NATIONAL BANK OF BELGIUM

WORKING PAPERS - RESEARCH SERIES

INVESTMENT, PROTECTION, OWNERSHIP, AND THE COST OF CAPITAL

Charles P. Himmelberg(*)
R. Glenn Hubbard(**)
Inessa Love(***)

The opinions, analysis and conclusions of this paper are solely our own and do not necessarily represent those of the Federal Reserve Bank of New York, the Council of Economic Advisors, the World Bank or the National Bank of Belgium.

We are grateful to Andy Abel, Steve Bond, Charles Calomiris, Peter Eglund, Martin Feldstein, Ray Fisman, Zsuzsanna Fluck, Bill Gentry, Mark Gertler, Simon Gilchrist, Denis Gromb, Bob Hall, Bob McDonald, Hamid Mehran, Andrew Samwick, David Scharfstein, John Vickers, Jeff Wurgler, an anonymous referee, and conference participants at the University of Brescia, Carnegie Mellon, Columbia, Georgetown, Harvard, Kansas, New York University, Wharton, the Federal Reserve Bank of New York, the World Bank, the Sveriges Riksbank/Stockholm School of Economics Conference on Asset Markets an Monetary Policy, the HBS Workshop on Emerging Markets, the NBER-CCER Conference on Chinese Economic Reforms, and the NBER Summer Institute and Corporate Finance Meetings for helpful comments and suggestions. Brian Chernoff provided excellent research assistance.

(*) Corresponding author: Prof. Charles P. Himmelberg, 606 Uris Hall, Columbia University, New York, NY 10027; email cph15@columbia.edu; phone: 212-854-2622.
(**) Council of Economic Advisers, Columbia University, and NBER.
(***) The World Bank.

Statement of purpose:

The purpose of these working papers is to promote the circulation of research results (Research Series) and analytical studies (Documents Series) made within the National Bank of Belgium or presented by outside economists in seminars, conferences and colloquia organised by the Bank. The aim is thereby to provide a platform for discussion. The opinions are strictly those of the authors and do not necessarily reflect the views of the National Bank of Belgium.

The Working Papers are available on the website of the Bank:
http://www.nbb.be

Individual copies are also available on request to:
NATIONAL BANK OF BELGIUM
Documentation Service
boulevard de Berlaimont 14
B - 1000 Brussels

Imprint: Responsibility according to the Belgian law: Jean Hilgers, Member of the Board of Directors, National Bank of Belgium.

ISSN: 1375-680X

Editorial

On May 27-28, 2002 the National Bank of Belgium hosted a Conference on *"New views on firms' investment and finance decisions"*. Papers presented at this conference are made available to a broader audience in the NBB Working Papers no 21 to 33.

Abstract

We investigate the cost of capital in a model with an agency conflict between inside managers and outside shareholders. Inside ownership reflects the classic tradeoff between incentives and risk diversification, and the severity of agency costs depends on a parameter representing investor protection. In equilibrium, the marginal cost of capital is a weighted average of terms reflecting both idiosyncratic and systematic risk, and weaker investor protection increases the weight on idiosyncratic risk. Using firm-level data from 38 countries, we estimate the predicted relationships among investor protection, inside ownership, and the marginal cost of capital. We discuss implications for the determinants of firm size, the relationship between Tobin's Q and ownership, and the effect of financial liberalizations.

JEL Classification: G31; G32; E22; D92; O16

Key Words: Investor protection, ownership, investment, cost of capital, agency costs.

TABLE OF CONTENTS:

1 Introduction

In this paper, we investigate the effect of investor protection on the cost of capital, where "investor protection" refers collectively to those features of the legal, institutional, and regulatory environment – and characteristics of firms or projects – that facilitate financial contracting between inside owners (managers) and outside investors. Building on the agency framework of Jensen and Meckling (1976) and ideas from the law and finance literature (e.g., La Porta, Lopez-de-Silanes, Shleifer, and Vishny – "LLSV", 1998), we investigate the empirical implications of investor protection using structural equations derived from a model of inside ownership and investment. In the model, insiders can divert value (or "steal") from outside investors at a cost which depends on the exogenous level of investor protection and the endogenous fraction of equity owned by insiders. Endogenous ownership incentives are expensive to provide, however, for the familiar reason that insiders are forced to bear undiversified idiosyncratic risk. If the exogenous level of investor protection were perfect, insiders would optimally choose to sell 100% of the equity (to diversify fully idiosyncratic risk) and steal nothing, but with imperfect investor protection, this contract cannot be (costlessly) enforced. By retaining a higher fraction of equity, insiders can credibly commit to lower rates of stealing, but are forced to bear higher levels of diversifiable risk.

The tradeoff between risk and incentives distorts insiders' incentive to invest in risky capital projects, even under the optimal ownership structure. This is because the cost of capital includes an additional premium for holding idiosyncratic risk which is absent when investor protection allows insiders to diversify fully. Thus the model determines not only the endogenous structure of ownership structure but also the endogenously determined cost of capital and level of capital investment. Our empirical strategy exploits the equilibrium relationship between inside ownership and the marginal return on capital implied by the model. In countries like the United States where investor protection is high, the model predicts endogenously low levels of insider ownership. Accordingly, the idiosyncratic risk premium applied to the cost of capital is low, and the steady-state level of capital approaches the first best level of efficiency that would obtain in the absence of financial contracting costs. In countries like Turkey or Peru, however, where investor protections are ostensibly weaker, the optimal ownership structure obliges insiders to hold large equity stakes and therefore bear large amounts of idiosyncratic risk, which implies steady-state levels of capital below the first-best level.

While the model helps to formalize our intuition, it more importantly formalizes the empirical specification used to investigate the predicted relationship among investor protection, inside ownership concentration, and the cost of capital. Using firm-level data from Worldscope for 38 countries, we investigate two predictions. First, we estimate the determinants of the fraction of equity owned by insiders. We verify that, as predicted, this fraction depends on measures of investor protection. We emphasize that investor protection has an important *cross–firm* dimension in addition to its more familiar *cross-country* dimension. Assets like factories that are difficult to steal provide a built-in degree of investor protection, whereas assets like the insiders' accumulated knowledge of the product market may be easier to expropriate if these employees can leave to start their own firms.[1] This cross-firm variation of investor protection can also explain the cross-sectional differences in the level of inside ownership observed, say, within the United States.

Second, and more important, we document a positive correlation between inside equity ownership and the marginal return to capital, a relationship which follows directly from the first-order condition for capital. The cost of capital in the first-order condition capital includes a risk premium that reflects the insiders' exposure to idiosyncratic risk. The higher the equilibrium level of inside ownership, the higher the risk premium in the marginal cost of capital. This explains the positive relationship between the marginal return to capital and inside ownership. In addition to providing a test of the above qualitative prediction,

[1]For additional examples of the "tunneling" schemes available to insiders to expropriate wealth from investors, see LLSV (2000a).

this equation allows us to obtain estimates of the steady-state risk premium. We estimate average premiums in the range of zero to five percent. Incorporating this value into the model and using the observed levels of inside ownership allows us to assess the magnitude of the capital distortions implied by weak investor protection. Though we consider these estimates and calculations exploratory, they imply that capital stock levels in countries with weak investor protections are less than half the level implied for countries like the United States and the United Kingdom.

1.1 Related Research

The research agenda that began with the pioneering work of Alchian and Demsetz (1972) and Jensen and Meckling (1976) has firmly established agency theory as a basic building block of corporate finance, but there have few attempts to integrate production theory with the agency theory of corporate financial behavior in a unified model of the firm suitable for structural empirical estimation. In this paper we derive a simple empirical model that builds on the recent work of Burkart, Gromb, and Panunzi (1997), LLSV (1998, 1999), Shleifer and Wolfenzon (2000). Like these papers, our goal is to understand the effect of investor protection on real and financial behavior. We borrow from these papers the assumption that "investor protection" can be modeled as a parameter in a cost-of-stealing technology that makes it costly (to varying degrees) for insiders with control over the firm's decision-making process to "steal" from outside (minority) shareholders. In contrast to the above models, we interpret investor protection as a parameter that varies not only across countries but also across firms. Consistent with standard agency models, but in further contrast to the previous research, we introduce insider risk aversion as the offsetting cost of insider ownership. Integrating this agency model of ownership with a conventional production technology generates the basic insight for the cost of capital, and our emphasis on this dimension of the problem is the primary distinguishing characteristic of our paper. In further contrast to previous research, we use the model to derive and estimate structural equations that we use to help understand the implications of unobserved heterogeneity resulting from the econometrician's incomplete measurement of investor protection. We also use the model to estimate the size of the additional risk premium in the marginal cost of capital, and use this to calculate the magnitude of investment distortions at the firm level.

There is a large literature recently surveyed by Hubbard (1998) which examines the extent to which investment decisions are affected by financial frictions. A recent paper by Demirgüc-Kunt and Maksimovic (1999) investigates whether such frictions are related to country-level measures of financial development and investor protection. They find that the fraction of firms growing faster than a "benchmark" model of unconstrained growth is positively related to indicators of financial development. Love (2001) estimates Euler equations and similarly finds that the marginal cost of funds also depends on country-level measures of investor protection. Both of these papers recognize the importance of using model structure to control for investment opportunities, but like previous research (Whited, 1992; Gilchrist and Himmelberg, 1998), such models are truly structural only under the null hypothesis of frictionless capital markets. Under the alternative hypothesis of financial frictions, the "financial side" of such models generally consists of little more than ad hoc model assumptions such as, for example, that the cost of capital is increasing in leverage and dividends are constrained to be non-negative. In this paper, by contrast, ownership structure and leverage are endogenous, and the additional "wedge" for external equity derives from the underlying agency costs. Moreover, the magnitude of this wedge is endogenously reflected by ownership structure. This result follows directly from the first-order conditions of a simple model and represents an empirical prediction which previous work has apparently not explored, namely, the predicted relationship between the marginal profit of capital and inside ownership.

Our framework sheds light on the structural interpretation of "ownership-performance" regressions of the sort estimated, for example, by Demsetz and Lehn (1985), Mϕrck, Shleifer, and Vishny (1988), McConnell and Servaes (1990), Himmelberg, Hubbard, and Palia (1999), and Holderness, Kroszner, and Sheehan (1999). Our model suggest interpretations of these regression results which differ sharply from those that have been suggested in past work (including our own), and more generally highlight the dangers of failing to recognize fully the joint endogeneity of ownership variables and balance sheet ratios.

Our focus on the relationship between investor protection and the cost of capital complements research which has attempted to determine whether cross-country variation in financial development is associated with investment and growth rates across countries, industries, and firms. A large body of research documents a link between financial development and economic growth using aggregate data (King and Levine, 1993; Levine and Zervos, 1998; Rousseau and Wachtel, 1998; Demirgüc-Kunt and Maksimovic, 1998; and Beck, Levine, and Loyaza, 2000). Rajan and Zingales (1998) use industry growth in the United States as a proxy for the investment opportunities of similar industries outside the United States to show that industries in countries with lower levels of financial development grow at slower rates. Consistent with these results, Wurgler (2000) uses industry data to show that the sensitivity of investment growth to value added growth (i.e., investment opportunities) is lower in countries with poorly developed financial markets.

The results in this paper are also related (though less directly) to research which seeks to understand the role of ownership rights for investor protection (Grossman and Hart, 1988; Stulz, 1988; Zwiebel, 1996; Fluck, 1998; and Myers, 2000).[2] For example, one-share, one-vote rules – which are often cited as being good for investor protection – have been analyzed in detail by Grossman and Hart (1988). The cost-of-stealing model used here does not explicitly model control rights, but we nevertheless view control considerations as an important determinant of the exogenous level of investor protection.[3] Finally, there is

[2]Identifying the sources of investor protection is one of the primary questions in the research on corporate governance recently surveyed by Shleifer and Vishny (1997).

[3]Burkart, Gromb, and Panunzi (1997) consider a model in which both cash flow and control rights are used to provide incentives for managers. They point out that the free-rider problem by target shareholders limits

a related literature which emphasizes the role of the legal system for investor protection. Levine (1999), for example, argues that the legal system is a key determinant of both financial development and economic growth, while LLSV (1997, 1998) and Coffee (2000) argue that common law systems provide stronger investor protection than civil law systems. The empirical model in this paper does not attempt to formalize the workings of alternative legal regimes; this is well beyond our scope. Instead, we summarize the effect of the legal system by positing an empirical mapping from observable features of the legal environment into a single parameter indexing the "cost of stealing," i.e., the level of investor protection. As we show, this characterization of the contracting environment does not necessarily limit our ability to assess many qualitative and quantitative implications of the model.

The remainder of the paper is organized as follows. We begin in section 2 by introducing a simple model from which we derive implications for ownership and the cost of capital. Section 3 explores econometric issues that arise in the specification of the empirical model, followed by empirical results in section 4. Section 5 discusses some interesting implications and applications, and section 6 concludes.

