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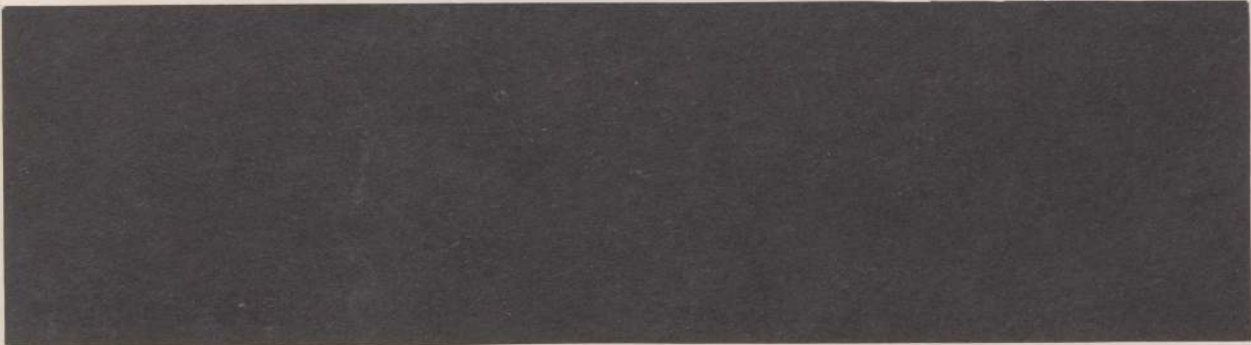
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*Financing of Investment in Eastern Europe:
A Theoretical Perspective*

Bengt Holmstrom

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*Financing of Investment in Eastern Europe:
A Theoretical Perspective*

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December, 1993

The paper looks at the role of collateral and intermediation in financing investments. Three variations of a simple information economic model are developed to shed light on the relative roles of these two basic solutions to the information problems attending investment. The main model shows that investments will be financed both with information intensive monitoring capital (intermediation) and with uninformed capital (e.g. bank finance). The degree of intermediation is a function of the level of collateralizable assets that a firm has. Less well capitalized firms must utilize more costly, information intensive finance. The paper applies the analysis to describe the likely forms of financing in Eastern Europe and the natural course of investments.

Author's Acknowledgements

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Disclaimer

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Executive summary:

When one faces complex decision problems, it is often more important to have the right conceptual picture than to get detailed analytical advice. In this paper I argue that traditional finance offers a misleading perspective on the financing of real investments. Information economics, which focuses on the reasons for asset illiquidity, provides a more useful conceptual framework. In this framework the basic problem of financing derives from an information gap between those who have excess money and those who have excess ideas. There are two main vehicles for matching money and ideas: collateral, which serves to secure investor funds, and intermediation, which helps bridge the information gap. Capital formation can be envisioned as a process in which firms transform prospective (illiquid) returns into proven (liquid) assets, using collateral and intermediation as the means of transformation. Through variations on a simple model, the paper studies the relative roles of collateral and intermediation in this transformation process.

There are three main messages from the analyses. The first is that a firm's net worth, the market value of its assets, largely determines its ability to raise funds; hence the distribution of wealth matters for growth. The second message is that if the funding capacity afforded by net worth is small, investment will require more information intensive sources of funds; intermediation substitutes for collateral and expands the firm's capacity to invest. The third message is that financial constraints affect investment decisions; firms facing a capital shortage will seek to build up their capital base via smaller, safer and shorter-term projects.

The first message implies that capital formation and growth in Eastern Europe is likely to be slow, both because the effective capital base is small

and because capital and information are poorly matched. Privatization is an essential and urgent step to get the growth process restarted. Efforts to make markets of collateralizable assets more liquid, should also receive high priority. In this regard, real estate markets rather than stock markets should be targeted; real estate is the dominant form of collateral in the West, because it is less subject to informational problems than stocks.

The second message implies that financing will have to be more information intensive to compensate for the lack of collateral in Eastern Europe. Banks will play a different, more active monitoring role than in the West. Also, investment companies, which take equity positions, discipline management, and reallocate capital, will likely be significant intermediaries. Information intensive monitoring requires strong incentives, and hence intermediaries should be well capitalized and their managers have a significant stake in company performance.

Perhaps the most important message is that growth through smaller and shorter-term investments is the natural course of development for an economy that is severely capital constrained. Large, glamorous investment projects, backed up by government funds, will be politically tempting, but such efforts to speed up the rate of capital formation are likely to back-fire, because large projects face more severe incentive problems. Instead, the situation calls for patience. The creation of an environment in which small and medium sized businesses can prosper on their own would seem to hold better long-term prospects than forced action. Subcontracting for foreign firms may be a particularly important activity, since it takes advantage of lower collateral requirements and provides access to trade credit and outside expertise.

Financing investments in Eastern Europe:
A theoretical perspective.

by Bengt Holmstrom

1. Introduction.

In the aftermath of liberalization, Eastern Europe has suffered from a worsening capital shortage problem. The capital stock from the Communist era is outmoded and much of it is obsolete. One can expect unemployment to worsen as the process of privatization progresses and the capital base deteriorates further through shut downs of plants and enterprises. To alleviate unemployment and set the economies back on a growth path, major investments in new technologies and capacity are required. The key question is where to find the needed funds. Some funds will be provided through Western subsidies, but for sustained growth, new private sources need to be mobilized. How will that be accomplished? And what can and should be done to speed up the process.

The potential for growth is evident. Unlike most developing economies that suffer from a capital shortage, Eastern Europe has a relatively well educated labor force with substantial skills. Also, most of the countries are close to the central markets in Europe. This should make Eastern Europe attractive to Western investors. Yet, the pace of investment has remained sluggish. One reason is the remaining uncertainty about the political future of Eastern Europe as well as the details of taxation and the general legal framework in which business can be conducted in these countries. Another reason is the current European recession, brought on by a stifling monetary policy that has driven real interest rates up and squeezed credit markets severely. A third reason, and the one that I will focus on in this paper, is

the primitive state of the capital markets in the East. Investment funds are short, because the institutions needed to channel funds from investors to firms are missing or function badly. If investment efforts are to be successful, proper credit mechanisms have to be developed.

I will look at this funding problem at a conceptual level, drawing on recent theoretical work in corporate finance. I should state at the outset that corporate finance is still in a primitive state. In developed economies, the task of allocating capital and coordinating real investments is shared between a large variety of institutions: firms, banks, financing companies, venture capitalists, stock and bond markets, and many less formal arrangements. It is a complicated network of intermediaries, a network we do not yet understand well. The various institutions compete with each other in some respects, and complement each other in other respects. How effective the overall results have been is hard to gauge. It is notable that countries with very different institutional choices, seem to have been equally successful. The U.S. and the U.K. have relied more heavily on external market finance than have most other economies, including Germany and Japan. Some would argue that this explains differences in growth, but I think this is a premature conclusion. To me, the record seems surprisingly similar. That, of course, does not mean that the choice of financial institutions is a matter of indifference, but merely that there appear to be several internally consistent solutions to the problem of allocating funds.

