398***	-0.060*	-0.037***
	(0.183)	(0.212)	(0.031)	(0.122)	(0.127)	(0.032)	(0.012)
$MktR^{a+}$	-0.062	-0.139	0.041**	-0.129*	-0.202***	0.031	0.026***
	(0.115)	(0.130)	(0.019)	(0.076)	(0.078)	(0.020)	(0.006)
$MktR^{a-}$	-0.531**	-0.545**	0.005	-0.414***	-0.323**	0.095**	0.043***
	(0.220)	(0.254)	(0.037)	(0.147)	(0.153)	(0.039)	(0.014)
Constant	0.619***	1.017***	0.106***	0.498***	0.872***	0.147***	-0.005
	(0.076)	(0.063)	(0.012)	(0.049)	(0.037)	(0.012)	(0.007)
Observations	18,284	19,854	18,816	17,964	19,808	18,745	48,593
Products	3,269	3,407	3,362	3,280	3,442	3,386	4,555
R-squared	0.017	0.028	0.004	0.033	0.051	0.008	0.015
Test 1	0.876	0.646	0.014	0.131	0.376	0.907	0.492
Test 2	0.092	0.201	0.451	0.124	0.526	0.180	0.324
Product FE	Y	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y	Y

Robust standard errors in parenthesis. *, **, *** significant at 10%, 5% and 1%, respectively. Variables were winsorized at the 1% and 99% of the empirical distribution. R is product return and $MktR$ is the market return. $MktR^{a}$ takes each product performance benchmark's return as the market return, while $MktR^{b}$ takes the return on the S&P500 Index for equity products and the Lehman Brothers Aggregate Bond Index for fixed income products as the market return. The rows named Test 1 and Test 2 show the P-values of testing the hypothesis that the coefficients R^{+}=R^{-} and $MktR^{+}$=$MktR^{-}$, respectively.

Table 3.10: Yearly asset flow-performance regressions
$\frac{A_{it}-A_{it-1}}{A_{it-1}} = \alpha + \beta R_{it} + \gamma MktR_{it} + \epsilon_{it}$, for each t

	(1) 1993	(2) 1994	(3) 1995	(4) 1996	(5) 1997	(6) 1998
R	1.222	-1.620*	1.051	1.708**	0.103	0.316
	(1.582)	(0.978)	(0.862)	(0.754)	(0.276)	(0.257)
$MktR^a$	2.244	3.914	-0.413	-1.540*	0.126	-0.530*
	(2.179)	(2.859)	(0.756)	(0.871)	(0.352)	(0.308)
Constant	0.009	0.254***	0.005	0.194***	0.193***	0.304***
	(0.279)	(0.069)	(0.094)	(0.066)	(0.060)	(0.036)
Observations	165	308	514	901	1,304	1,756
R-squared	0.014	0.011	0.014	0.014	0.001	0.003
Mean R	0.159	0.006	0.243	0.154	0.196	0.120
S.D. R	0.124	0.061	0.121	0.106	0.149	0.149
Mean $R - MktR^a$	0.015	0.015	-0.005	0.015	0.005	-0.020
S.D. $R - MktR^a$	0.078	0.057	0.080	0.070	0.097	0.110

	(7) 1999	(8) 2000	(9) 2001	(10) 2002	(11) 2003	(12) 2004
R	0.592***	0.697***	0.971***	1.260***	0.913***	2.406***
	(0.190)	(0.209)	(0.214)	(0.415)	(0.269)	(0.546)
$MktR^a$	-0.095	-0.503**	-0.569**	-1.323***	-0.479*	-0.790
	(0.257)	(0.207)	(0.264)	(0.412)	(0.275)	(0.538)
Constant	0.152***	0.216***	0.220***	0.191***	0.076**	-0.020
	(0.030)	(0.020)	(0.022)	(0.025)	(0.033)	(0.039)
Observations	2,085	2,303	2,449	2,488	2,414	1,508
R-squared	0.015	0.007	0.012	0.007	0.012	0.026
Mean R	0.200	0.020	-0.006	-0.096	0.291	0.126
S.D. R	0.229	0.157	0.135	0.144	0.187	0.084
Mean $R - MktR^a$	0.026	0.045	0.043	0.009	0.017	0.003
S.D. $R - MktR^a$	0.163	0.133	0.106	0.071	0.099	0.052

Robust standard errors in parenthesis. *, **, *** significant at 10%, 5% and 1%, respectively. Variables were winsorized at the 1% and 99% of the empirical distribution. R is product return and $MktR$ is the market return. $MktR^a$ takes each product performance benchmark's return as the market return, while $MktR^b$ takes the return on the S&P500 Index for equity products and the Lehman Brothers Aggregate Bond Index for fixed income products as the market return.