2 The Model

Consider the two-period problem confronting an entrepreneur (alternately "manager" or "insider") who is initially endowed with liquid wealth W_{it} and a project which yields a total return of $\Pi(K_{it}, \theta_{it})$, where K_{it} denotes the stock of fixed capital. For simplicity, we assume there are no adjustment costs, and normalize the purchase price of capital to one; we add adjustment costs later in the empirical specification. In the first period, the entrepreneur can sell equity or borrow to finance capital expenditures, K_{it}, and consumption, C_{it}. Equity financing X_{it} is raised by selling claims to a fraction $1 - \alpha_{it}$ of future dividends. Borrowing

the incentive properties of disciplinary takeovers, and therefore tends to favor using cash flow rights to align insider incentives. Their results provide some justification for our simplified model in which the allocation of cash flow rights is endogenous, but the allocation of control rights is captured by the cost-of-stealing function.

(or saving) occurs at the rate r_{t+1}. The borrowing-saving rate need not be riskless (e.g., the manager can invest in the market portfolio), but we assume the return cannot be made contingent on the idiosyncratic outcome of the firm. This assumption is important, and is meant to capture the intuition that equity (and not debt) is the natural instrument for sharing the firm's idiosyncratic risk.

The agency problem between insiders and outsiders arises because insiders can steal or divert a fraction s_{it+1} of firm profits to themselves before paying dividends. The manager cannot costlessly commit in period one to the level of stealing in period two. Stealing is, however, discouraged by an exogenous punishment technology which imposes a monetary cost $c(\phi_{it}, s_{it}) = \frac{1}{2}\phi_{it}s_{it}^2$. The parameter ϕ_{it} is therefore a quantitative index of investor protection, where higher parameter values impose a higher cost of stealing, and therefore indicate better protection. The parameter ϕ_{it} is easy to interpret because it is proportional to the cost of stealing; to double the cost of stealing, for example, we double ϕ_{it}.[4] Under this functional form assumption, the total and marginal costs of stealing are increasing in ϕ_{it}, so that $c_\phi > 0$ and $c_{s\phi} > 0$. This functional form also has the intuitively appealing property that the cost of stealing be convex in s_{it}.

According to the model, "investor protection" is anything that exogenously increases the cost to insiders of stealing from outsiders. In particular, the model does not distinguish *firm*-level and *country*-level determinants of investor protection; the parameter ϕ_{it} is meant to summarize the net impact of *all* features of the contracting environment. Thus a firm operating hard-to-steal assets in a country with weak legal enforcement could have insider ownership levels comparable to a firm operating easy-to-steal assets in a country with strong legal enforcement.[5] Our empirical specification for inside equity ownership explicitly allows

[4] If the probability of disciplinary takeover were a cost of stealing, and if voting rights were exogenously tied to dividend rights, one could argue that the takeover probability is an increasing function of $1 \square \eta_i\alpha_{it}$, where $\eta_i \geq 0$ is an inverse index of the effectiveness of the market for corporate control. This would imply a generalized stealing function of the form $c(\phi_i, s_{it}, \alpha_{it}) = \frac{1}{2}\phi_i s_{it}^2 (1 \square \eta_i\alpha_{it})$. We assume the probability disciplinary takeovers does not much depend on the allocation of *dividend* rights (that is, $\phi_{it} > 0$ and $\eta_i = 0$). Arguments in Burkart, Gromb, and Panunzi (1997) are consistent with this assumption.

[5] Another firm-level characteristic on which investor protection might also depend is the *identity* of the

for such cases.

To the extent that insiders own equity in the firm, they only steal from themselves. Inside ownership of equity therefore provides a mechanism with which managers can commit to lower levels of future stealing. Under the above assumptions, stealing at the rate s_{it} generates a direct benefit of $(s_{it} - c(\phi_{it}, s_{it}))\,\Pi(K_{it}, \theta_{it})$ for insiders, and leaves $(1 - s_{it})\,\Pi(K_{it}, \theta_{it})$ to be divided up among shareholders (including the inside shareholders). The manager's net return N_{it+1} in period $t+1$ from operating the firm is therefore:

$$N_{it+1} = [\alpha_{it}(1 - s_{it+1}) + s_{it+1} - c(\phi_{it}, s_{it+1})]\,\Pi(K_{it+1}, \theta_{it+1}). \tag{1}$$

Equity proceeds raised from outside investors must guarantee (in expectation) the market rate of return. If investors value next-period cash flows according to the stochastic discount factor M_{t+1}, the proceeds from selling a fraction $1 - \alpha_{it}$ of the equity is given by:

$$X_{it} = E_t[M_{t+1}(1 - \alpha_{it})((1 - s_{it+1})\,\Pi(K_{it+1}, \theta_{it+1}))]. \tag{2}$$

Stealing occurs in the second period *after* the proceeds X_{it} have been raised. Thus the second-period level of stealing maximizes equation (1) without regard for equation (2), and is characterized by the first-order condition

$$c_s(\phi_{it}, s_{it+1}) + \alpha_{it} = 1,$$

where $c_s(\phi_{it}, s_{it+1})$ denotes the derivative of c with respect to s_{it+1}. This equation says that at the optimum, the marginal cost of stealing, $c_s(\phi_{it}, s_{it+1})$, plus the marginal reduction of the insiders' dividends, α_{it}, is equated with the marginal benefit of stealing, which equals one. If the cost-of-stealing function is monotonically increasing, as we assume, then stealing

minority shareholders. For example, foreign investors may be treated differently than domestic investors if they carry less political clout with law enforcement agencies.

is monotonically increasing in outside ownership. As in LLSV (1999a), we assume the functional form $c(\phi_{it}, s_{it+1}) = \frac{1}{2}\phi_{it}s_{it+1}^2$, in which case optimal stealing is given by

$$s_{it+1} = \phi_{it}^{-1}(1 - \alpha_{it}). \tag{3}$$

In the language of principal-agent theory, equation (3) represents the manager's incentive-compatibility constraint, and equation (2) represents the investors' participation constraint. Both of these constraints must be recognized by the managers and investors in period one when the choices of α_{it}, K_{it+1}, and C_{it} are made. The manager's problem is therefore to choose the vector $\{\alpha_{it}, s_{it+1}, K_{it+1}, C_{it}\}$ to maximize total expected utility,

$$u(C_{it}) + \beta E_t[u(C_{it+1})], \tag{4}$$

subject to equations (1), (2), and (3) and the budget constraint, given by

$$C_{it+1} = N_{it+1} + (1 + r_t) A_{it}, \tag{5}$$

where $A_{it} = W_{it} + X_{it} - K_{it+1} - C_{it}$ is the manager's net position in the market asset. We do not impose any constraints or penalties on the amount of saving or (default-free) borrowing. It is often argued that debt helps to reduce agency costs because it represents a harder claim which reduces the free cash flows from which managers can steal. We assume debt is repaid with probability one. In other words, managers can credibility promise not to steal from debt holders and therefore riskless debt is frictionless. In this sense, managers are not borrowing-constrained – debt markets are willing to let managers borrow as much as they need. Despite this, managers have strong ex ante incentives to use outside equity because default-free debt cannot be used to diversify the idiosyncratic risk. Thus the burden of risk sharing falls solely on equity. At the cost of additional complexity, our model could be generalized to allow risky debt. This might yield additional interesting predictions for leverage, but because debt is such a crude instrument for risk sharing, we think it is unlikely that this would substantially change the qualitative or quantitative predictions of the model for ownership.

2.1 The Benchmark Case: Perfect Investor Protection

If the manager could contractually commit to the level of stealing in period two (i.e., if investor protection were "perfect", so that $\phi_{it} = \infty$), it follows immediately from equation (3) that regardless the level of managerial ownership, the manager would optimally choose to steal nothing. In this case there is no incentive benefit from having the managers retain an equity stake in the firm, so diversification motives make it optimal to sell 100% of the equity to outside investors. It is easy to show in this case that the first-order condition for capital is:

$$E_t \left[M_{t+1} \Pi^K_{it+1} \right] = 1, \tag{6}$$

where $\Pi^K_{it+1} = \partial \Pi_{it+1} / \partial K_{it+1}$ is the marginal value of capital. This is the standard first-order condition for the efficient choice of capital. To put this equation in more familiar terms, denote the total return on capital by $\Pi_{it} = \pi_{it} + (1 - \delta) K_{it}$, where π_{it} denotes the current level of variable profit, δ denotes the rate of physical depreciation on capital, and $(1 - \delta) K_{it}$ represents the resale value of the capital stock (we maintain the assumption of zero adjustment costs). By assumption, the market's stochastic discount factor (SDF) satisfies $E_t [M_{t+1}] = \left(1 + r^f_{t+1}\right)^{-1}$, where r^f_{t+1} is the risk-free rate. Hence we can write the previous equation as:

$$E_t \left[\pi^K_{it+1} \right] = r^f_{t+1} - \frac{cov_t \left[M_{t+1}, \pi^K_{it+1} \right]}{E_t [M_{t+1}]} + \delta, \tag{7}$$

where $\pi^K_{it+1} = \partial \pi_{it+1} / \partial K_{it+1}$ is the marginal profit of capital. The right-hand side of this equation represents the firm's "user cost of capital," which is the sum of the (risk-adjusted) opportunity cost of funds and depreciation costs. The covariance between the market's

SDF and the marginal profit of capital (scaled by $E_t\left[M_{t+1}\right]$) is non-zero to the extent that firm profits are affected by (nondiversifiable) aggregate shocks. For example, if π_{it+1}^K were negatively correlated with the market's SDF (i.e., if the firm had a positive "beta"), its payout would on average be high in states of the world where high payouts are valued less. Thus, $cov_t\left[M_{t+1}, \pi_{it+1}^K\right] < 0$ would imply a positive risk premium. As usual, idiosyncratic shocks to π_{it+1}^K (i.e., shocks that are orthogonal to M_{t+1}) are not priced because it is assumed they can be costlessly diversified by outside investors. In short, our discussion thus far has produced the textbook advice for managers: Invest up to the point where the expected marginal profit of capital equals the user cost of capital, where the user cost is adjusted for nondiversifiable risks (and ignores idiosyncratic risk).

2.2 Imperfect Investor Protection

When investor protection is not perfect (that is, when exogenous costs of stealing are not infinite, or $\phi_{it} < \infty$), agency conflicts arise. Such contracting frictions could arise for a variety of reasons. For example, it could simply be the case that stealing is unobservable. Even if stealing is observable, however, frictions could still arise because contract enforcement is costly and unreliable. Although the former interpretation is common in the classical analysis of agency problems, the latter interpretation is a better description of the empirical setting we have in mind. It easily accommodates interpretations based on the quality of the exogenous contracting environment as determined by the legal system such as, for example, laws or judicial traditions which determine the protection of minority shareholders. Such protections are summarized by the cost-of-stealing parameter, ϕ_{it}.

It is straightforward to show that the first-order condition characterizing the optimal capital choice is:

$$g_{it} E_t\left[m_{it+1} \Pi_{it+1}^K\right] + h_{it} E_t\left[M_{t+1} \Pi_{it+1}^K\right] = 1, \tag{8}$$

where $\Pi^K_{it+1} = \partial \Pi_{it+1} / \partial K_{it+1}$ is the marginal value of capital, and

$$m_{it+1} \equiv \beta \frac{u'(C_{it+1})}{u'(C_{it})} \tag{9}$$

is the SDF for the *manager*.[6] To simplify notation, equation (8) uses:

$$g_{it} \equiv \alpha_{it}(1 - s_{it+1}) + s_{it+1} - \frac{1}{2}\phi_{it} s^2_{it+1}, \tag{10}$$

$$h_{it} \equiv (1 - \alpha_{it})(1 - s_{it+1}), \tag{11}$$

where s_{it+1} denotes the optimal (ex-post) level of stealing, which is itself a function: $s_{it+1} = \phi_{it}^{-1}(1 - \alpha_{it})$. Note the contrast between m_{it+1}, which is the SDF for the manager, and M_{t+1}, which is the SDF for the market. Under complete markets (complete risk-sharing), the covariance properties of M_{it} and m_{it} are the same. In the current setting, however, risk sharing is incomplete due to the existence of moral hazard, and the covariance properties of M_{it} and m_{it} are *not* the same.

The first-order condition for capital can alternatively be written:[7]

$$E_t\left[\pi^K_{it+1}\right] \simeq r^f_{t+1} + \delta - g_{it} \frac{cov_t\left[m_{it+1}, \pi^K_{it+1}\right]}{E_t\left[m_{it+1}\right]} - h_{it} \frac{cov_t\left[M_{t+1}, \pi^K_{it+1}\right]}{E_t\left[M_{t+1}\right]}. \tag{12}$$

This equation says the risk adjustment to the user cost of capital is the weighted sum of two terms. The first term, $\frac{cov_t\left[m_{it+1}, \pi^K_{it+1}\right]}{E_t\left[m_{it+1}\right]}$, reflects the covariance between the manager's SDF and the marginal profit of capital. To the extent that a sizeable fraction of the manager's income is derived from the profitability of the firm, the manager's consumption is exposed to idiosyncratic risk. In particular, idiosyncratic profit shocks increase π^K_{it+1} and consumption, thus decreasing the marginal utility of consumption, which implies $cov_t\left[m_{it+1}, \pi^K_{it+1}\right] < 0$.