Despite the fact that our current understanding is so limited, I think it is timely and worthwhile to discuss the emerging theoretical approach to corporate finance. Let me give three reasons why I think so. First, the theory has advanced far enough to offer a conceptual framework for thinking

about investment problems in a new, more realistic way. Understanding the underlying reasons why financing is needed, and the contractual problems that must be overcome, helps us to zero in on the right set of issues. My experience is that practitioners have found the paradigm useful for interpreting current Western financing schemes, and my hope is that those who have to grapple with the design of financial institutions in Eastern Europe will find the approach similarly illuminating.

The second reason for talking, somewhat prematurely, about the new theory, is that the old theory is so misleading. Finance textbooks commonly give the impression that, since security markets are efficient, these markets automatically solve the problem of allocating funds among competing real investment proposals. Therefore, funding shortages in Eastern Europe should be dealt with by creating well-functioning stock and bond markets. In fact, "efficient markets" has a particularly narrow meaning in the finance literature. In layman terms it simply says that prices will adjust so speedily to information that only a fair return can be earned on investments into special information. What this has to do with real investment is less clear. The fact that relative prices of existing assets are constantly adjusted to eliminate arbitrage opportunities, provides us with information about the return opportunities and risk preferences in the stock market, but not about the return opportunities and risks in funding real investments. When a person buys a share of IBM, that money does not go to IBM, but to the seller of the share. At the margin, such a trade does not affect any IBM decisions. Taking "market efficiency" to mean that the funding of real investments is dealt with effectively through asset markets, is one of the great misconceptions of finance. Of course, I'm not saying that asset markets

are unimportant for investment. But the true link between asset markets and real investment remains to be spelled out in a satisfactory way.

At the recent IPR meetings in Prague, it was evident that the representatives of Eastern Europe believed that establishing liquid stock markets is one of the first steps in the direction of improving access to capital. It is sobering to consider Western evidence on this matter. Colin Mayer (1988) has recently studied the financing of real investments empirically, and the results are quite surprising. In looking at the data on flow of funds into and out of the non-financial sectors of various economies, including the US, the UK, Germany and some other European nations, he finds that around 70% of new investment into physical capital is financed by retained earnings. Around 25% is provided by bank loans and the rest by trade credits, equity issues and bonds issues. In other words, less than 5% of financing comes from asset markets. These calculations apply equally to the Anglo-American economies as to the more bank oriented European economies. The findings sound paradoxical, since it is well known that firms in the US and the UK have relied more extensively on stock and bond issues than have firms in say Germany or Scandinavia, in which stock and bond markets are less developed. The paradox is resolved by noting that the quoted figures refer to aggregates across all firms over a fifteen year period. If one looks at subsets of firms, for instance small and large ones, there are differences across countries. Also, the patterns vary over time in any given country. Nevertheless, Mayer's findings are useful in getting into the right frame of mind: an emphasis on stock and bond markets can be misguided, particularly at the early stages of development.

The third reason for theorizing at this early stage is that the only

alternative would seem to be imitation. But which financial system is the best one to copy? And how relevant is it in the current situation? One should keenly keep in mind that the advanced financing networks that we observe in developed economies have evolved over a long period of time to suit changing needs and to match new opportunities. It may be more appropriate to seek blueprints from historical records than to try to adopt institutions that are not yet ripe for a less developed economy. For instance, in the early days of banking in the Northeastern US, the investment practices were diametrically opposite to what they are today. The owners of the banks invested the bulk of their funds into their own industrial projects, something that would be considered corrupt today. Yet, this history played itself out in a different context, without the benefits of modern information technologies, or the potential support of highly advanced capital markets in neighboring nations. Again, it is hard to draw lessons that are readily applicable to the situation in Eastern Europe. Having a paradigm for thinking about the reasons why institutions developed the way they did, and what the problems were that they tried to solve, ought to be useful for assessing their relevance in today's situation.

The paper proceeds as follows. I will start by asking why firms need funds for investment. This seemingly naive question leads most expediently to the heart of the matter: the need for liquid funds, because of informational problems in evaluating and monitoring projects. Liquid funds are assets about which there is symmetric information. The fundamental problem of real investment, is to match those with money (liquid funds) but no information (ideas), to those with information but no money. All solutions involve transforming illiquid ideas into liquid claims, possibly through a chain of

intermediaries. Intermediaries, and this includes firms, bridge the gap by offering liabilities that are more liquid than their assets. Collateral (proven assets) plays the central role in increasing the liquidity of liabilities and in determining the firm's capacity to fund investments. This general perspective is laid out and discussed in section 2.

Section 3 offers the simplest possible model in which the central role of collateral can be studied (following Hoshi et al (1992)). It illustrates how firm growth is limited by the net worth of its marketable assets. Section 4 extends the analysis to specialized assets for which the liquidation value is less than the on-going value. Section 5 looks at an important second variation, that of intermediation. It shows that firms for which the information gap is large will rely on intermediation, while firms which can bridge the information gap through marketable collateral can do without. The analysis shows why firms may want to use several different sources of funds to minimize the cost of financing and how the mix may change over time from more information intensive financing (intermediation) in the early stages to less information intensive financing (secured debt) at a more mature stage. A key feature of the intermediation model is that intermediaries themselves are constrained by their net worth.

Finally, section 6 concludes the paper by drawing some lessons from the analysis regarding the status and future of financing in Eastern Europe. I should caution that these lessons are illustrative and general. To give specific policy advice would require a much more detailed knowledge of the Eastern European situation than I have. Indeed, my objective is not to influence policy directly but indirectly, through a framework that I believe is useful for those involved in implementing policy.

2. Why do firms need financing?

Modern asset pricing theories are all descendants of the famous Modigliani-Miller propositions. These propositions introduced the powerful logic of arbitrage. When one combines the logic of arbitrage with the assumption that markets are complete, one gets a very elegant theory of the relative prices of assets. There exists a pricing operator for the underlying state-contingent claims and every asset price can be expressed as a suitably weighted average of these primitive claims.

The theory has straightforward implications for investment. It says that at any given moment in time all projects with positive net present value should be undertaken. The identity of the firm that is considering a project makes no difference, only the cash flow matters. Whether the firm is just starting up or already is a large conglomerate or has little debt or much debt — none of these things should influence the decision. Nor does it matter whether the firm has money to finance the project. If it doesn't it will readily find investors in the capital market, willing to provide the needed cash. It does not matter how the cash is raised: equity or debt will do equally well, since how the proceeds from the project are sliced up between investors will not influence the cost of capital. Finally, the identity of the lender is of no relevance. A bank, an insurance company, a finance firm or an individual investor, all will do equally well.

In this "it doesn't matter" world — or more appropriately, "only cash flow matters" world — firms are viewed as portfolios of projects with total firm value equalling the sum of its individual parts, each independently priced by the logic of arbitrage. I think this theory is helpful in understanding the pricing of securities (or mutual funds) in the secondary

markets. It is not very helpful for understanding the constraints facing those who have to finance real investment projects.