Table 3.11: Market-flow-performance regressions $\frac{A_{it}-A_{it-1}}{A_{it-1}} = \alpha_i + \sum_{j=1}^{4} \beta_j R_{it} \times U_{ij} + \sum_{j=1}^{4} \gamma_j MktR_{it} \times U_{ij} + \eta_t + \epsilon_{it}$

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
		Asset Change			Accounts Change		Termi-
	Net	Gained	Lost	Net	Gained	Lost	nation
$R\times$ Dom. Eq.	0.332***	0.430***	-0.011	0.278***	0.302***	-0.052***	-0.029***
	(0.074)	(0.084)	(0.012)	(0.049)	(0.050)	(0.013)	(0.004)
$R\times$ Dom. FixInc.	0.032	0.316	0.119	-0.073	0.134	0.018	-0.032
	(0.528)	(0.597)	(0.089)	(0.351)	(0.360)	(0.091)	(0.023)
$R\times$ Int.Eq.	0.774*	1.313***	0.172**	0.417	0.114	-0.173**	-0.026
	(0.406)	(0.459)	(0.067)	(0.299)	(0.299)	(0.073)	(0.022)
$R\times$ Int.Fix.	0.833	0.913	-0.075	-0.105	-0.091	0.054	0.019
	(1.202)	(1.403)	(0.205)	(0.790)	(0.837)	(0.210)	(0.073)
$MktR^a\times$ Dom.Eq.	-0.219**	-0.247**	0.039**	-0.222***	-0.275***	0.041***	0.031***
	(0.092)	(0.105)	(0.015)	(0.061)	(0.063)	(0.016)	(0.005)
$MktR^a\times$ Dom.Fix.	0.711	0.484	-0.003	0.213	0.220	0.040	0.039*
	(0.522)	(0.593)	(0.089)	(0.345)	(0.355)	(0.090)	(0.022)
$MktR^a\times$ Int.Eq.	-0.803*	-1.404***	-0.216***	-0.353	0.062	0.173**	0.017
	(0.478)	(0.538)	(0.079)	(0.358)	(0.356)	(0.086)	(0.026)
$MktR^a\times$ Int.Fix.	0.008	-0.135	-0.052	-0.223	0.181	0.299*	-0.009
	(0.967)	(1.079)	(0.165)	(0.635)	(0.644)	(0.169)	(0.050)
Constant	0.624***	1.018***	0.101***	0.499***	0.867***	0.144***	-0.006
	(0.076)	(0.063)	(0.012)	(0.048)	(0.037)	(0.012)	(0.007)
Observations	18,284	19,854	18,816	17,964	19,808	18,745	48,593
Products	3,269	3,407	3,362	3,280	3,442	3,386	4,555
R-squared	0.017	0.028	0.005	0.033	0.051	0.008	0.015
Product FE	Y	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y	Y

Robust standard errors in parenthesis. *, **, *** significant at 10%, 5% and 1%, respectively. Variables were winsorized at the 1% and 99% of the empirical distribution. R is product return and $MktR$ is the market return. $MktR^a$ takes each product performance benchmark's return as the market return, while $MktR^b$ takes the return on the S&P500 Index for equity products and the Lehman Brothers Aggregate Bond Index for fixed income products as the market return.

Table 3.12: Flow-performance-arbitrage regressions $\frac{A_{it}-A_{it-1}}{A_{it-1}} = \alpha_i + \beta_1 R_{it} + \beta_2 R_{it} \times Arb_i + \gamma_1 MktR_{it} + \gamma_2 MktR_{it} \times Arb_i + \eta_t + \epsilon_{it}$

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Asset Change			Accounts Change			Termi-nation
	Net	Gained	Lost	Net	Gained	Lost	
R	0.337***	0.443***	-0.008	0.276***	0.294***	-0.055***	-0.031***
	(0.072)	(0.083)	(0.012)	(0.048)	(0.049)	(0.013)	(0.004)
$MktR^a$	-0.181**	-0.229**	0.040***	-0.213***	-0.236***	0.050***	0.033***
	(0.088)	(0.101)	(0.015)	(0.058)	(0.060)	(0.015)	(0.005)
$R \times Arb$	-0.024	0.237	0.162*	0.165	0.327	-0.088	0.071**
	(0.542)	(0.624)	(0.091)	(0.414)	(0.412)	(0.101)	(0.031)
$MktR^a \times Arb$	-0.066	-0.408	-0.254***	0.176	-0.026	0.063	-0.110***
	(0.536)	(0.617)	(0.088)	(0.417)	(0.416)	(0.098)	(0.029)
Constant	0.632***	1.019***	0.104***	0.499***	0.874***	0.145***	-0.006
	(0.076)	(0.063)	(0.012)	(0.049)	(0.037)	(0.012)	(0.007)
Observations	18,033	19,592	18,564	17,726	19,554	18,502	47,890
Products	3,219	3,357	3,312	3,231	3,391	3,336	4,474
R-squared	0.017	0.028	0.005	0.033	0.051	0.007	0.016
Product FE	Y	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y	Y