[6] The manager is also free to borrow and lend at the rate r_{t+1} (where r_{t+1} is possibly stochastic, but *not* contingent on the firm's profits). We therefore have the usual first-order condition for consumption: $E_t\left[m_{it+1}(1 + r_{t+1})\right] = 1$.

[7] This approximation assumes $g_{it} + h_{it} \simeq 1$. Note that $g_{it} + h_{it} = 1 - \frac{1}{2}\phi_i s^2_{it+1}$, hence the approximation is accurate when s_{it} is "small."

The second term, $\frac{cov_t\left[M_{t+1},\pi^K_{it+1}\right]}{E_t[M_{t+1}]}$, reflects the usual compensation for nondiversifiable risk (just as in equation (7)). When the equilibrium level of stealing is "small," then g_{it} and h_{it} approximately equal α_{it} and $1 - \alpha_{it}$, respectively. Thus the fraction of equity held by managers reveals the extent to which the user cost of capital applied by the managers reflects idiosyncratic as opposed to systematic risk. When $\alpha_{it} = 0$, outside investors own all of the equity in which case only the systematic risk of the firm is priced. At the other extreme, when $\alpha_{it} = 1$, the firm is a proprietorship and the total risk of the firm is priced according to the manager's SDF.

Additional structure on the nature of the above risk premiums is provided by the insiders' ownership choice. The first-order condition for ownership implies:

$$g^{\alpha}_{it} E_t\left[m_{it+1}\Pi_{it+1}\right] + h^{\alpha}_{it} E_t\left[M_{t+1}\Pi_{it+1}\right] = 0, \tag{13}$$

where $g^{\alpha}_{it} = \partial g_{it}/\partial \alpha_{it}$ and $h^{\alpha}_{it} = \partial h_{it}/\partial \alpha_{it}$. Under our functional form assumptions on the cost of stealing, $g^{\alpha}_{it} = 1 - s_{it}$ and $h^{\alpha}_{it} = 2s_{it} - 1$. Hence equation (13) can be re-written as:

$$E_t\left[m_{it+1}\Pi_{it+1}\right] = \left(\frac{1 - 2s_{it}}{1 - s_{it}}\right) E_t\left[M_{t+1}\Pi_{it+1}\right]. \tag{14}$$

which implies:

$$E_t\left[m_{it+1}\Pi_{it+1}\right] < E_t\left[M_{t+1}\Pi_{it+1}\right]. \tag{15}$$

This equation says that managers assign a lower value to risky profits than outside investors do. If investor protection were perfect, the level of stealing would be zero, and these values would be equal. Under imperfect investor protection, however, managers assign a lower value to stochastic profits because they discount for idiosyncratic risk, whereas the market, by contrast, is indifferent to this risk. The manager's ownership choice is nevertheless privately optimal because the marginal value of reducing idiosyncratic risk exposure by selling more equity equals the marginal reduction in the market price this would require in compensation for the higher rate of equilibrium stealing that would accompany the lower ownership stake.

If we assume the value function Π_{it+1} is homogenous of degree one in the capital stock, equation (13) can also be used with equation (8) to derive an alternative expression for the first-order condition for capital. Linear homogeneity implies $\Pi_{it+1} = K_{it+1}\Pi^K_{it+1}$, which allows us to combine equations (8) and (13) to obtain:

$$\left(g^\alpha_{it} h_{it} - g_{it} h^\alpha_{it}\right) E_t\left[M_{t+1}\Pi^K_{it+1}\right] = 1. \tag{16}$$

Under our functional form assumption for the cost of stealing, $g^\alpha_{it} h_{it} - g_{it} h^\alpha_{it} = 1 - \frac{1}{2} s_{it}\left(3 + \alpha_{it}\right)$, hence we can rewrite this equation as:

$$\left(1 - \frac{1}{2} s_{it}\left(3 + \alpha_{it}\right)\right) E_t\left[M_{t+1}\Pi^K_{it+1}\right] = 1. \tag{17}$$

It follows immediately, that $E_t\left[M_{t+1}\Pi_{it+1}\right] > 1$. From the market's perspective, this equation says that the marginal value of profit exceeds its purchase price. That is, in contrast to the benchmark case of perfect investor protection characterized in equation (6), the manager is underinvesting.

The magnitude of the "wedge" between the first and second best allocations of capital is roughly proportional to the equilibrium level of stealing, s_{it}. For example, suppose the level of managerial ownership were $\alpha_{it} = 0.4$, which is the median in our sample. Suppose further that the equilibrium rate of stealing were a (relatively modest) two percent ($s_{it} = 0.02$). Then $\frac{1}{2} s_{it}\left(3 + \alpha_{it}\right) = 0.034$. That is, such a firm would invest as if its cost of capital were about three and a half percentage points higher. Increasing the assumed equilibrium level of stealing to five percent implies a marginal cost of capital of over eight percentage points higher! Cost of capital differences of this magnitude are large enough to have first-order effects on firm size and the growth and development of industries and countries. This motivates the empirical investigation in the remainder of the paper.

3 Empirical Implications

The primary goal of our empirical work is to investigate the first-order condition for capital in equation (12) or equation (17). In practice, estimation of either equation is complicated by two issues. First, should we assume that the econometrician observes π_{it+1}? Or should we recognize that perhaps "after-stealing" profits are being reported, $(1 - s_{it})\,\pi_{it+1}$? Second, given that we do not observe stealing, how do we evaluate the expressions for g_{it} and h_{it}?

Regarding the measurement of profits, reasonable arguments can be made both ways depending on whether stealing is deducted from accounting profits. On the one hand, if self-dealing which takes the form of a manager purchasing input goods from a relative at inflated prices, then the econometrician measures $(1 - s_{it})\,\pi_{it+1}$. On the other hand, if self dealing involves stock transactions that benefit managers at the expense of minority shareholders, then accounting profit is correctly measured. As a practical matter, we are inclined to think the former is more descriptive in most settings. In this case, equation (12) can be formulated in terms of observed marginal profit as:

$$E_t\left[(1 - s_{it})\,\pi^K_{it+1}\right] \simeq r^f_{t+1} + \delta + \left(\frac{\alpha_{it} + \frac{1}{2}s_{it}\,(1 - \alpha_{it})}{1 - s_{it}}\right)\gamma_{it} + (1 - \alpha_{it})\,\Gamma_{it}, \qquad (18)$$

where:

$$\gamma_{it} = -\frac{cov_t\left[m_{it+1}, \pi^K_{it+1}\right]}{E_t\left[m_{it+1}\right]}, \qquad (19)$$

$$\Gamma_{it} = -\frac{cov_t\left[M_{t+1}, \pi^K_{it+1}\right]}{E_t\left[M_{t+1}\right]}. \qquad (20)$$

We are still not ready to estimate equation (18) because neither s_{it} nor γ_{it} (nor Γ_{it}, for that matter) is observable in the data. In particular, one cannot calculate the necessary covariance without observing m_{it+1}, which requires knowing the current and future values of the manager's consumption.

Our empirical investigation is based on equation (12) and proceeds from the assumption that s_{it} is "small" relative to α_{it}. This implies $g_{it} \simeq \alpha_{it}$, and $h_{it} \simeq 1 - \alpha_{it}$. Next, we model γ_{it} and Γ_{it} using variable coefficient models in which we assume $\gamma_{it} = \bar{\gamma} + \varepsilon_{it}^{\gamma}$ and $\Gamma_{it} = \bar{\Gamma} + \varepsilon_{it}^{\Gamma}$. This allows us to write equation (18) as

$$\bar{\pi}_{it+1}^{K} \simeq r_{t+1}^{f} + \delta + \bar{\Gamma} + \left(\bar{\gamma} - \bar{\Gamma}\right) \alpha_{it} + u_{it}, \tag{21}$$

where $\bar{\pi}_{it+1}^{K} = (1 - s_{it})\, \pi_{it+1}^{K}$, $u_{it} = \varepsilon_{it}^{\Gamma} + \alpha_{it} \left(\varepsilon_{it}^{\gamma} - \varepsilon_{it}^{\Gamma}\right) + \omega_{it}$, and ω_{it} is a rational expectations error orthogonal to information at time t. In the presence of the random coefficient error, $\varepsilon_{it}^{\Gamma} + \alpha_{it} \left(\varepsilon_{it}^{\gamma} - \varepsilon_{it}^{\Gamma}\right)$, we need to consider whether an instrumental variable estimator based on instruments z_{it} in the time-t information set satisfies $E\left[u_{it} z_{it}\right] = 0$. Given the rational expectations error ω_{it}, and given no reason to expect covariation between $\varepsilon_{it}^{\Gamma}$ and α_{it}, the validity of the moment condition reduces to establishing zero conditional covariance between α_{it} and $\varepsilon_{it}^{\gamma}$. This condition is not easy to verify a priori because the covariance depends on the source of the underlying shocks. In the model, a negative shock to the insiders' private wealth would imply a negative reponse of $\varepsilon_{it}^{\gamma}$ (because the marginal utility of wealth is lower in good states) and a positive response of α_{it} (because lower risk aversion encourages more inside ownership). That is, wealth shocks would imply $E\left[\varepsilon_{it}^{\gamma} \alpha_{it} | z_{it}\right] < 0$, which would bias estimates of $\bar{\gamma} - \bar{\Gamma}$ in equation (21) toward zero. Alternatively, the covariance implied by shocks to investment opportunities would imply a positive correlation and an upward bias. As a practical matter, ownership stakes tend to evolve slowly, so we are not overly concerned about the magnitude of the bias in either direction, especially when equation (21) is estimated using instrumental variables.

4 Empirical Results

4.1 Data

Our empirical investigation uses annual firm-level data from the Worldscope database, which contains information on large, publicly traded firms, and monthly firm-level stock price data from Datastream.[8] All countries in the Worldscope database (May 1999 Global Researcher CD) with at least 30 firms and at least 100 firm-year observations are included in the sample. We exclude data from former socialist economies. This results in a sample of 38 countries. The sample does not include firms for which the primary industry is either financial (one-digit-SIC code of 6) or service-oriented (one-digit-SIC codes of 7 and above). From this universe we select three samples. Our first sample (the "International Sample") includes 38 countries with over 6000 firms for the years 1988-1998. The United States has by far the largest representation in this sample with over 15,000 firm-year observations, almost double the number of the next closest country (the United Kingdom ranks second with 8,338 observations), so to reduce the influence of the United States on the international sample, we chose a 50% random sample. Our second sample (the "Largest 150 Sample") is a proper subset of the first sample and includes only the 150 largest firms from each country in each year, where the cutoff is recalculated for each year. The cutoff is binding only for countries with large firm populations like the United States, United Kingdom and Japan, and is intended to refine cross-country comparisons among firms. Our third sample (the "Non-US/UK Sample") is a subset of the first which excludes firms from the United States and the United Kingdom, and is chosen so we can investigate whether results obtained on the above samples are somehow unique or dominated by the two countries with the largest firm populations.

[8] Worldscope attempts to standardize accounting information to improve cross-country comparability. For example, if one company reports sales with included excise taxes and another company excludes taxes, Worldscope corrects this difference and presents both with taxes excluded. This is important for our purposes because sales is the key ingredient in the measure of the marginal product of capital. It is therefore obviously desirable that it have as much cross-country comparability as possible.

We construct a beginning-of-period capital stock variable which is used to construct investment and sales-to-capital ratios as well as our measure of the marginal product of capital (see the next section). The most obvious measure, the lagged end-of-period capital stock, is problematic because mergers, acquisitions, divestitures, and similar events give rise to large, unexplained changes in ratios using capital in the denominator. There is no easy, systematic way of identifying these transactions in the data, and even if we could, throwing them out would substantially reduce sample size, so we calculate beginning-of-period capital stock as the current end-of-period stock minus current period gross investment plus depreciation.

We also construct firm-level measures of the variance of idiosyncratic stock returns. We match monthly stock market data from Datastream to estimate the variance of idiosyncratic returns for over 90% of our Worldscope firm-year observations. In the raw data, there are a few returns which appear to be outliers (e.g., returns below 100%); these are removed by eliminating values for which the absolute value of returns exceeds 100%; this rule deletes fewer than one tenth of one percent of the observations, and estimates are not sensitive to this cutoff. Our measure of idiosyncratic risk is the variance of the residual from obtained by regressing monthly firm-level stock returns on the respective country-level measure of the market return (the country-level market index is also obtained from Datastream).