Perhaps the most striking way of expressing the shortcoming of the standard theory for corporate finance is by asking the simple question: Why do firms need financing? In the world of standard theory the answer is that they don't. The very logic that underlies the Modigliani-Miller proposition about the indifference between equity and debt financing, also implies that firms should not have to ask for money in the first place. They could equally well pay all the needed inputs with claims on the future returns of the project, thereby making the input suppliers the financiers.

To understand funding needs and the distinguishing features of corporate finance compared with asset pricing, it is illuminating to ask why, in practice, firms seek financing for their investments when they don't have money of their own. The answer seems straightforward. Suppose a worker is needed to build a new plant. If the worker were offered a share in the future returns of the plant, it would most likely be the case that the worker couldn't tell how much such a claim was worth. The resulting adverse selection problem would cause the share of a positive net present value project to be priced at a discount. On many projects no agreement would be reached, because the worker would demand an excessive share. But even in the unlikely case that the worker did know the value of the share and a fair price could be found, the worker, unless he had money of his own, would face a similar adverse selection problem when he tried to pay for his consumption. The grocer would not know how to value a claim on the future returns of an unknown company. Or if she did, what about the next party from whom the grocer bought her inputs?

The problem is evident. The difficulty in valuing the firm's claim makes it an unacceptable means of payment; the claim is illiquid.¹ What the worker wants is a claim that is highly liquid so that he can pay his consumption needs with it. The asset that is most liquid is money. The reason it is the most liquid asset is that it also is the asset about which different individuals in the economy hold the most symmetric information. When the firm offers the worker money, the worker need not worry that the firm is trying to peddle him some asset, which the firm knows is less valuable than the worker thinks. The reason information about money is so symmetric is that it represents a claim on a large portfolio of future assets about which it is unlikely that the firm has private information. Even if it has private information on pieces of the full portfolio, the pieces are so small as to make the potential adverse selection problem trivial.

I've run through this logical sequence, not because it holds any surprises, but because it shows how the question, "Why do firms need financing", directly leads to the heart of the problem, that of asset illiquidity. In the traditional theory all assets are fully liquid, because there is no asymmetric information (markets are complete). Only if the firm's investment forces it to hold assets that are less than fully liquid, that is, assets about which there is private information, will there be a need for financing.

In the parable above, illiquidity is caused by adverse selection: the worker's inability to evaluate the project. Moral hazard is an alternative

¹Banerjee and Maskin (1991) use this line of reasoning to develop a formal model of money. The interpretation of illiquidity as an adverse selection problem, is particularly clearly articulated in S. Williamson (1988), who also offers an analysis of intermediation based on this view.

reason for illiquidity: the worker may fear that if he were to wait for payment until the project is completed, the firm could take a part of his share or squander it in some other way. The worker would have to spend time monitoring the firm's activities, but rarely knowing whether the actions taken by management represent legitimate or illegitimate decisions, he could be deceived. It is the implications of this line of reasoning that I will model. As we will see, moral hazard causes illiquidity, in the sense that some projects with positive net present will not be possible to finance.²

3. The role of net worth.

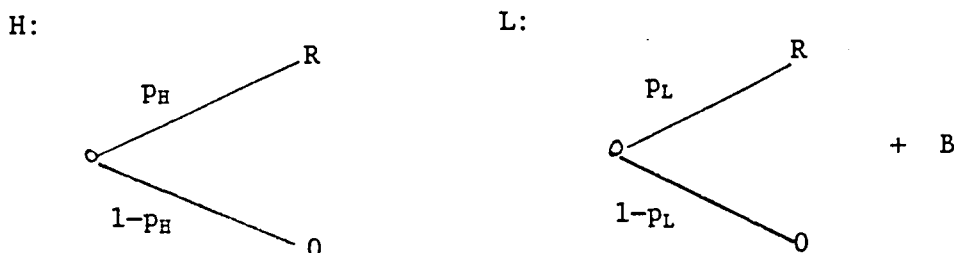
The purpose of this section is to introduce the simplest model in which the liquidation value of a firm's assets, the firm's current net worth, restricts the amount of investment it can undertake.³ It is a two-period moral hazard model featuring a risk neutral firm (entrepreneur) and a risk neutral investor.

In the initial period, indexed $t = 0$, there is an opportunity to invest. The investment costs I dollars. The gross payoff from the investment one period later ($t = 1$) is either R (a success) or 0 (a failure). The probability of success depends on an unobserved action taken by the firm. This action can be given many interpretations. Here I will interpret it as the firm's choice on how to spend the investment funds I . For simplicity,

²Search costs provide a third reason for illiquidity. A model of money based on costly search has been developed recently by Kiyotaki and Wright (1990).

³The model is taken from Hoshi et al (1992). The seminal paper on credit rationing is Stiglitz and Weiss (1981).

assume that the money can be spent in one of two ways. It can be spent on an efficient technology H, which consumes all the funds I, or it can be spent on an inefficient technology L, which costs $I - B$ and leaves B dollars for the firm to use for its own consumption. The probability of success is p_H if H is chosen and p_L if L is chosen. Naturally, $p_H > p_L$. The following diagram describes the two return options from investing:



I will assume that the expected return on the investment is negative if the low action is taken and positive if the high action is taken:

$$(1) \quad p_H R - I > 0 > p_L R - I + B.$$

Thus, it is better not to invest at all, than to invest and have the firm choose the inefficient technology.

The firm currently has assets worth A dollars. I assume that this also is the amount of cash that can be obtained if the assets are liquidated in the second period. Some of these assets could be cash, but as we will see shortly, this makes no difference in the basic model, so as a convention, I will assume that all of A is tied up in fixed assets that are needed for production. The value A thus represents the maximum liability of the firm, that is, the maximum the firm can be forced to pay under liquidation, because the investment I is assumed to have no salvage value. This is

inconsequential, since in this simple model a non-contingent salvage value would just reduce the effective investment cost, dollar for dollar.

Because the firm has no cash, it can invest only if it can obtain I dollars from the outside investor. I assume the investor can observe whether the investment is a success or a failure. With the liquidation proceeds added to the investment return, the total cash value of the firm is $R + A$ if the investment succeeds and A if it fails. A contract δ divides these proceeds between the investor and the firm in any feasible way, $\delta = (y_s, y_f)$, where y_i is the amount of cash that the investor is paid back in state $i = s, f$. Feasibility requires that the payment to the investor not exceed the cash value of the firm in either state:

$$(2) \quad y_s \leq R + A, \quad y_f \leq A.$$

This limited liability constraint is the source of the firm's liquidity problem. For convenience, assume the opportunity cost of the investor's funds is zero. Then the investor's expected payoff from the contract δ is:

$$E_i(y_s, y_f) = p_j y_s + (1 - p_j) y_f - I,$$

where p_j is the probability of success (either p_H or p_L). Let $x_s = R + A - y_s$ denote the firm's residual claim when the investment succeeds, and $x_f = A - y_f$, its residual claim when the investment fails. The firm's payoff then is:

$$E_e(x_s, x_f) = p_j x_s + (1 - p_j) x_f + B_j,$$

where $B_H = 0$ and $B_L = B$.