Robust standard errors in parenthesis. *, **, *** significant at 10%, 5% and 1%, respectively. Variables were winsorized at the 1% and 99% of the empirical distribution. R is product return and $MktR$ is the market return. $MktR^a$ takes each product performance benchmark's return as the market return, while $MktR^b$ takes the return on the S&P500 Index for equity products and the Lehman Brothers Aggregate Bond Index for fixed income products as the market return. The arbitrage dummy is equal to one if the product self reported the arbitrage strategy as very important, important or used (instead of not important or not used).

Table 3.13: Flow-performance-contrarian regressions $\frac{A_{it}-A_{it-1}}{A_{it-1}} = \alpha_i + \beta_1 R_{it} + \beta_2 R_{it} \times C_i + \gamma_1 MktR_{il} + \gamma_2 MktR_{it} \times C_i + \eta_t + \epsilon_{it}$

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
		Asset Change			Accounts Change		Termi-
	Net	Gained	Lost	Net	Gained	Lost	nation
R	0.529***	0.611***	-0.029*	0.364***	0.375***	-0.060***	-0.033***
	(0.097)	(0.110)	(0.016)	(0.065)	(0.067)	(0.016)	(0.006)
$MktR^a$	-0.429***	-0.467***	0.071***	-0.274***	-0.284***	0.075***	0.040***
	(0.124)	(0.142)	(0.020)	(0.084)	(0.086)	(0.021)	(0.007)
$R \times C$	-0.449***	-0.396**	0.049*	-0.207**	-0.203*	0.004	0.011
	(0.154)	(0.176)	(0.025)	(0.104)	(0.107)	(0.026)	(0.009)
$MktR^a \times C$	0.571***	0.469**	-0.083***	0.208*	0.17	-0.017	-0.015*
	(0.166)	(0.190)	(0.027)	(0.112)	(0.115)	(0.028)	(0.009)
Constant	0.654***	1.066***	0.099***	0.528***	0.938***	0.130***	-0.005
	(0.091)	(0.077)	(0.014)	(0.060)	(0.046)	(0.014)	(0.009)
Observations	14,310	15,497	14,689	14,062	15,463	14,627	37,083
Products	2,582	2,694	2,647	2,586	2,712	2,665	3,583
R-squared	0.018	0.028	0.005	0.037	0.053	0.008	0.016
Product FE	Y	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y	Y

Robust standard errors in parenthesis. *, **, *** significant at 10%, 5% and 1%, respectively. Variables were winsorized at the 1% and 99% of the empirical distribution. R is product return and $MktR$ is the market return. $MktR^a$ takes each product performance benchmark's return as the market return, while $MktR^b$ takes the return on the S&P500 Index for equity products and the Lehman Brothers Aggregate Bond Index for fixed income products as the market return. The contrarian dummy is equal to one if the product self reported the contrarian strategy as very important, important or used (instead of not important or not used).

Table 3.14: Firing and hiring regressions
Change of Manager= $\alpha_i + \beta R_{it} + \gamma MktR_{it} + \eta_t + \epsilon_{it}$

	(1) LPM	(2) Logit	(3) Probit	(4) LPM	(5) Logit	(6) Probit
R	-0.033	-0.501	-0.065	-0.076**	-0.830**	-0.136
	(0.054)	(0.744)	(0.299)	(0.035)	(0.386)	(0.175)
$MktR^a$	0.022	0.41	0.246			
	(0.061)	(0.846)	(0.341)			
$MktR^b$				0.063	0.745	0.004
				(0.052)	(0.585)	(0.270)
Constant	0.883***		1.346***	0.869***		1.392***
	(0.014)		(0.113)	(0.012)		(0.098)
Observations	3,751	1,166	3,751	6,098	1,995	6,098
R-squared	0.002			0.002		
Products	1,204		1,204	1,985		1,985
Product FE	Y	Y	Y	Y	Y	Y
Time FE	Y	Y	Y	Y	Y	Y

Robust standard errors in parenthesis. *, **, *** significant at 10%, 5% and 1%, respectively. Variables were winsorized at the 1% and 99% of the empirical distribution. R is product return and $MktR$ is the market return. $MktR^a$ takes each product performance benchmark's return as the market return, while $MktR^b$ takes the return on the S&P500 Index for equity products and the Lehman Brothers Aggregate Bond Index for fixed income products as the market return.