Inside ownership concentration is a key variable for analysis. Though it is less than the ideal measure, we use the Worldscope variable "closely held shares" as our measure of inside ownership. At the country level, we augment these firm-level data with three indicators of investor protection which we construct by aggregating the indices of "shareholder rights," "creditor rights," and "legal efficiency" assembled by LLSV (1998). The "shareholder rights" index measures how strongly the legal system favors minority shareholders against managers or dominant shareholders in the corporate decision-making process. This index is a sum of seven characteristics, each of which is assigned a value of one if the right increases shareholder protection, and zero otherwise. The components of this index are: (1)

one share-one vote rule; (2) proxy by mail; (3) shares not blocked before meeting (in some countries, the law requires depositing shares with the company several days prior the shareholder meeting, a practice which prevents shareholders from selling or voting their shares); (4) cumulative voting/proportional representation; (5) oppressed minority rights (the shareholder right to challenge director's decisions in court or force the company to repurchase the shares from minority); (6) preemptive right to new issues (which protects shareholders from dilution); and (7) percentage of share capital required to call an extraordinary shareholder meeting.

The "creditor rights" index measures the rights of senior secured creditors against borrowers in reorganizations and liquidations. This index is a sum of four characteristics. The components of this index are: (1) no automatic stay on assets (which makes it harder for secured creditors to seize collateral); (2) secured creditors paid first; (3) restrictions on going into reorganization (equal to one for countries that require creditors' consent to file for reorganization); (4) management does not stay in reorganization (equal to one if management is replaced at the start of reorganization procedure). Finally, the "legal efficiency" index is an assessment of the efficiency and integrity of the legal environment as it affects business, particularly foreign firms. The index is produced by the country-risk rating agency Business International Corporation. The value we use is the average between 1980-1993, scaled from 0 to 10, with lower scores for lower efficiency levels.

Finally, we delete observations meeting any of the following criteria: (1) three or fewer years of coverage; (2) zero, negative, or missing values reported for capital expenditures, capital stock (property, plant, and equipment), sales or closely held shares; (3) investment-to-capital ratios greater than 2.5 (which is the upper first percentile); (4) sales-to-capital ratios greater than 20 (which is the upper fifth percentile).[9] Table 1 reports the number

[9] The sales-to-capital rule is tighter than might otherwise seem necessary because we want to exclude firms for which capital is not an important factor of production. Half of the firms deleted by this rule were in the United States and United Kingdom. Another quarter of the deleted firms were in Japan, France, and Denmark.

of firm-year observations remaining for each country following the application of the above selection criteria, and Table 2 reports summary statistics for these variables across the three samples.

Table 1 shows that the number of firms varies widely across countries. As noted by LLSV (1997), Worldscope's coverage of firms within countries varies widely from as little as one percent of all listed domestic firms included (for India) to as many as 82% (for Sweden). This variation reflects several factors. Some countries are simply larger, and therefore have more firms. The sample reflects the endogenous decision of firms to go public or remain private. For example, there are more firms in countries like the United Kingdom (993 firms in the full sample) which have strong legal protection for minority shareholders than there are in countries like Germany (375 firms in the full sample), which has a larger economy but is thought to have weaker shareholder protection. We have fewer observations for countries like India where, despite a large number of public firms, many firms are not actively traded, and Worldscope presumably does not bother to collect data for such firms. To the extent that weak investor protection lowers market liquidity, this presumably weakens the power of our tests by selecting against the very firms for which the correlation between inside ownership and the marginal return on capital would presumably be strongest.

4.2 Measuring the Marginal Profit of Capital

Estimation of the model requires a measure of the marginal profit of capital. Suppose the firm's production function is $Y_{it} = f(A_{it}, K_{it}, Z_{it})$, where A_{it} is a measure of total factor productivity, Y_{it} is output, K_{it} represents the stock of fixed property, plant and equipment, and Z_{it} is a vector variable factor inputs (e.g., materials, energy, unskilled production workers, etc.). Assuming that the firm faces an inverse demand curve $P(Y_{it})$ and variable factor prices w_{it} (in a competitive factor market), the profit function is defined by

$$\pi(K_{it}, w_{it}) = \max_{Z_{it}} P(Y_{it})Y_{it} - w_{it}Z_{it} \tag{22}$$

$$\text{s.t. } Y_{it} = f(A_{it}, K_{it}, Z_{it}). \tag{23}$$

By the envelope theorem, the marginal profitability of fixed capital, $\partial \pi_{it}/\partial K_{it}$, is

$$\frac{\partial \pi_{it}}{\partial K_{it}} = \left(1 + \eta^{-1}\right) P_{it} \frac{\partial f_{it}}{\partial K_{it}}. \tag{24}$$

where $\eta \equiv (\partial Y/\partial P)P/Y < -1$ is the (firm-level) price elasticity of demand. If the production function is assumed to be homogeneous of degree κ, then

$$\frac{\partial \pi_{it}}{\partial K_{it}} = \left(1 + \eta^{-1}\right) \kappa \left(\frac{P_{it}Y_{it}}{K_{it}}\right), \tag{25}$$

where $P_{it}Y_{it}/K_{it}$ denotes the sales-to-capital ratio. Thus, up to a scaling factor $\left(1 + \eta^{-1}\right) \kappa$, and assuming the book value of capital is a reasonable proxy for replacement value, the marginal profit of capital is easily measured using the sales-to-capital ratio.

We allow for the possibility that the scaling factor $\left(1 + \eta^{-1}\right) \kappa$ may vary across industries. Following Gilchrist and Himmelberg (1998), we construct estimates of $\left(1 + \eta^{-1}\right) \kappa$ for each industry by assuming that firms are, on average, near their equilibrium capital stocks. In steady state, the expected marginal return on capital equals the user cost of capital:

$$\theta_j \left(\frac{P_{it}Y_{it}}{K_{it}}\right) \simeq r + \delta, \tag{26}$$

where θ_j is the industry-specific value of $\left(1 + \eta^{-1}\right) \kappa$, and where r and δ are the average risk-adjusted required return and depreciation rate of capital, respectively. Replacing population moments with sample moments over all firms and years in industry j, a consistent estimate of θ_j is given by:

$$\hat{\theta}_j = \left(\sum \frac{P_{it}Y_{it}}{K_{it}}\right)^{-1} (r + \delta) \,. \tag{27}$$

We assume $r + \delta = 0.18$ for all industries (results are not sensitive to alternative assumptions). Thus, $\pi_{it}^K = \hat{\theta}_j \left(P_{it}Y_{it}/K_{it}\right)$ is our measure of marginal return to capital.

4.3 The Determinants of Inside Ownership

Our first empirical exercise estimates the effect of firm-level and country-level measures of investor protection (described above) on inside ownership. In Table 3 we report coefficient estimates for five alternative specifications for the determinates of inside ownership concentration. The first three columns use data for the international sample of firms. To insure robustness of our results to the possibility of selection bias introduced by the idiosyncrasies of the Worldscope data, column (4) reports estimates using the largest 150 firms in each country. Columns (5) and (6) report results for a third sample intended to check the robustness of the results to the exclusion of the United States and the United Kingdom.

The results reported in Table 3 broadly support the proposition that ownership concentration is determined by the level of investor protection. For the sake of comparison with previous work, the specification in column (1) includes only country-level determinants of investor protection. The coefficients on both "legal efficiency" and "shareholder protection" are negative and precisely estimated, as predicted by theory, while the coefficient on "creditor protection" is not statistically different from zero. These results are consistent with the results found by LLSV (1998). For the sake of comparison with previous work on firm-level determinants of ownership, column (2) excludes country-level determinants. Following Himmelberg, Hubbard, and Palia (1999), the specification includes the log of sales, the ratio of sales-to-capital, the ratio of R&D-to-sales, the standard deviation of the idiosyncratic component of stock returns, two-digit (SIC) industry dummies, and country-specific year dummies. We also include the dummy variable RDDUM which equals unity if R&D information is reported. This variable provides an additional discrete indicator of R&D intensity because R&D is usually not reported when the amount is negligibly small. Columns (3) and (4) combine country-level and firm-level determinants both with and without the stock sigma. Columns (5) and (6) repeat the specification in column (4) for the samples of the largest 150 firms and the sample excluding firms from the United States and United Kingdom, respectively.

The pattern of estimated coefficients signs and magnitudes on the firm-level regressors is stable across all of the above specifications. The estimated coefficient on the firm size measure (log sales) is negative and statistically significantly different from zero in all specifications. There are several reasons why inside ownership concentration might be lower for large firms. First, investors in large firms may enjoy access to better protections. For example, there could be economies of scale to monitoring, or large firms could systematically operate assets from which wealth is more difficult to expropriate. Second, the ratio of firm value to the private wealth of insiders could be higher for large firms, in which case insider incentives could be optimally provided by smaller ownership stakes. Third, it could be that the relationship reflects the joint endogeneity of firm size and inside ownership. We offer some numerical calculations illustrating this possibility in section 5.1.

The coefficient on the ratio of sales to capital is positive and statistically significant at the one-percent level in all five specifications. It is traditional in such regressions to interpret the sales-to-capital ratio as a measure of asset tangibility, because high ratios implicitly indicate the presence of intangible assets like firm-specific human capital, technology, or market power. If intangible assets are easier to divert or steal (perhaps because they are difficult to observe), then this would explain why sales-to-capital is such a strong, positive predictor of inside ownership. An alternative explanation for the sales-to-capital ratio is that this correlation arises endogenously because the sales-to-capital ratio is closely related to the marginal profit of capital, and hence reflects the relationship in equation (21). This model prediction is the primary focus of the next section. The desire to control for tangibility of assets is also part of the motivation for the inclusion of the R&D-to-sales ratio and the R&D dummy. This argument predicts a positive coefficient. The R&D variables could also capture idiosyncratic risk which is not measured by the variance of idiosyncratic stock returns (e.g., peso risk), in which case the predicted coefficient would be negative. In addition, it is likely that R&D is endogenous – firms with better investor protection would have an easier time financing R&D, in which case R&D, like low inside ownership, would be an endogenous proxy for good investor protection. This, too, would predict a negative coefficient. The coefficient estimates in Table 3 are more consistent with the view that R&D is a proxy for unmeasured risk or an endogenous indicator of weak investor protection.

The point estimates on our measure of idiosyncratic risk ("stock sigma") are all negative, though only the estimate in column (5) for the non-US/UK firms is statistically different from zero. In the model, the ownership choice equates the marginal benefits of incentives and risk sharing; idiosyncratic risk makes it costly for insiders to own equity in the firm. The results in Table 3 are consistent with this prediction of the model. Alternative explanations are possible, however. For example, Demsetz and Lehn (1985) suggest that stock price volatility could also be a proxy for asymmetric information. If ownership concentration were the result of adverse selection, then the predicted coefficient on stock sigma would be positive rather than negative. According to this view, the coefficient on sigma would be positive, but the estimates in Table 3 are negative, hence the data are more consistent with moral hazard than adverse selection as an explanation for insider ownership concentration. Of course, these stories are not mutually exclusive; the coefficient on sigma could reflect both effects.

In column (3), our preferred specification, the estimated coefficients on legal efficiency and shareholder protection are all negative and precisely estimated. These results are robust to the exclusion of smaller firms outside the largest 150 firms in each country. The negative signs on legal efficiency and shareholder protection support the argument in LLSV (1998) that ownership concentration is a substitute for legal institutions as a mechanism for constraining the expropriation of outside equity investors. The economic intuition for the negative coefficient on creditor protection in column (3) is less obvious, but still consistent with this view; to the extent that debt financing is costlier due to weak creditor protection, firms may rely more on equity financing. Moreover, the coefficients on firm-level variables are robust to the inclusion of country-level variables, and conversely, the coefficients on country-level variables are not substantively affected by the inclusion of firm-level variables. Indeed, the incremental adjusted R^2 more than doubles from 0.112 to 0.233 when the specification using only firm-level variables in column (2) is expanded to include country-level variables in column (3).

Finally, it is interesting to compare the results for the full international sample in column (3) with the samples of in columns (4) and (5). Although there is some overlap in the samples, it is nevertheless reassuring to note that the results for the full international sample are robust across the two subsamples.

4.4 The First-Order Condition for the Capital Stock

Table 4 reports the estimated coefficient from simple OLS and instrumental variable regressions of the marginal return on investment (π_{it}) on inside ownership concentration – that is, the specification in equation (21), which for ease of reference is reproduced here:

$$\pi^K_{it+1} \simeq r^f_{t+1} + \delta + \bar{\Gamma} + \left(\bar{\gamma} \square \bar{\Gamma}\right) \alpha_{it} + u_{it}. \tag{28}$$

These regressions produce estimates of $\left(\bar{\gamma} \square \bar{\Gamma}\right)$, which is the average additional risk premium for bearing idiosyncratic risk (beyond the usual premium $\bar{\Gamma}$ for bearing systematic risk, which is absorbed in the constant term and therefore not identified in this specification). The top half of the table (panel A) reports results using the international sample of firms representing 38 countries, while the bottom half (panel B) reports symmetric results using the subsample that omits firms from the United States and United Kingdom. All of the standard error estimates reported in Tables 4 and 5 (like Table 3) reflect adjustments to account for the potential presence of heteroskedasticity and cross-sectional correlation among observations within a single firm, and are therefore as conservative as possible. Most of the specifications (as indicated) also include industry and time dummies as controls.