There are two decisions to be made: First, whether to undertake the investment at all and second, what contract δ to use if an investment is made.

Since the investment return is negative if the firm does not choose the efficient technology, a necessary condition for investing is that the following incentive compatibility constraint be satisfied:

$$p_H x_s + (1 - p_H) x_f \geq p_L x_s + (1 - p_L) x_f + B.$$

This constraint can be rewritten in the simpler form

$$(3) \quad x_s - x_f \geq B/\Delta p,$$

where $\Delta p = (p_H - p_L)$. To induce the firm to invest efficiently, the firm must be given a reward that at a minimum covers its opportunity cost of raising the probability of success.

If we can find a feasible contract, satisfying (2), such that the incentive constraint (3) is met, and the investor at least breaks even,

$$(4) \quad p_H y_s + (1 - p_H) y_f \geq I,$$

then it is also optimal to undertake the investment. To see this, note that if there exists a contract δ satisfying (2)-(4) — call such a contract *viable* — then there also exists a viable contract δ' satisfying (4) as an equality; simply reduce y_s and y_f by a constant. Since the investor earns zero under δ' , the firm receives the total surplus. According to (1), the total surplus is maximized by choosing H.

To see when there exists a viable financing contract, first note that we can restrict attention to contracts that set $x_f = 0$, the smallest feasible value by (2). Any viable contract δ with $x_f > 0$, can be replaced by a viable contract δ' with $x_f = 0$ by lowering the value of x_f and raising the value of x_s in a way that keeps the investor's, and hence the firm's payoff unaltered.

Since this change relaxes the incentive constraint (3), δ' is viable.

Given the minimum payment $x_s = B/\Delta p$ that is necessary to keep the firm diligent, is there enough left over for the investor to recoup the investment cost I ? Substituting $x_s = B/\Delta p$ and $x_f = 0$ into (4) and rearranging terms shows that this is the case if and only if:

$$(5) \quad A \geq \bar{A} = I - p_R(R - B/\Delta p).$$

Condition (5) puts a lower bound \bar{A} on the assets that the firm must have in order to be able to attract funds. Assumption (1) implies that the term in parenthesis is strictly positive and also that $p_R R - I > 0$. Consequently, \bar{A} is always less than I ; this is just another way of saying that the firm's assets are equivalent to cash. \bar{A} can be negative, in which case the firm does not need any assets at all to invest. This happens when the minimum payment to keep the firm diligent, $B/\Delta p$, leaves enough of R to cover the full investment cost: $p_R(R - B/\Delta p) > I$. In what follows I will assume this is not the case. Then all firms with $A < \bar{A}$ will be excluded from investing even though they could technologically undertake a project with positive net present value: in other words, these firms are capital constrained.

Its instructive to elaborate on the reason why firms are capital constrained. Rewrite (5) in the form:

$$(5') \quad p_R R - I \geq p_R B/\Delta p - A.$$

The right hand side measures the rent a firm earns if it is paid the minimum viable amount $B/\Delta p$. A firm with $A < p_R B/\Delta p$, earns a strictly positive rent. This rent is taken out of the total surplus, the left hand side of (5'). We see then that the presence of a positive rent will push the hurdle rate for

acceptable projects above the opportunity cost of funds. In other words, the net present value of the project, $p_H R - I$, must be strictly positive to cover the rent. The fact that projects with positive net present value get rejected is an allocational distortion, caused by the inability to transfer sufficient surplus from the firm to the investor. In this model, as in most other models with liquidity constraints, total surplus maximization does not define efficiency.

The comparative statics of (5) are straightforward. The cut-off value \bar{A} decreases in p_H , R and I and increases in p_L and B . This simply says that the need for own capital decreases when the efficient H-project becomes more attractive or when the inferior L-project becomes less attractive. The transfer problem, and the consequent allocational distortion, is less severe, the larger is the value differential between the efficient and the inefficient project. Of course, an increase in I also raises \bar{A} , since the effective need for funding is $I - A$.

These comparative statics are simple, but useful. They suggest a remedy to the incentive problem that does not rely on financial rewards. One could instead reduce the firm's opportunity cost from choosing the efficient project, by making the inferior L-project less attractive. I will return to this idea in section 5.

In a related fashion, suppose there are several positive net present value projects (H-projects) which the investor and the firm can jointly choose from (without being able to prevent the firm from choosing L, however). Which projects will be favored, when one takes into account the incentive costs? To look at this, consider a variation in p_H and R that leaves the expected return $p_H R$ unaltered. Specifically, assume p_H goes up and R goes down, that is, we

are moving in the direction of safer projects. This decreases $p_H/\Delta p$. It follows from (5) that the minimum level of assets \bar{A} needed to finance the project decreases, or alternatively from (5'), that the hurdle rate for accepting the project is reduced. Thus, firms that are capital constrained can be expected to move towards safer projects to get financing, even though the net present value of such projects are lower. The rent that accrues to the firm, $p_H B/\Delta p$, is lower for safer projects, leaving more surplus to be distributed to the investor. This is another manifestation of allocational distortions that arise when transfers are limited, that is, when there are liquidity constraints. It should be noted that this conclusion is distinct from the typical conclusion that a firm with debt will wish to take riskier projects. In this model, it is assumed that the choice between different H-projects is observed by the investor, or in an alternative interpretation, that the investor is choosing between firms of different riskiness.

Let me summarize the main results.⁴

Proposition 1. In the model described above:

- (a) A firm for which $A < p_H B/\Delta p$ can only invest if the project has a strictly positive net present value.
- (b) The minimum level of assets required for an investment in a project with $p_H(R - B/\Delta p) < I$ is \bar{A} , defined in (5). Firms with $A < \bar{A}$ cannot get funds. \bar{A} decreases in p_H and R and increases in p_L , B and I .

⁴ These results can be generalized to outcomes that are continuous. With a continuous outcome variable z , the optimal contract would look like debt: there would be an outcome level Z , such that the firm pays the investor $\min\{Z, z\}$; see Innes (1990). For alternative models of debt, see Gale and Hellwig (1985), Lacker (1992) and Townsend (1979).

(c) Capital constrained firms will at the margin invest in safer projects.

Assuming a single positive net present value project (p_H, R, I) , the net value of the firm as a function of its own assets A is:

$$V_1(A) = \begin{cases} A & , \text{ if } A < \bar{A}, \\ A + p_H R - I & , \text{ if } A \geq \bar{A}. \end{cases}$$

There is a discontinuity in $V_1(\bar{A})$, at the minimum level of capital \bar{A} , which means that, at the margin, a dollar is worth more inside the firm than outside. With variable investment the internal rate of return is always higher. To illustrate this, suppose that the project can be undertaken at any scale $I > 0$, with the return in case of success proportional to I : $R(I) = R \cdot I$. Also, assume that the funds that the firm can divert to its own use are proportional to I : $B(I) = B \cdot I$. Everything else, including p_H and p_L , is unchanged. In this case, the firm's assets determine the scale of investment. Solving (5) for I , gives the maximum investment level:

$$(6) \quad I(A) = A/\bar{A}(1),$$

where $\bar{A}(1) = 1 - p_H(R - B/\Delta p)$, represents the level of assets needed for an investment of size $I = 1$ according to (5). Note that $\bar{A}(1) > 0$, because I continue to assume that the firm earns a rent, that is, $p_H(R - B/\Delta p) < 1$. The value of the firm in the variable investment scenario is:

$$(7) \quad V_2(A) = ((p_H R - 1)/\bar{A}(1) + 1) \cdot A.$$

By definition, we have $V_1(\bar{A}) = V_2(\bar{A})$. The two cases are compared in Figure 1.