In the first column of Table 4, we report OLS estimates obtained from regressing marginal profit on inside ownership excluding any other control variables. For the international sample in panel A, the estimated value of $(\bar{\gamma} - \bar{\Gamma})$ is 0.027 with a standard error of 0.006. In panel B, using only non-US/UK firms yields a somewhat larger estimate: 0.058, with a standard error of 0.008. In column (2), some of this explanatory power is absorbed by the inclusion of country-specific year dummies; this only slightly changes the estimated coefficients in panel A (falling to 0.023 with a standard error of 0.006), but reduces the estimate in panel B to 0.019 with a standard error of 0.008. In column (3), adding industry dummies in addition to the year dummies has little additional impact on the ownership coefficient for either sample. Finally, column (4) repeats column (3) using only the 150 largest firms in each country. In panel A, this cuts the sample size roughly in half, and reduces the estimated coefficient to 0.018 (with a standard error of 0.008). In panel B, the estimated coefficient in column (4) falls slightly from 0.021 to 0.019 with a standard error of 0.008. In results not reported in the tables, we find similar estimates when we restrict our sample to firms from the United States only. The estimated coefficients in columns (1) and (2), for example, are both 0.029 with a standard error of 0.012. The estimates in columns (2), (3), and (4) are very similar, too. This result is interesting because it suggests that even *within* countries, there is enough variation in investor protection at the firm level to identify the relationship between ownership and marginal profit.[10]

The OLS results in columns (1)-(4) of Table 4 indicate positive and statistically signifi-

[10] Within-country variation in investor protection is not the *only* possible source of variation in ownership and marginal profit. For example, this variation could theoretically arise from unobserved differences in the total wealth of insides.

cant estimates of $\left(\bar{\gamma} \,\square\, \bar{\Gamma}\right)$ ranging from 0.018 to 0.056. We consider three possible reasons why these estimates might be biased. First, as discussed in section 3, inside ownership is endogenous, raising the potential for bias caused by correlation between inside ownership and the error term. However, it is important to be clear about the source of the endogeneity and its implications for the estimation of equation (21). The endogeneity of α_{it} is not by itself sufficient to generate the correlation between α_{it} and the error term that would bias OLS estimates. Indeed, this endogeneity is the very source of the predicted correlation between α_{it} and the expectation of π_{it} on which our empirical evidence is based. Moreover, the rational expectations error introduced by the difference between the actual and expected value of π_{it} is not known at the time α_{it} is chosen and is therefore orthogonal to α_{it}. In short, the model does not imply any obvious *economic* sources of correlation between inside ownership and the error term.

Because our data provide only relatively crude measures of inside ownership, however, it is likely that the OLS estimates in Table 4 are contaminated by classical measurement error. In the column (5), we reestimate the specification in column (6) using three lags of all right-hand side variables as instruments. These estimates are consistent with the existence of measure error. The instrumental variable estimates increase slightly in panels A and B to 0.033 and 0.045, respectively, with standard errors of 0.009 and 0.011. In column (6), we add the log of sales to control for size effects that might be spuriously correlated with ownership (although the model identifies no structural reason for doing so except, perhaps, as a crude control for cross-sectional differences in depreciation rates or systematic risk). This raises the estimated coefficients in Panels A and B to 0.037 and 0.049, respectively, with standard errors of 0.010 and 0.011. Finally, as discussed at the end of section 3, our instrumental variable estimates could correct for bias due to the variable coefficient component of the error term. In particular, the lagged instrument set may be less correlated with the term involving product of the ownership and the unobserved innovation to the insiders' SDF $(\varepsilon^{\gamma}_{it}\alpha_{it})$. Either story would be consistent with the larger coefficient magnitudes observed for the instrumental variable estimates in Table 4.

4.5 Adjustment Costs and Leverage Effects

For simplicity, the specification estimated in Table 4 is derived under the assumption of zero adjustment costs and frictionless debt markets. Previous research, however, shows that both adjustment costs and leverage effects are important features of investment behavior (see Gilchrist and Himmelberg, 1998, for a recent treatment). It is therefore important to show that the estimates in Table 4 do not spuriously reflect either of these two features of a more general model. Fortunately, the necessary model extensions can be applied in a straightforward way to equations (13) and (8), and equation (21) can be modified accordingly.

Adjustment costs can be appended to the existing model by recognizing that the total return on capital, $\Pi^K_{it+1} = \pi^K_{it+1} + 1 - \delta$, generalizes to $\left(\pi^K_{it+1} + (1 - \delta)(1 + c_{it+1})\right) / (1 + c_{it})$ under adjustment costs, where c_{it+1} is the marginal adjustment cost of installing an additional unit of capital. We assume this marginal adjustment cost can be parameterized as $c_{it+1} = \tau_1 \left((I/K)_{it+1} - \tau_2 (I/K)_{it}\right)$. To add leverage effects to the model, we first note that the model already allows managers to borrow and save freely at the rate r_{t+1}. To allow for the further possibility that leverage incurs a deadweight loss which is borne by managers, we can make the common and convenient modeling assumption that the borrowing rate r_{t+1} includes an additional premium which is linearly increasing in the debt-to-asset ratio. In this case, r^f_{t+1} in equation (28) is replaced by $r^f_{t+1} + \eta (B/K)_{it}$ (see Gilchrist and Himmelberg, 1998, for example).

The empirical specification of the Euler equation can therefore be written:

$$\begin{aligned} \pi^K_{it+1} \simeq \; & r^f_{t+1} + \delta + \bar{\Gamma} + \left(\bar{\gamma} - \bar{\Gamma}\right) \alpha_{it} \\ & + b_1 (I/K)_{it+1} + b_2 (I/K)_{it} + b_3 (I/K)_{it-1} + \eta (B/K)_{it} + \varepsilon_{it+1}, \end{aligned} \tag{29}$$

where $b_1 = -\tau_1 (1 - \delta)$, $b_2 = \tau_1 (1 + \tau_2 (1 - \delta))$, $b_3 = -\tau_1 \tau_2$. In the absence of adjustment costs for investment and costly debt financing, the reduced-form coefficients b_1, b_2, b_3, and η are zero, and equation (29) reduces to the static first-order condition for capital in equation (8).

We report estimates of the Euler equation in equation (29) in Table 5. These specifications are estimated by instrumental variables where the instrument list consists of lags $t-1$, $t-2$, and $t-3$ of all variables appearing in the model specification being estimated.[11] All specifications are estimated with country-specific year dummies and industry dummies. For the sake of comparison with the estimates in Table 4, columns (1), (2), and (3) of Table 5 report instrumental variable estimates of our modified Euler equation under the assumption that adjustment costs are zero (column (1) repeats column (5) from Table 5 exactly). These estimates reveal that the inclusion of leverage has essentially no impact on the estimated coefficient on inside ownership. In the second column of Panel A, for example, the estimated coefficient on market leverage is -0.004, and is not statistically different from zero. In the third column of Panel A, using book leverage instead of market leverage yields a precisely estimated leverage coefficient of 0.096, and the coefficient on inside ownership rises to 0.041 (from its estimated value of 0.033 reported in the fifth column of Table 5). In regression results not reported here, we control for size by including the log of sales; this addition does not substantively alter the estimated coefficients or standard errors on inside ownership. Finally, the results for the non-US/UK sample reported in Panel B are qualitatively the same as those in Panel A, except that the coefficient estimates for the static model in Panel B tend to be somewhat larger.

Columns (4), (5), and (6) of Table 5 repeat the specifications in the first three columns allowing for adjustment costs. Here again, we are primarily interested in noting the impact on the estimated coefficient on inside ownership. The coefficients on ownership in the

[11] The magnitudes of the point estimates are not sensitive to instrument selection; using fewer lags somewhat reduces precision.

Euler equation estimates in Panel A are uniformly higher than the estimates for the static specification reported in Table 4 and the first three columns of Table 5. For example, in the column (4) of Panel A, the estimated coefficient on inside ownership is 0.052 (with a standard error of 0.023), which is larger though less precisely estimate than the estimate of 0.033 (with a standard error of 0.009) reported in the fifth column of Table 5. This estimate rises to 0.069 (with a standard error of 0.021) in the sixth column when we add book leverage to the specification. Once again, the results for the non-US/UK sample in Panel B are qualitatively and quantitatively similar, indicating that our results are not being driven by large representation of firms in the United States and the United Kingdom.

While the comparison between the static and dynamic models reveals only modest differences for the coefficient on ownership, it substantially increase both the size and significance of the estimated coefficient on leverage. With adjustment costs, the estimated coefficient on market leverage reported in the sixth column of Panel A rises to 0.264 (with a standard error of 0.030), which, in contrast to the estimate reported in the second column, is now large and statistically significantly different from zero. The sixth column of Panel A reports a similar increase in magnitude for the coefficient on book leverage with an estimated coefficient of 0.239 (with a standard error of 0.030). In these two specifications, the coefficients on inside ownership remain large and precisely estimated at 0.047 and 0.069 (with standard errors of 0.019 and 0.021, respectively). Similar changes in the leverage coefficient are observed in Panel B. In addition to showing the robustness of the results in Table 5, these results appear to indicate that leverage, too, is correlated with the cost of capital used by insiders to discount future cash flows. This is consistent with the leverage effects for investment found by Whited (1992) and Gilchrist and Himmelberg (1998), among others.

5 Discussion

5.1 The Magnitude of Capital Stock Distortions

The magnitude of the underinvestment implied by our estimates of $\bar{\gamma} - \bar{\Gamma}$ in Tables 4 and 5 depend on the distortion to the marginal cost of capital, as revealed by the term $\left(\bar{\gamma} - \bar{\Gamma}\right) \alpha_{it}$, and the elasticity of the capital stock to the marginal cost of capital. Although it is perhaps difficult to judge the value of this elasticity at the level of the macroeconomy, it is not difficult to make reasonable assumptions at the *firm* level. The elasticity depends on the curvature of the firm's profit function. If the production function is Cobb-Douglas with constant returns to scale, and if the firm is a price taker in factor and product markets, then the firm's profit function is linear in capital, and firm size is indeterminate. To generate a concave profit function (so that firm size is bounded), we need to introduce diminishing marginal revenue. This would be consistent with decreasing returns to scale in production, market power, or both. For simplicity, we assume constant returns to scale and a downward sloping demand curve for output given by $P\left(Y_{it}\right) = Y_{it}^{-\eta}$, where $-\eta$ is the inverse price elasticity of demand. For this demand curve, the profit function function has the form $\pi_{it} = A_{it} K_{it}^{1-\eta}$, where A_{it} is a "profitability" parameter that embeds productivity levels, factor prices, and parameters of the production and demand functions. In the absence of adjustment costs, equation (21) implies:

$$\left(1 - \eta\right) A_{it} K_{it}^{-\eta} = r^f + \delta + \bar{\Gamma} + \left(\bar{\gamma} - \bar{\Gamma}\right) \alpha_{it}. \tag{30}$$

Equation (30) allows us to examine the sensitivity of the capital stock to changes in the user cost of capital. When investor protection is perfect, equation (30) implies $\left(1 - \eta\right) A_{it} K_{it}^{-\eta} = \delta + r$. Abstracting from adjustment costs, the elasticity of capital with respect to the user cost in this model is $-1/\eta$. Hence, for example, if $\eta = 0.2$, then $-1/\eta = 5.0$, so that a 10% increase in the user cost of capital implies a 50% decrease in the optimal capital stock.

To illustrate the effect of changes in investor protection on the capital stock, we assume parameter values for η, δ, r, and Γ, respectively, of 0.2, 0.07, 0.10, and 0.0. The value of A is chosen to normalize $K = 100$ when investor protection is perfect (this corresponds to $\alpha = 0$ in equilibrium). Using equation (30), we ask: Given our estimates of $\bar{\gamma} - \bar{\Gamma}$ and plausible values of the remaining parameters, what is the magnitude of the relationship between the equilibrium values of α and K? Table 6 provides the answer for a range of values. For various values of α_{it} and $\bar{\gamma} - \bar{\Gamma}$, the table reports the implied equilibrium values of marginal profit (π_{it}^{K}) and the associated capital stock (K_{it}).

Table 6 reveals the quantitative importance of cost of capital distortions for the determinants of firm size. Even at the low end of our range of estimates ($\bar{\gamma} - \bar{\Gamma} = 0.03$), a firm with equilibrium ownership concentration of 80% would accumulate only about half as much capital as a firm with inside ownership of 10%. The effect is even larger if we use our preferred estimate of $\bar{\gamma} - \bar{\Gamma} = 0.05$. At this level, a firm with ownership concentration of 80% has an equilibrium capital stock which is 37% of its first-best level. These are large differences. Though our model is stylized, these calculations suggest that ownership concentration (and by implication, investor protection) has an important impact on the marginal cost of capital.

In related research, Kumar, Rajan, and Zingales (2001) investigate the determinants of firm size and find that their measure of judicial efficiency is an important explanatory variable. The numerical calculations in Table 6 are consistent with their evidence. Moreover, these results illustrate the endogeneity of the relationship between firm size and inside ownership concentration proposed in section (4.3) as an explanation for the robust empirical relationship observed in Table 3. The calculations in Table 6 imply a relationship between ownership concentration and the log of capital is approximately linear with a slope of roughly -1.3, whereas the estimated coefficients in Table 3 range from -2.44 to -3.59. Hence, the sign is correct and the values from this calibration exercise have the right order of magnitude. It is tempting to propose a model for firm size by taking the log of equation (30) and, rearranging terms, regressing $\log K_{it}$ on ownership concentration and other controls for other determinants of the cost of capital. Of course, ownership is endogenous, so it would not be appropriate to interpret ownership as a "determinant" of firm size. Rather, this regression would simply recover the negative equilibrium relationship between firm size and ownership. Although the negative relationship between ownership and firm size is a robust feature of the data, the problem with this proposed regression, unfortunately, is that "profitability" parameter, $\log A_{it}$, appears in the error term. This parameter is highly endogenous to both firm size and ownership. Without instrumental variables to account for this omitted variable, such a regression provides biased estimates of the structural parameters. The specification in equation (28), by contrast, do not suffer from this bias.

5.2 Inside Ownership and Tobin's Q

The marginal value of capital, or *marginal* q, is the discounted marginal value (to the market) of an additional dollar of investment. That is, marginal q is defined as:

$$q_{it} \equiv E_t \left[M_{t+1} \Pi^K_{it+1} \right]. \tag{31}$$

Under zero adjustment costs, constant returns to scale, perfectly competitive product markets, and perfect investor protection, equation (6) says that marginal q equals one in equilibrium. It also follows immediately from the discussion of equation (17) that under imperfect investor protection and linear homogeneity of π, the equilibrium value of marginal q exceeds one. It is an easy algebraic exercise to extend this result to the case where the value function is homogenous of degree less than one, $\psi < 1$.[12]

To map these statements about marginal q into statements about Tobin's *average* Q, we consider the general case where the one-period profit function π is homogeneous of degree $\psi < 1$. Under this assumption, the relationship between marginal q and Tobin's Q is given

[12] Homogeneity of degree ψ implies $\pi^K = \psi \frac{\pi}{K}$. This implication combined with equations (8) and (14) can be used to show $q > 1$.

by:[13]

$$\psi \left(Q_{it} - \frac{1-\delta}{1+r^f} \right) = q_{it} - \frac{1-\delta}{1+r^f}. \tag{32}$$

In the special case that the profit function is linearly homogeneous ($\psi = 1$), we have the familar result that marginal q equals Tobin's Q. In the general case ($\psi < 1$), equation (32) implies $Q_{it} > q_{it}$. If ψ is a constant, the relationship between Q_{it} and q_{it} is linear. Thus, under fairly general conditions, weak investor protection implies the equilibrium value of Tobin's Q is greater than one. Moreover, by the relationship of marginal q to marginal profit and the logic of equation (21), the model predicts Tobin's Q is positively related to inside ownership concentration.

Our model thus provides an alternative explanation some of the results found with regressions of Tobin's Q on inside ownership (e.g, Mϕrck, Shleifer, and Vishny, 1988; McConnell and Servaes, 1990; Holderness, Kroszner, and Sheehan, 1999; and Himmelberg, Hubbard, and Palia, 1999, among others). A common interpretation for positive estimated coefficients on inside ownership in the above regression is "better incentives generate better performance." In this view, high values of Tobin's Q indicate "good performance," and therefore Tobin's Q should be higher for firms with "good incentives," i.e., higher concentrations of inside ownership. McConnell and Servaes (1990), Himmelberg, Hubbard, and Palia (1999), and Demsetz and Villalonga (2001), however, raise various objections to this interpretation as well as to the practice of regressing Tobin's Q on ownership. The primary complaint is that ownership is endogenous. Our model addresses this problem by providing an empirical framework within which the consequence of this endogeneity can in principal, at least, be interpreted. In our model, high values of *marginal q* reflect *underinvestment* resulting from low levels of investor protection, which in turn is positively correlated with ownership concentration. Hence equation (32) turns the traditional interpretation on its

[13] If π is homogeneous of degree ψ, then $\Pi^K = \psi \frac{\Pi}{K} + (1-\psi)(1-\delta)$. Multiplying by M, taking expecations, and collecting terms gives equation (32).

head; ownership concentration implies better incentives, but such incentives are necessary only when investor protection is weak. Ownership concentration and high values of Tobin's Q are merely joint symptoms of weak investor protection.

Because of the potential biases introduced by measurement problems with Tobin's Q (Himmelberg, Hubbard, and Palia, 1999; Demsetz and Villalonga, 2001), we do not attempt to estimate equation (32). For example, if the firm's value function is not homogeneous of degree one ($\psi < 1$) due to, say, market power, then average Q does not equal marginal q. The discrepancy between the two stems from the fact that average Q values inframarginal rents on assets in place whereas marginal q concerns only the value of rents on the margin. This point holds for any other source of inframarginal rents, and applies to inframarginal costs as well. With fixed costs in production, for example, Tobin's Q can be *less* than marginal q. In short, average Q can easily reflect substantial variation which is unrelated to marginal q. To make matters worse, if inframarginal rents are correlated with unobserved firm-level or country-level investor protection variables, then the error term is correlated with the regressors, and in the absence of good instruments, least squares estimates of equation (32) are biased downward. By contrast, our adjusted sales-to-capital-based measure of marginal profit is robust to market power, fixed cost, and various other measurement issues that break the link between average and marginal q.

5.3 Financial Liberalizations

Our results suggest large potential gains from financial sector reforms that improve the level of investor protection. Most research on financial liberalization approaches the issue from an asset-pricing perspective which focuses on changes in the risk-free rate or the price of systematic risk (or both) as a consequence of improved international diversification. As Shleifer and Wolfenzon (2000), among others, have pointed out, however, removing the barriers to capital flows does not guarantee that capital flows to its most efficient use unless international investors can be credibly convinced that investments will be repaid;

the expected return to investors depends on the level of investor protection. For example, the estimates in Chari and Henry (2001) indicate that for a firm operating in a market in which the covariance between the local and world market returns exceeds 0.01, financial liberalization causes a firm-specific revaluation on the order of 3.4%. This revaluation occurs only for "investible firms"; firms which are "off limits to foreign investors" bear no significant relationship to differences in local and world covariances.

The model in this paper formalizes this idea by providing quantitative guidance on the extent to which firms are "off limits" to investors. Recall from equation (12) that the first-order condition for capital is:

$$E_t\left[\pi^K_{it+1}\right] \simeq r^f_{t+1} + \delta - g_{it}\frac{cov_t\left[m_{it+1}, \pi^K_{it+1}\right]}{E_t\left[m_{it+1}\right]} - h_{it}\frac{cov_t\left[M_{t+1}, \pi^K_{it+1}\right]}{E_t\left[M_{t+1}\right]}. \tag{33}$$

If financial liberalization improves international diversification, this implies a change in the stochastic properties of the market's SDF, M_{t+1}, which would change the risk-free rate, r^f_{t+1}, and presumably lower the premium for systematic risk, $h_{it}\frac{cov_t\left[M_{t+1},\pi^K_{it+1}\right]}{E_t\left[M_{t+1}\right]}$. If investor protection were *perfect*, then we would have $g_{it} = 0$ and $h_{it} = 1$, in which case the *only* mechanism by which financial liberalization could affect investment would be through changes in the risk-free rate and the repricing of systematic risk.

Under imperfect investor protection, however, the weight given to *idiosyncratic* risk is reflected by the level of inside ownership. In the polar case for which investor protection is so weak that owners are autonomous ($g_{it} = 1$, $h_{it} = 0$), the effects of financial liberalization on investment would have to operate indirectly through the effects on the risk-free rate or the market's SDF caused by capital flows out of the country.[14] More generally, equation (33) describes a range of intermediate cases for which the weights g_{it} and h_{it} fall somewhere between zero and one.

[14] Even for a privately held firm, the equilibrium properties of the manager's SDF could change due to changes in the manager's portfolio opportunities. These effects are indirect, though, and would likely be smaller than the direct effect on covariance risk for a publicly traded firm with a low level of inside ownership.

Equation (33) therefore provides an empirical framework for distinguishing the diversification benefits from the investor protection reforms that often (to some extent) accompany financial market liberalizations. Intriguingly, and consistent with the evidence reported in Chari and Henry (2001), Bekaert, Harvey, and Lundblad (2001) find that the pre-existence of an Anglo-Saxon legal system magnifies the response of the investment-to-GDP ratio to financial liberalization events. This is precisely what the model presented in this paper predicts.

6 Conclusions

We investigate the cost of capital in a model in which investor protection determines the agency conflict between inside managers and outside shareholders. Our principal empirical results confirm two predictions of the model. First, the weaker is investor protection, the higher is the concentration of inside equity ownership. Second, the higher is the concentration of inside ownership, the higher is the implied cost of capital. While previous research has investigated the determinants of ownership structure, we are not aware of previous research that has identified the theoretical and empirical relationship between ownership and marginal profit. Our results are robust to extensions of the empirical specification that explicitly accommodate adjustment costs for investment and financial frictions due to leverage. Moreover, these results hold both for our full sample of firms across 38 countries as well as for various subsamples of firms. The logic linking inside ownership to the cost of capital is quite general, and the robustness and pervasiveness of these empirical patterns provide broad support for the predictions of the model.

We have highlighted several interesting implications of our results. First, our results suggest that the magnitude of the departure from the first-best level of capital is potentially quite large for firms in countries in which investor protection is weak. Even in countries like the United States and the United Kingdom in which investor protections are good, many firms maintain high concentrations of inside ownership. This fact suggests there is still substantial room for improvement in the design of the legal and regulatory environment for financial contracting and corporate governance even in what are commonly thought to represent "best practice." Second, our model combines what Kumar, Rajan, and Zingales (2001) have termed the "technological" and "organizational" theories of the firm. We provide new evidence consistent with the view that "organizational" factors (like investor protection) are important determinants of firm size. Third, we have formally argued that because weak investor protection leads to underinvestment, the marginal profit of capital is not driven down to its first-best level and therefore Tobin's Q is greater than one in equilibrium. In addition, because inside ownership concentration is higher under weak investor protection, the equilibrium relationship between inside ownership and Tobin's Q is positive. Subject to qualifications regarding possible discrepancies between average and marginal Q, these results provide a new interpretation for ownership-performance correlations which differs from previous explanations. Fourth, our model helps to shed light on the real economic effects of financial liberalizations. In particular, it helps to formalize the widely recognized fact that while lowering international barriers to capital flows is obviously a necessary condition for liberalization, it is not sufficient; capital will not flow unless adequate investor protections are in place. Existing empirical work already provides evidence for this intuition which is succinctly captured by our expression for the cost of capital.

These results suggest several important directions for additional research. First, our data do not allow us to distinguish cleanly between insiders and large but passive outside shareholders. To the extent that we mistakenly classify large outsiders as insiders, we likely introduce measurement error and thus a downward bias in the estimated distortion to the cost of capital. Improving the measurement of the equity holdings and risk exposures of insiders is an important direction for additional work. Second, we have made ownership of dividend rights endogenous without considering the endogenous allocation of control rights. The large gaps between ownership and control rights observed in many countries suggests the importance of such an extension. Third, our empirical results show that leverage, like inside ownership, is positively correlated with the marginal profit of capital.[15] The treatment of debt in our framework could be relaxed by making it defaultable rather than riskless, and would ideally identify the structural role of creditor protections, in particular. Such a model would obviously be useful for refining our theoretical understanding of what is already a well-documented empirical relationship between leverage and the implied cost of capital.

[15] Heaton and Lucas (2001) explore the implications for hurdle rates in a model with debt constraints and no equity.

References

Alchian, A., Demsetz, H., 1972. Production, Information Costs, and Economic Organization. American Economic Review 62, 777-805.

Allen, F. G., 2000, Comparing Financial Systems. MIT Press, Cambridge.

Beck, T., Levine, R., Loayza, N., 2000. Finance and the Sources of Growth. Journal of Monetary Economics 46, 31-77.

Bekaert, G., Harvey, C. R., Lundblad, C., 2001. Does Financial Liberalization Spur Growth?" Working Paper No. 8245, National Bureau of Economic Research.