From (7) we see that the value of each inside dollar exceeds the value

of an outside dollar by the amount $p_H R / \bar{A}(1)$. If one transferred a dollar from the market to the firm, this dollar could be used to expand the firm by $1/\bar{A}(1)$ for an added net return of $(p_H R - 1)/\bar{A}(1) > 0$. In other words, the inside dollar is worth a dollar plus the value of the incentive effect. Consequently, the internal cost of capital is higher than the market cost of capital.

Does this mean that the social surplus could be increased by transferring funds from those with money but no projects to those with projects but no money? Total surplus would clearly increase. But the move would not be a Pareto improvement, since there would be no way to compensate those from which the dollar is taken; as noted earlier, this is not a model where Pareto optimality is characterized by total surplus maximization.⁵ Put differently, there are no externalities in this model other than those between the investor and the firm, and these are fully internalized by the optimal investment arrangement identified above. The case for subsidizing investment by direct or indirect transfers of funds, must rest either on interpersonal comparisons of utility, or on externalities across firms. To address this issue, I will next look at the case of specialized assets. Also, this case gets rid of an unattractive feature of the basic model, namely that the optimal contract is not unique. In the model above, the investor could be paid back in many different ways; having the firm receive nothing in case of failure was just the most convenient contract for calculating a minimum asset level.

⁵See Bernanke and Gertler (1990) for a discussion of government redistribution in a similar model with capital shortage. They use total surplus rather than Pareto optimality as a welfare criterion, but that is inappropriate. On the other hand, if one is merely interested in maximizing the rate of growth, then total surplus is the right criterion.

4. Specialized assets.⁶

In the basic model firm assets were equivalent to cash: giving the investor a dollar or a dollar's worth of assets (liquidated) made no difference to the firm. In this section I assume assets are specialized in the sense that the liquidation value of the assets is less than their value in continued use by the firm.

Let L be the amount of assets liquidated, measured in the same units as A . Let $(A - L)$ be the firm's valuation of the remaining assets. That the internal value is linear in the amount of assets is merely a normalization; we can always measure assets along a scale that gives linearity. Let $f(L)$ be the market value of the liquidated assets, where f is an increasing function with $f(0) = 0$. Specialization then means that $f(L) < L$, an assumption that will be maintained.

It is convenient to include in the contract the cash to be transferred as well as the amount of assets to be liquidated in the second period as a function of the outcome.⁷ Let l_j be the amount of assets, and r_j the amount of cash given to the investor in state $j = s$ or f . A contract is a four-tuple $\delta = (l_s, l_f, r_s, r_f)$. The investor's payoff in state j is $y_j = r_j + f(l_j)$. The firm's payoff is $x_j = z_j - r_j + (A - l_j)$, where $z_s = R$ and $z_f = 0$.

An efficient contract, assuming there is one involving investment, solves the following program:

⁶A closely related liquidation analysis, based on Townsend's (1979) costly state verification model, can be found in Bolton and Scharfstein (1992). See also Lacker (1992).

⁷This is not necessary. If the contract asked for more cash than the firm has, the balance would determine the amount of assets that the firm would have to liquidate.

Maximize $p_H x_s + (1 - p_H) x_f$

subject to

(IC) $(p_H - p_L)(x_s - x_f) \geq B,$

(P) $p_H y_s + (1 - p_H) y_f \geq I,$

(Dy) $y_j = r_j + f(l_j), j = s, f$

(Dx) $x_j = z_j - r_j + (A - l_j), j = s, f$

(LL) $l_j \leq A, r_s \leq R, r_f \leq 0.$

The constraints are: incentive compatibility (IC), participation by the investor (P), definition of y_j (Dy), definition of x_j (Dx), and limited liability of the firm (LL).

The solution to the program is easy to see. First, note that there must be some liquidation, unless the maximum cash disbursement to the investor, $r_s = R - B/\Delta p$, is enough to cover the initial investment cost. As before, I will assume this is not the case. Since assets are worth more within the firm than liquidated, it is clear that $l_j > 0$ implies $r_j = z_j$, that is, the firm is left with no cash if any assets have to be liquidated. Also, it cannot be the case that l_s and l_f are both strictly positive, since then the firm would be better off not investing; it gets no cash and loses assets. Finally, since $x_s > x_f$, we cannot have $l_s > 0$, and $l_f = 0$. This leaves as the remaining possibility that $l_s = 0$ and $l_f > 0$, implying that $r_s < R$ and $r_f = R$. This solution has the feature that the firm gets to retain all its assets and some cash, if there is a success, while failure leaves the firm with no cash and forces it to surrender some of its assets.

Liquidation raises the amount that the investor can recover from the project both directly and indirectly. Directly, there is $f(l_f)$ more cash in state f that the investor gets. Indirectly, the cash that can be paid in the

good state rises. The fact that liquidation lowers the payoff to the firm in the bad state, implies that the firm's payoff can be lowered also in the good state without violating incentive compatibility. From the (IC) constraint, we see that the maximum disbursement to the investor in the good state is $r_s = R - B/\Delta p + l_f$, which is l_f more than without liquidation. In total, the investor's expected payoff can be increased by $p_H l_f + (1 - p_H)f(l_f)$. Since the total surplus decreases in l_f , it is optimal to minimize the amount of assets liquidated. The minimum necessary is obtained by satisfying (P) with an equality:

$$(8) \quad p_H(R - B/\Delta p + l_f) + (1 - p_H)f(l_f) = I.$$

If this cannot be done with $l_f \leq A$, then the project cannot be financed at all.

Proposition 2. Assume $p_H(R - B/\Delta p) < I$. Then the optimal contract is unique and has the following features:

- (a) There will be some liquidation in the bad state (f), but not in the good state (s). The amount to be liquidated, l_f , is given by (8).
- (b) The firm pays out all its cash in the bad state.
- (c) If the functions $f_1(L)$ and $f_2(L)$ describe two different degrees of asset specialization, and $f_1 < f_2$, implying that f_1 represents a higher degree of specialization, then $\bar{A}_1 > \bar{A}_2$: the minimum level of assets required for investment is larger for the more specialized assets.

Parts (a) and (b) were argued earlier. Part (c) is obvious from the

optimization program; by inspection, if an investment is viable with more specialized assets it is also viable with the less specialized assets (see (8)).