Burkart, M., Gromb, D., Panunzi, F., 1998. Why Higher Takeover Premia Protect Minority Shareholders. Journal of Political Economy 106, 172-204.

Carlin, W., and Mayer, C., 2000. Finance, Investment, and Growth. Unpublished working paper, University of Oxford.

Chari, A., Henry, P. B., 2001. Stock Market Liberalizations and the Repricing of Systematic Risk. Working Paper No. 8265, National Bureau of Economic Research.

Claessens, S., Djankov, S., Lang, L., 2000. The Separation of Ownership and Control in East Asian Corporations. Journal of Financial Economics 58, 81-112.

Coase, R., 1960. The Problem of Social Cost. Journal of Law and Economics 3, 1-44.

Demsetz, H., Villalonga, B., 2001. Ownership Structure and Corporate Performance. Journal of Corporate Finance 7, 209-233.

Coffee, J. C. Jr., 2000. Privatization and Corporate Governance: The Lessons from the Securities Market Failure. Working Paper No. 158, Columbia Law School.

Demsetz, H., Lehn, K., 1985. The Structure of Corporate Ownership: Causes and Consequences. Journal of Political Economy 93, 1155-1177.

Demirgüc-Kunt, A., Maksimovic, V., 1998. Law, Finance, and Firm Growth. Journal of Finance 53: 2107-2137.

Demirgüc-Kunt, A., Maksimovic, V., 1999. Instutitions, Financial Markets and Firm Debt Maturity. Journal of Financial Economics 54, 295-336.

Fluck, Z., 1998. Optimal Financial Contracting: The Design of Optimal Securities. Review of Financial Studies 11, 383-418.

Fluck, Z., 1999. The Dynamics of the Management-Shareholder Conflict. Review of Financial Studies 12, 379-404.

Gertler, M., Hubbard, R. G., 1988. Financial Factors in Business Fluctuations. In: Financial Market Volatility. Federal Reserve Bank of Kansas City, Kansas City.

Gilchrist, S., Himmelberg, C. P., 1998. Investment, Fundamentals, and Finance. In: Ben Bernanke and Julio J. Rotemberg (eds.), NBER Macroeconomics Annual. MIT Press, Cambridge.

Grossman, S., Hart, O., 1988. One-Share-One-Vote and the Market for Corporate Control. Journal of Financial Economics 20, 3175-3202.

Harris, M., Raviv, A., 1988. Corporate Governance: Voting Rights and Majority Rules. Journal of Financial Economics 20, 203- 235.

Harris, M., Raviv, A., 1991. The Theory of Capital Structure. Journal of Finance 46, 297-355.

Hart, O., 1995. Firms, Contracts and Financial Structure, Clarendon Lectures in Economics. Clarendon Press, Oxford.

Hart, O., Moore, J., 1990. Property Rights and the Nature of the Firm. Journal of Political Economy 98, 1119-1158.

Hart, O., Moore, J., 1995. Debt and Seniority: An Analysis of the Role of Hard Claims in Constraining Management. American Economic Review 85, 567-85.

Heaton, J., Lucas, D., 2001. Capital Structure, Hurdle Rates, and Portfolio Choice: Interactions in an Entrepreneurial Firm. Unpublished working paper. Northwestern University, Evanston.

Himmelberg, C. P., Hubbard, R. G., Palia, D., 1999. Understanding the Determinants of Managerial Ownership and the Link Between Ownership and Performance. Journal of Financial Economics 53, 353-384.

Holderness, C., Kroszner, R., Sheehan, D., 1999. Were the Good Old Days That Good? Changes in Managerial Stock Ownership Since the Great Depression. Journal of Finance 54, 435-469.

Hubbard, R. G., 1998. Capital-Market Imperfections and Investment. Journal of Economic Literature 36, 193-225.

Hubbard, R. G., Kashyap, A. K., Whited, T., 1995. Internal Finance and Firm Investment. Journal of Money, Credit, and Banking 27, 683-701.

Jensen, M., Meckling, W., 1976. Theory of the Firm: Managerial Behavior, Agency Costs, and Ownership Structure. Journal of Financial Economics 3, 305-360.

Johnson, S., McMillan, J., Woodruff, C., 1999. Property Rights, Finance, and Entrepreneurship. Unpublished working paper, Sloan School of Management, Boston.

King, R., Levine, R., 1993. Finance and Growth: Schumpeter Might Be Right. Quarterly Journal of Economics 108, 717-737.

Kumar, K., Rajan, R., Zingales, L., 2001. What Determines Firm Size? Unpublished working paper. University of Chicago, Chicago.

La Porta, R., Lopez-de-Silanes, F., Shleifer, A., Vishny, R., 1997. Legal Determinants of External Finance. Journal of Finance 52, 1131-1150.

La Porta, R., Lopez-de-Silanes, F., Shleifer, A., Vishny, R., 1998. Law and Finance. Journal of Political Economy 106, 1113-1155.

La Porta, R., Lopez-de-Silanes, F., Shleifer, A., Vishny, R., 1999a. Investor Protection and Corporate Valuation. Working Paper No. 7403, National Bureau of Economic Research.

La Porta, R., Lopez-de-Silanes, F., Shleifer, A., Vishny, R., 1999b. Corporate Ownership Around the World. Journal of Finance 54, 471-517.

La Porta, R., Lopez-de-Silanes, F., Shleifer, A., Vishny, R., 2000a. Tunnelling. American Economic Review 90, 22-27.

La Porta, R., Lopez-de-Silanes, F., Shleifer, A., Vishny, R., 2000b. Investor Protection and Corporate Governance. Journal of Financial Economics 58, 3-27.

Levine, R., 1999. Law, Finance, and Economic Growth. Journal of Financial Intermediation 8, 8-35.

Love, I., 2001. Financial Development and Financing Constraints: International Evidence from the Structural Investment Model. Mimeograph, Columbia University.

Mϕrck, R., Shleifer, A., Vishny, R., 1988. Management Ownership and Market Valuation: An Empirical Analysis. Journal of Financial Economics 20, 293-315.

Myers, S., 2000. Outside Equity. Journal of Finance 55, 1005-1037.

Oliner, S., Rudebusch, G., 1992. Sources of the Financing Hierarchy for Business Investment. Review of Economics and Statistics 74, 643-654.

Rajan, R., Zingales, L., 1998. Financial Dependence and Growth. American Economic Review 88, 559-586.

Rousseau, P., Wachtel, P., 1998. Financial Intermediation and Economic Performance: Historical Evidence from Five Industrialized Countries. Journal of Money, Credit, and Banking 30, 657-78.

Shleifer, A., Vishny, R., 1997. A Survey of Corporate Governance. Journal of Finance 52, 737-783.

Shleifer, A., Wolfenzon, D., 2000. Investor Protection and Equity Markets. Working Paper No. 7974, National Bureau of Economic Research.

Stulz, R., 1988. Managerial Control of Voting Rights: Financing Policies and the Market for Corporate Control. Journal of Financial Economics 20, 25-54.

Whited, T., 1992. Debt, Liquidity Constraints, and Corporate Investment: Evidence from Panel Data. Journal of Finance 47, 1425-1460.

Wurgler, J., 2000. Financial Markets and Allocation of Capital. Journal of Financial Economics 58, 187-214.

Zingales, L., 2000. In Search of New Foundations. Journal of Finance 55, 1623-1653.

Zwiebel, J., 1996. Dynamic Capital Structure Under Managerial Entrenchment. American Economic Review 86, 1197-1215.

Table 1
Sample Coverage Across Countries

	Full Sample			Largest 150 Firms (each year)		
Country	# Obs.	# Firms	Median Inside Equity Ownership	# Obs	# Firms	Median Inside Equity Ownership
Argentina	39	9	0.61	39	9	0.61
Australia	1,370	187	0.41	1,293	169	0.40
Austria	126	38	0.55	126	38	0.55
Belgium	394	62	0.60	394	62	0.60
Brazil	350	75	0.48	340	65	0.48
Canada	839	241	0.31	515	118	0.37
Chile	352	55	0.60	352	55	0.60
Denmark	548	102	0.20	548	102	0.20
Finland	506	72	0.42	506	72	0.42
France	2,537	363	0.63	1,078	173	0.55
Germany	2,393	375	0.67	748	97	0.61
Hong Kong	777	129	0.52	777	129	0.52
India	115	35	0.51	109	33	0.51
Indonesia	409	83	0.70	409	83	0.70
Ireland	369	44	0.26	369	44	0.26
Israel	37	13	0.54	37	13	0.54
Italy	512	108	0.61	512	108	0.61
Japan	3,170	588	0.38	1,098	175	0.34
Malaysia	1,278	195	0.51	1,113	180	0.51
Netherlands	689	124	0.47	689	124	0.47
Norway	539	79	0.50	539	79	0.50
Pakistan	70	15	0.63	70	15	0.63
Peru	13	5	0.83	13	5	0.83
Philippines	25	21	0.65	25	21	0.65
Portugal	156	33	0.56	156	33	0.56
Singapore	713	111	0.58	713	111	0.58
South Africa	1,050	130	0.57	1,050	130	0.57
South Korea	720	184	0.26	612	160	0.26
Spain	539	94	0.57	539	94	0.57
Sweden	773	116	0.41	773	116	0.41
Switzerland	537	112	0.44	537	112	0.44
Taiwan	69	33	0.15	69	33	0.15
Thailand	164	84	0.46	148	81	0.44
Turkey	65	16	0.75	65	16	0.75
United Kingdom	8,338	993	0.25	1,548	227	0.01
United States-50%	7,821	1,187	0.19	1,488	212	0.02
United States	19,256	2,562	0.19	1,566	300	0.01
Total	38,714	6165	0.40	19709	3348	0.42

Source: Authors' calculations based on Worldscope data.
Note: "United States-50%" is a random 50 percent sample of full United States sample.

Table 2
Definitions and Summary Statistics for Firm-Level Variables

Variable	Variable Definition
Sales/Capital	The ratio of firm sales to the beginning-of-period capital stock
MPK	The industry-adjusted measure of the marginal return on capital (see Appendix A)
I/K	The ratio of capital expenditures to the beginning-of-period capital stock
Book Leverage	The ratio of the book value of debt to the book value of assets
Market Leverage	The ratio of the book value of debt to the market value of assets
Inside Ownership	The fraction of equity held by insiders (in Worldscope, the variable "closely held shares")
Log(Sales)	The log of firm sales, where sales is measured in constant U.S. dollars
R&D/Sales	The ratio of R&D expenditures to sales
R&D Dummy	A dummy variable equal to one if R&D is missing, zero otherwise
Stock Sigma	Variance of residual from CAPM regression

	Summary Statistics							
					Percentiles			
Variable	Sample	# obs	Mean	Min	5%	50%	95%	Max
Sales/Capital	Full	38,714	4.430	0.000	0.430	3.490	12.330	19.990
	Largest 150	19,709	3.940	0.000	0.410	2.980	11.450	19.990
	Non-US/UK	24,349	4.342	0.000	0.433	3.425	12.030	19.989
MPK	Full	38,714	0.200	0.000	0.040	0.160	0.460	1.000
	Largest 150	19,709	0.180	0.000	0.040	0.150	0.440	1.000
	Non-US/UK	24,349	0.193	0.000	0.039	0.162	0.453	0.998
I/K	Full	38,714	0.240	0.000	0.030	0.180	0.660	2.000
	Largest 150	19,709	0.240	0.000	0.030	0.180	0.630	2.000
	Non-US/UK	24,349	0.244	0.000	0.031	0.185	0.661	2.000
Book Leverage	Full	38,714	0.540	0.000	0.200	0.550	0.840	1.000
	Largest 150	19,709	0.550	0.010	0.210	0.560	0.840	1.000
	Non-US/UK	24,349	0.548	0.000	0.213	0.558	0.847	1.000
Market Leverage	Full	38,714	0.450	0.000	0.110	0.440	0.830	1.000
	Largest 150	19,709	0.470	0.000	0.120	0.460	0.870	1.000
	Non-US/UK	24,349	0.462	0.001	0.119	0.448	0.842	1.000
Inside Ownership	Full	38,714	0.400	0.000	0.000	0.390	0.840	1.000
	Largest 150	19,709	0.420	0.000	0.000	0.430	0.840	1.000
	Non-US/UK	24,349	0.45	0.000	0.004	0.453	0.900	1.000
Log(Sales)	Full	38,632	12.670	1.940	9.830	12.540	15.880	18.930
	Largest 150	19,677	13.340	1.940	10.260	13.320	16.370	18.930
	Non-US/UK	24,349	12.669	1.153	9.780	12.500	15.921	18.590
R&D/Sales	Full	38,714	0.010	0.000	0.000	0.000	0.060	8.820
	Largest 150	19,709	0.010	0.000	0.000	0.000	0.050	3.650
	Non-US/UK	24,349	0.008	0.000	0.000	0.000	0.047	7.197
R&D Dummy	Full	38,714	0.610	0.000	0.000	1.000	1.000	1.000
	Largest 150	19,709	0.650	0.000	0.000	1.000	1.000	1.000
	Non-US/UK	24,349	0.68	0.000	0.000	1.000	1.000	1.000
Stock Sigma	Full	34,892	0.11	0.026	0.057	0.100	0.195	0.412
	Largest 150	16,914	0.103	0.026	0.055	0.093	0.183	0.390
	Non-US/UK	22,265	0.107	0.026	0.059	0.098	0.185	0.390

Table 3
Determinants of Inside Ownership Concentration

Coefficients from regressions of inside ownership on country-level and firm-level measures of investor protection. Constant terms are not reported. Standard errors (in parentheses) adjust for heteroscedasticity and within-firm serial correlation. Statistical significance levels are denoted by stars, where ** and * denote significance at the one and five percent levels, respectively (two-tailed tests).