Note that the optimal contract is unique as soon as there is any degree of asset specialization, unlike in section 3. But with only two outcomes, one cannot associate the optimal contract with debt or equity (or any other common financial instrument), because it can be interpreted in either way. Yet, there is a sense in which specialization shifts the optimal contract in the direction of equity: as the degree of specialization increases, relatively more of the investor's payoff will come from cash in the good state than from liquidation proceeds in the bad state. This suggests that firms with few tangible assets are financed more by equity, which appears empirically true.⁸

These observations have several simple, but important implications. First, if there is a choice of scale, as discussed earlier, then the scale will be smaller if assets are specialized, since the firm's liquidation cost is higher. Second, if there is a choice between projects that differ in the degree of specialization as well as return characteristics, then a firm with sufficiently low net worth will be forced to invest in less specialized projects that yield a lower total surplus. A lower total surplus is the price one must pay for the improved transferability of funds inherent in less specialized assets.

⁸Williamson (1988) was the first to discuss the connection between asset characteristics and capital structure.

The reader is cautioned that the interpretation of equity versus debt is strained in that it does not take account of the fact that equity and debt holders are typically different investors. In my model there is a single investor and I'm interpreting the investor's contract as a combination of equity and debt. The next section provides a model in which there are two different groups of investors. For other models that rationalize mixed financing, see Dewatripont and Tirole (1993) and Gorton and Pennacchi (1990).

The third implication is that specialization entails an externality between firms. The value of the assets on the market, in case assets have to be liquidated, depends on the choices made by other firms, the potential buyers of the liquidated assets. If there are firms that can find ready use for the liquidated assets, then liquidation costs may be modest and the effective degree of specialization low. This is the important point made by Shleifer and Vishny (1992). As they observe, there could be multiple equilibria: one in which no firm specializes, because the market value of liquidated assets is expected to be low, and another in which several firms specialize, because they expect that liquidated assets will find a ready market. In each equilibrium, the expectations are self-fulfilling. This is easy to envision without a formal model. Two firms could be just short of capital, because the liquidation value of their assets is low. But were both to invest, then the market value of the assets would go up and both could afford the investment. This, of course, assumes that when one firm is forced to liquidate, the other firm is in a position to buy the liquidated assets; the outcomes of the firms cannot be perfectly correlated. Industries in which aggregate shocks play an important role will have more difficulties with financing than do industries in which outcomes are idiosyncratic. That liquidation values depend on other firms' actions means that there is an externality. This raises the possibility that the government can do something to counteract it, a point I will return to in section 6.

So far, I have simply assumed that the internal value of assets is higher than their market value. This may seem like an eminently reasonable assumption, since at a minimum, it will cost something to transfer assets from one firm to another. But there remains the deeper question: if assets are

worth more inside the firm, why not leave them there and give the investor a share in the future proceeds? Why liquidate at all? To address this issue, one must look at a multi-period extension. Let me do so to show why liquidation in fact may be necessary.

Suppose that there are two periods of production instead of one. In each period the production returns either R or 0 dollars per unit of capital employed. The firm's private cost of being diligent is B per unit of capital employed. The initial investment brings the level of capital to A . After the first period outcome l_j units of capital are liquidated, where j indexes the first-period outcome. For simplicity, I assume that the market value of the liquidated assets is λ dollars per unit, so liquidation brings cash in the amount λl_j . The second period commences with $A_j = A - l_j$ units of capital, which return either $A_j R$ or 0 , and cost the firm $A_j B$ to operate diligently. After the second period, capital is worthless (its useful life is exactly two periods).

The contract between the firm and the investor can specify cash payments contingent on the sequence of outcomes as well as the amount to be liquidated, if any. Because the contract is complete in this sense, the second period continuation must be Pareto optimal: the initial contract cannot be rewritten after the first period in a way that improves the welfare of both parties. Let u_j and v_j be the second period continuation utilities of the firm and the investor if the outcome in the first period is j . Let $u_j = F_j(v_j)$ characterize the Pareto frontier in state j , that is, $F_j(v_j)$ is the maximum payoff that can be assured the firm, if the investor is guaranteed v_j . The key step is to describe this frontier.

Let z_j be the outcome in the first period. The decisions before period

2 are: how to split the outcome z_j , how much of the assets to liquidate and how to share the proceeds from the second period. As a convention, I assume the liquidation proceeds are paid directly to the investor. Let m_j be the additional amount of cash that the firm pays the investor before the second period starts (this could be a negative number, ie a payment from the investor to the firm). Since the firm has limited liability, $m_j \leq z_j$. Let x_j be the firm's share per employed unit of asset in the second period and $y_j = R - x_j$ the investor's residual share. In order for the firm to choose H rather than L, it has to be given at least a share $x_j \geq B/\Delta p$, leaving at most the share $y_j = (R - B/\Delta p)$ for the investor. Let $k = p_H(R - B/\Delta p)$. Then the maximum expected return to the investor is kA_f . The continuation utilities are:

$$v_j = m_j + \lambda l_j + p_H y_s A_j \leq \lambda l_j + k(A - l_j),$$

$$u_j = -m_j + p_H x_s A_j \geq B p_H (A - l_j) / \Delta p.$$

Keeping m_j fixed, the firm prefers as little liquidation as possible, since $x_s > 0$. But if $\lambda > k$, the investor prefers to liquidate. Let me argue that this is a relevant case. Suppose $\lambda < k$ and therefore that the investor also prefers no liquidation. The maximum amount the investor can be paid back in this case is $2k$, which is provided by paying the investor the share $(R - B/\Delta p)$ of each successful outcome. If $k < 1/2$, the investor cannot be paid back without liquidating assets. If in addition, $\lambda > 1/2$, that is, more than half of the asset value can be recovered from liquidation, then the investor prefers liquidation in the second period. Hence the investor can be paid back more by liquidating some of the assets. If the gap between what the investor can be paid without liquidation, $2k$, and the cost of investment, I , is not too large, the investment can be carried out, but not without liquidating some

assets. Since the total surplus of investing is positive, and the investor gets a zero expected return, the firm also benefits from investing if the liquidated amount is small enough (by continuity). The exact parameter restrictions for which investment, followed by liquidation, is optimal, are not particularly informative, so I record the discussion in the vague form:

Proposition 3. For some parameter values, the optimal investment contract will specify liquidation after the first period.⁹

One can interpret this case as one in which the investor requires that the firm is scaled down in response to a reduction in the firm's net value, the sum of the its fixed assets and cash. If the net value drops too low, the firm will have too little at stake to take the right action. Assets are liquidated to bring net worth in line with the firm's stake. This is a common response to a financial crisis. As part of restructuring, creditors typically require the firm to sell some of its assets to reduce its debt. In this model, I have assumed complete contracts, so the scaling back can be planned in advance and implemented through contingent contracting rather than through renegotiation, but the basic logic is the same.

It is worth noting that the most liquid assets will be sold first. Above, I assumed that all assets are sold at the reduced rate λ , but it is obvious from the general logic, as well as from the one-period model, that those assets that have the highest resale value will be the most efficient to

⁹Note that the logic behind this proposition is different from that provided by Stiglitz and Weiss (1983). In their model termination of financing (which is similar to liquidation) after the first period is merely a first-period incentive device. In my model liquidation also affects first-period incentives, but more importantly, it is part of an optimal continuation contract.

give up first. In the parlance of the business strategy literature, the firm is required to focus in response to a financial crisis. Focus means that the firm concentrates on the activities it has a comparative advantage at. Giving up assets that have the smallest ratio of internal to external value has precisely this meaning: assets that others can employ as efficiently as the firm and therefore have the same external as internal value, are by definition ones that are not part of the firm's particular business knowledge.

Finally, I note that the two period model that I have sketched can be used to look at investment choice, particularly with regard to the timing of investment returns. If there is any liquidation in the first period, then a dollar return in the first period is worth more than an expected dollar return in the second period. The dollar adds to the capital base of the firm in the first period and allows the firm to reduce the amount of assets that get liquidated in case of a failure.¹⁰ One dollar of cash buys back more than one dollar worth of assets, just as it did in the one-period model. The conclusion is that capital constrained firms can be expected to engage in projects that are of a shorter duration, at the cost of lower expected returns. This allows them to build up their capital base.¹¹

5. Intermediation.¹²

Let me return to the basic one-period model with a fixed level of investment and initial assets A equivalent to cash. The notation below

¹⁰This assumes that the investment returns something in the bad state as well as the good.

¹¹A similar point is made by Thakor (1990).

¹²This section is based on joint work with Jean Tirole, extending the model in Hoshi et al (1992).

assumes that A is cash, with the interpretation that the firm is just starting up. Nothing would materially change if one were to assume that A is the liquidation value of assets in place and I will allow myself this extended interpretation. To produce, the firm needs to buy fixed assets that cost I . For simplicity, these fixed assets are assumed to be worth zero upon liquidation. I concluded earlier that the firm needs to have cash in the amount $A > \bar{A}$ to be able to produce (see (5)). With less cash it cannot produce, since the maximum amount of outside capital that it can attract is $\bar{I}_u = I - \bar{A} = p_H(R - B_L/\Delta p)$.

In this section I want to consider an important variation on this basic model. I will introduce an intermediary who can monitor the firm and thereby reduce the required amount of capital that the firm needs. Monitoring is often thought to involve an evaluation of the expected return of a firm's project. This would require that firms differ either in the probabilities p_H and p_L or in the outcomes R and 0 . A simpler, and not unrealistic modelling alternative, is to assume that monitoring reduces the opportunity cost of the firm being diligent. Accordingly, I assume that if a firm is monitored, the private benefit B will be reduced to a lower level. Let B_L be the private return of an unmonitored firm that chooses an inefficient project (formerly just B) and let $B_M < B_L$ be the private return of a monitored firm that chooses an inefficient project. One interpretation of this assumption is the following. The firm has two inefficient projects it can undertake, M and L , with the associated private benefits described above. In other respects the projects are identical to each other (they both return R with probability p_L and 0 otherwise). If both projects are available to the firm, then evidently the firm will choose L over M , since L has a higher private return and the

same financial return. Thus, adding M to the earlier story changes nothing. Now enter monitoring. Monitoring eliminates the L option, but not the M option. We may think of the L option as a more blatant form of misconduct, which with sufficient monitoring can be detected and prevented. It could also be a covenant, the observance of which requires the intermediary's attention. Or it could literally be an investment that a person, representing the intermediary on the company's board, can veto. Whatever the interpretation, I think monitoring often involves this kind of enforcement of constraints that reduce the firm's opportunity cost of being diligent.¹³

The benefit of monitoring is that it lowers the share of R that needs to be paid to the firm to keep it from making the wrong project choice. Let B be a generic level of the private benefit. As before, it is optimal to pay the firm nothing in case the project fails. Therefore, the minimum payoff in case of success that the firm has to receive in order to be diligent (choose the H project) is:

$$\underline{R}_e(B) = B/\Delta p.$$

Since $B_M < B_H$, a firm that is monitored can be induced to choose H with a lower payment $\underline{R}_e(B_M) < \underline{R}_e(B_L)$. Consequently, there is a larger residual payoff, $R - \underline{R}_e(B_M)$, that can be offered to outside investors. This raises the amount of outside capital that can be brought in to finance the project. A firm that had too little own money to invest without monitoring ($A < \bar{A}$), may now be able to invest with monitoring.

Before jumping to this conclusion, however, we must consider the costs

¹³Of course, restrictions on the firm's ability to invest will often be coarse and therefore exclude socially valuable activities as well.

of monitoring. I will assume that it costs the intermediary a private amount c to exclude the L-project from the firm's portfolio. The firm can observe whether the monitor has eliminated the L-project; if it has not, the firm still has the option to choose L. I will further assume that monitoring cannot be contracted for directly, that is, against a flat fee. Rather, the intermediary must be induced to monitor via a contract that is contingent on the project outcome. Just as in the case of the firm's incentive problem, the optimal way to solve the intermediary's incentive problem, is to pay it zero if the project fails and a positive amount R_m if the project succeeds. The minimum amount the intermediary must be paid in order to monitor is:

$$R_m = c/\Delta p.$$

Note that $p_H R_m - c > 0$, so the intermediary is earning a rent. This rent can be reduced by asking the intermediary to pay up front a fixed fee. It is natural to interpret this fixed fee as capital invested by the intermediary in return for the payment R_m . If I_m is the invested amount, then the intermediary's rate of return (gross of the private cost c) is $\beta = p_H R_m / I_m$. Since we must have $p_H R_m - c - I_m > 0$ in order for the intermediary to participate, it follows that $\beta > 1$. The rate of return β will be the variable that equilibrates the market for intermediary capital.

I assume that there are many intermediaries: an unspecified but sufficiently large number so that we can view the intermediary market as competitive. In the aggregate, the intermediaries have capital in the amount K_m . I assume that intermediaries have no constraints on the time they can spend monitoring. In principle, a single intermediary could monitor any number of firms. This is the sense in which the intermediary market is

competitive. What limits the amount of intermediation in equilibrium is that intermediaries have to invest capital in the firms they monitor. In other words, expert or informed capital is scarce.

A firm that is monitored need not obtain all its capital from an intermediary. A key feature of the model is that firms can ask for additional capital from the uninformed, that is, those who do not monitor. As before, the uninformed are assumed to be satisfied with a unit rate of return on their capital. If R_u is the share of the payoff to the uninformed, they are willing to supply $I_u = p_H R_u$ of capital, leaving them with a zero expected profit.

A firm that is monitored must be paid at least $R_e(B_L)$ and the intermediary must be paid at least R_m , to get the firm to choose H. If the intermediary is paid less, it will not monitor and the firm will be able to choose L. Therefore, there is at most $R_u - R - R_e(B_M) - R_m$ left over to compensate the uninformed investors. I assume that $R_u > 0$, so that there is room for uninformed investors. The maximum amount of uninformed capital that a monitored firm can attract is $I_u = p_H R_u = p_H(R - B_M/\Delta p - c/\Delta p)$. To make the problem interesting, I assume that $I_u < I$, so that all investment cannot be financed with uninformed capital alone.