	Full International Sample				150 Largest Firms	Non -US/UK Sample
Variables	(1)	(2)	(3)	(4)	(5)	(6)
Country-Level Characteristics						
Legal Efficiency	-2.94 **		-2.40 **	-2.21 **	-2.02 **	-1.47 **
	(0.21)		(0.21)	(0.24)	(0.26)	(0.24)
Creditor Protection	0.38		-0.73 **	-0.65 **	-0.08	-0.17
	(0.23)		(0.22)	(0.23)	(0.38)	(0.32)
Shareholder Protection	-6.20 **		-5.90 **	-5.81 **	-3.16 **	-2.05 **
	(0.23)		(0.24)	(0.28)	(0.38)	(0.32)
Firm-Level Characteristics						
Log(Sales)		-2.51 **	-2.97 **	-3.14 **	-3.59 **	-2.44 **
		(0.17)	(0.16)	(0.19)	(0.28)	(0.24)
Sales/Capital		0.50 **	0.42 **	0.35 **	0.32 **	0.56 **
		(0.08)	(0.07)	(0.80)	(0.12)	(0.10)
R&D/Sales		-9.66 **	-9.11 **	-9.45 **	-14.76	-4.70 *
		(3.01)	(2.76)	(3.17)	(11.10)	(2.10)
R&D Dummy		10.09 **	5.94 **	6.18 **	8.57 **	6.87 **
		(0.62)	(0.59)	(0.63)	(0.97)	(0.83)
Stock Sigma				-10.70	-13.40	-36.10 **
				(7.90)	(12.86)	(11.23)
Year Dummies	No	Yes	Yes	Yes	Yes	Yes
Industry Dummies	No	Yes	Yes	Yes	Yes	Yes
R2	0.167	0.112	0.243	0.233	0.227	0.125
Nobs	38714	38634	38632	34812	16887	19339

Table 4
Estimates of the First-Order Condition for the Capital Stock

Coefficients from regressions of the marginal return on capital (MPK) on inside ownership (equation (11) in the paper). Constant terms and dummy variables are not reported. Column (2) repeats columns (1) adding country-specific time dummies, and column (3) repeats column (2) adding industry dummies. Column (4) repeats column (3) using the sample of the 150 largest firms in each country. Column (5) repeats column (3) using three lags of all variables as instruments. Column (6) adds the log of sales to column (5). Standard errors (in parentheses) adjust for heteroscedasticity and within-firm serial correlation. Statistical significance levels are denoted by stars, where ***, ** and * denote significance at the one-, five- and ten-percent levels, respectively (two-tailed tests).

Panel A: International Sample (All Firms)

	OLS				IV	
	(1)	(2)	(3)	(4)	(5)	(6)
Inside Ownership	0.027 ***	0.023 ***	0.023 ***	0.018 ***	0.033 ***	0.037 ***
	(0.006)	(0.006)	(0.006)	(0.008)	(0.009)	(0.010)
Log(Sales)						0.001
						(0.001)
Country-Specific Year Dummies	No	Yes	Yes	Yes	Yes	Yes
Industry Dummies	No	No	Yes	Yes	Yes	Yes
R2	0.003	0.002	0.002	0.001	NA	NA
Nobs	38,716	38,716	38,716	19,711	19,330	19,327

Panel B: Non-US/UK Sample

	OLS				IV	
	(1)	(2)	(3)	(4)	(5)	(6)
Inside Ownership	0.058 ***	0.019 **	0.021 ***	0.019 **	0.045 ***	0.049 ***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.011)	(0.011)
Log(Sales)						0.003
						(0.002)
Country-Specific Year Dummies	No	Yes	Yes	Yes	Yes	Yes
Industry Dummies	No	No	Yes	Yes	Yes	Yes
R2	0.011	0.001	0.001	0.001	NA	NA
Nobs	24,349	24,349	24,349	18,101	11,361	11,358

Table 5

Estimates of Euler Equations and Leverage Effects

Model extensions to the regression of the marginal return on capital (MPK) on inside ownership (equation (11) in the paper). Column (1) reproduces model (5) from Table 4 for comparison. Columns (2) and (3) add leverage, measured as the ratio of the book value of total liabilities to total liabilities plus equity (using the market and book values of equity, respectively). Columns (4)-(6) report Euler equation estimates to capture dynamics in MPK resulting from adjustment costs. All specifications are estimated with industry- and country-specific year dummies, and all use three lags of the dependent and explanatory variables as instrumental variables. Standard errors (in parentheses) adjust for heteroscedasticity and within-firm serial correlation. Statistical significance levels are denoted by stars, where ***, ** and * denote significance at the one-, five- and ten-percent levels, respectively (two-tailed tests).

Panel A: International Sample (All Firms)

	Static (Steady-State) Specifications			Dynamic (Euler Equation) Specifications		
	(1)	(2)	(3)	(4)	(5)	(6)
Inside Ownership	0.033 ***	0.033 ***	0.041 ***	0.052 ***	0.047 ***	0.069 ***
	(0.009)	(0.009)	(0.009)	(0.023)	(0.019)	(0.021)
Market Leverage		-0.004			0.264 ***	
		(0.010)			(0.030)	
Book Leverage			0.096 **			0.239 ***
			(0.011)			(0.030)
$(I/K)_{t+1}$				-2.942 ***	-2.123 ***	-2.360 ***
				(1.147)	(0.825)	(0.934)
$(I/K)_{t}$				5.204 ***	4.103 ***	4.382 ***
				(1.196)	(0.859)	(0.963)
$(I/K)_{t-1}$				-1.289 ***	-1.013 ***	-1.099 ***
				(0.214)	(0.156)	(0.170)
Nobs	19,330	19,330	19,327	14,753	14,753	14,752

Panel B: U.S. Sample

	Static (Steady-State) Specifications			Dynamic (Euler Equation) Specifications		
	(1)	(2)	(3)	(4)	(5)	(6)
Inside Ownership	0.045 ***	0.049 ***	0.049 **	0.035 a	0.047 *	0.041 *
	(0.011)	(0.011)	(0.011)	(0.023)	(0.026)	(0.022)
Market Leverage		0.015			0.215 ***	
		(0.014)			(0.041)	
Book Leverage			0.111 ***			0.191 **
			(0.015)			(0.036)
$(I/K)_{t+1}$				-1.557 **	-1.790 **	-1.520 **
				(0.741)	(0.840)	(0.698)
$(I/K)_{t}$				3.519 ***	3.530 ***	3.330 ***
				(0.753)	(0.850)	(0.709)
$(I/K)_{t-1}$				-0.784 ***	-0.756 ***	-0.734 ***
				(0.131)	(0.147)	(0.122)
Nobs	11,361	10,408	11,361	8,421	7,658	8,421

Table 6

Equilibrium magnitude of underinvestment implied by observed ownership concentration under alternative values of the idiosyncratic risk premium, γ-Γ

Solutions for π^K and K assuming η=0.2, r+δ+Γ=0.18, and values for α and γ-Γ as indicated in the respective row and column headings. The value of the "profitability" parameter A is chosen to normalize K equal to 100 in the benchmark case in which perfect investor protection (i.e., α=0).

	γ-Γ=0.03		γ-Γ=0.05		γ-Γ=0.07	
α	π^K	K	π^K	K	π^K	K
0.00	0.180	100.00	0.180	100.00	0.180	100.00
0.01	0.180	99.17	0.181	98.62	0.181	98.07
0.10	0.183	92.06	0.185	87.19	0.187	82.63
0.30	0.189	78.35	0.195	67.02	0.201	57.59
0.80	0.204	53.48	0.220	36.66	0.236	25.81

NATIONAL BANK OF BELGIUM - WORKING PAPERS SERIES

1. "Model-based inflation forecasts and monetary policy rules" by M. Dombrecht and R. Wouters, *Research Series*, February 2000.

2. "The use of robust estimators as measures of core inflation" by L. Aucremanne, *Research Series*, February 2000.

3. "Performances économiques des Etats-Unis dans les années nonante" by A. Nyssens, P. Butzen, P. Bisciari, *Document Series*, March 2000.

4. "A model with explicit expectations for Belgium" by P. Jeanfils, *Research Series*, March 2000.

5. "Growth in an open economy: some recent developments" by S. Turnovsky, *Research Series*, May 2000.

6. "Knowledge, technology and economic growth: an OECD perspective" by I. Visco, A. Bassanini, S. Scarpetta, *Research Series*, May 2000.

7. "Fiscal policy and growth in the context of European integration" by P. Masson, *Research Series*, May 2000.

8. "Economic growth and the labour market: Europe's challenge" by C. Wyplosz, *Research Series*, May 2000.

9. "The role of the exchange rate in economic growth: a euro-zone perspective" by R. MacDonald, *Research Series*, May 2000.

10. "Monetary union and economic growth" by J. Vickers, *Research Series*, May 2000.

11. "Politique monétaire et prix des actifs: le cas des Etats-Unis" by Q. Wibaut, *Document Series*, August 2000.

12. "The Belgian industrial confidence indicator: leading indicator of economic activity in the euro area?" by J.J. Vanhaelen, L. Dresse, J. De Mulder, *Document Series*, November 2000.

13. "Le financement des entreprises par capital-risque" by C. Rigo, *Document Series,* February 2001.

14. "La nouvelle économie" by P. Bisciari, *Document Series*, March 2001.

15. "De kostprijs van bankkredieten" by A. Bruggeman and R. Wouters, *Document Series*, April 2001.

16. "A guided tour of the world of rational expectations models and optimal policies" by Ph. Jeanfils, *Research Series*, May 2001.

17. "Attractive Prices and Euro - Rounding effects on inflation" by L. Aucremanne and D. Cornille, *Documents Series*, November 2001.

18. "The interest rate and credit channels in Belgium: an investigation with micro-level firm data" by P. Butzen, C. Fuss and Ph. Vermeulen, *Research series*, December 2001.

19 "Openness, imperfect exchange rate pass-through and monetary policy" by F. Smets and R. Wouters, *Research series*, March 2002.

20. "Inflation, relative prices and nominal rigidities" by L. Aucremanne, G. Brys, M. Hubert, P. J. Rousseeuw and A. Struyf, *Research series*,May 2002.

21. "Lifting the burden: fundamental tax reform and U.S. economic growth" by D. Jorgenson and Kun-Young Yun *Research series*, May 2002.

22. "What do we know about investment under uncertainty?" by L. Trigeorgis, *Research series*, May 2002.

23. "Investment, uncertainty and irreversibility: evidence from Belgian accounting data" by D. Cassimon, P.-J. Engelen, H. Meersman, M. Van Wouwe, *Research series*, May 2002.

24. "The impact of uncertainty on investment plans" by P. Butzen, C. Fuss, Ph. Vermeulen, *Research series*, May 2002.

25. "Investment, protection, ownership, and the cost of capital" by Ch. P. Himmelberg, R. G. Hubbard, I. Love, *Research series*, May 2002.

26. "Finance, uncertainty and investment: assessing the gains and losses of a generalized non-linear structural approach using Belgian panel data", by M. Gérard, F. Verschueren, *Research series*, May 2002.

27. "Capital structure, firm liquidity and growth" by R. Anderson, *Research series*, May 2002.

28. "Structural modelling of investment and financial constraints: where do we stand?" by J.-B. Chatelain, *Research series*, May 2002.

29. "Financing and investment interdependencies in unquoted Belgian companies: the role of venture capital" by S. Manigart, K. Baeyens, I. Verschueren, *Research series*, May 2002.

30. "Development path and capital structure of Belgian biotechnology firms" by V. Bastin, A. Corhay, G. Hübner, P.-A. Michel, *Research series*, May 2002.

31. "Governance as a source of managerial discipline" by J. Franks and C. Mayer, *Research series*, May 2002.

32. "Financing constraints, fixed capital and R&D investment decisions of Belgian firms" by M. Cincera, *Research series*, May 2002.

33. "Investment, R&D and liquidity constraints: a corporate governance approach to the Belgian evidence" by P. Van Cayseele, *Research series*, May 2002.