There is a continuum of firms with a total measure N . Firms differ only in the amount of assets A that they own. The distribution of assets across firms is represented by a cumulative distribution function G . Thus, $G(A)$ is the fraction of firms with assets less than A .

Suppose β is the going rate of return on intermediary funds. What will the demand for intermediary funds be? A firm that demands I_m units of informed capital, will have to offer the intermediary $R_m = \beta I_m / p_H$ if the project succeeds. Since the intermediary will not monitor unless $R_m \geq R_m$, the

minimum amount of informed capital that will be demanded (if any) is $\underline{I}_m(\beta) = p_H R_m / \beta$. Now let me argue that this is also the maximum amount that any firm will demand. One way to see this is to recall that the cost of intermediary capital is $\beta > 1$, while the cost of uninformed capital is only 1. However, one must also consider that the amount of uninformed capital that the firm can obtain is limited to \underline{I}_u , as defined above. Suppose this amount of capital together with the firm's own capital A and the minimum intermediary capital $\underline{I}_m(\beta)$ is insufficient to cover the cost of the investment I . That is, suppose $A < \underline{A}(\beta) \equiv I - \underline{I}_m(\beta) - \underline{I}_u$. Could the intermediary supply the missing amount by raising its investment above $\underline{I}_m(\beta)$? The answer is no and the reason is the following. For every dollar more of informed capital that the firm obtains, it has to offer the informed β/p_H dollars more out of the return R . This reduces by the same amount the maximum that can be paid out to the uninformed investors. Hence, the uninformed are now willing to contribute $p_H(\beta/p_H) = \beta$ dollars less. The net effect is that the firm obtains one dollar from the informed, but loses β dollars from the uninformed. Since $1 - \beta < 0$, the total amount the firm can obtain decreases rather than expands and so a firm that cannot be financed with a minimum of informed capital, cannot be financed at all.

With these preliminaries it is easy to describe the demand for informed capital. The demand can be divided into three categories as a function of the level of firm assets A . First, there are those firms which have enough own assets, $A > \bar{A}$, that they can finance their investment with uninformed capital alone. Since informed capital costs more, they will not want any of it. Second, there are those firms which have so few own assets that they cannot finance the investment with any combination of uninformed or informed capital.

These are the firms for which $A < \underline{A}(\beta)$, as discussed above. Note that for some values of β , $\underline{A}(\beta)$ could be negative, implying that this category is empty. However, if $NG(\bar{A})(I - \underline{I}_u) > K_m$, that is, if the total amount of funds needed to finance those firms that cannot invest without informed capital, exceeds the available amount of informed capital, then $\underline{A}(\beta)$ must be positive in equilibrium. I assume this is the case. Finally, the third category of firms are those with assets A such that $\underline{A}(\beta) \leq A < \bar{A}$. These firms can invest by using a mixture of informed and uninformed capital. As described above, they will ask for the minimum amount $\underline{I}_m(\beta)$ needed to induce the intermediary to monitor.

From this discussion follows that the aggregate demand for informed capital is simply:

$$(9) \quad I_D(\beta) = N[G(\bar{A}) - G(\underline{A}(\beta))]\underline{I}_m(\beta).$$

This demand is decreasing in β , since $\underline{I}_m(\beta)$ is decreasing and therefore $\underline{A}(\beta)$ is increasing. The equilibrium value of β , call it β^* , is achieved when the demand for informed capital equals the supply: $I_D(\beta^*) = K_m$.

There are two loose ends that need to be tied up before considering this an equilibrium. The first is that β^* may be lower than the minimum return required to cover the intermediary's monitoring cost c . Given R_m , the most the intermediary is willing to invest is $p_B R_m - c$, else it is better off not participating. Therefore, the minimum value for β is $\underline{\beta} = p_B R_m / (p_B R_m - c)$, which implies $\underline{I}_m(\underline{\beta}) = p_L c / \Delta p$. The expression for $\underline{\beta}$ simplifies to $p_B / p_L > 1$ (curiously, if $c = 0$, then $\underline{\beta} = 1$). If $\beta^* < \underline{\beta}$, then the true equilibrium is $\underline{\beta}$ and the intermediaries will invest their excess funds in the general market (without monitoring). I will rule out this case by assuming that

$N[G(\bar{A}) - G(\underline{A}(p_H/p_L))]p_Lc/\Delta p > K_m$, that is, at the minimum return $\underline{\beta}$, the demand for informed capital exceeds the supply.

The second loose end is that $\underline{A}(\underline{\beta})$ may be greater than \bar{A} , so that at the minimum acceptable return to the intermediary, the amount of funds it is willing to supply, $\underline{I}_m(\underline{\beta})$, is insufficient to make it possible for a firm with assets $A < \bar{A}$ to invest. In other words, $\bar{A} + \underline{I}_u + \underline{I}_m(\underline{\beta}) < I$, or using the definition of \bar{A} , $\bar{I}_u - \underline{I}_u > \underline{I}_m(\underline{\beta})$. The implication in this case is that monitoring is ineffective in furthering investment; firms with assets below \bar{A} are unable to invest even with the help of informed capital and therefore no intermediation will take place. Since $\underline{I}_u = p_H(R - B_M/\Delta p - c/\Delta p)$ and $\bar{I}_u = p_H(R - B_L/\Delta p)$, we have $\bar{I}_u - \underline{I}_u = p_H(B_M - B_L - c)/\Delta p$. There is no basis for making an assumption about the sign of this expression. The existence of an equilibrium with intermediation requires that $p_H(B_M - B_L + c) < p_Lc$, which is condition $\bar{I}_u - \underline{I}_u > \underline{I}_m(\underline{\beta})$ written in an alternative form. Note that since $B_M - B_L < 0$, this condition is always met for a small enough c . When the condition does not hold, intermediation is socially too expensive and will not be used.

The preceding discussion is recorded in:

Proposition 4. Suppose monitoring is valuable ($c < p_H(B_L - B_M)/\Delta p$) and the demand for informed capital exceeds the supply at the minimum rate of return $\underline{\beta} = p_H/p_L$; ie. $(N[G(\bar{A}) - G(\underline{A}(p_H/p_L))]p_Lc/\Delta p > K_m)$. Then there exists an equilibrium, characterized by a rate of return $\beta^* > \underline{\beta}$ on informed capital and a level of intermediary investment $I^* = \underline{I}_m(\beta^*)$ such that:

- (a) If $A \geq \bar{A}$, the firm finances its investment with uninformed capital alone ($\underline{I}_u = I - A$).
- (b) If $I - \underline{I}_u - I^* \leq \bar{A} < \bar{A}$, the firm finances its investment with I^* of intermediary capital and \underline{I}_u of uninformed capital.

(c) If $A < I - \underline{I}_u - I^*$, the firm is unable to invest.

Let me comment on the key features of this equilibrium. The main prediction is that firms with insufficient own capital will either not be able to invest or will have to resort to a more information intensive, and hence more expensive form of financing. I think this is a central, quite robust idea, that holds up well empirically.¹⁴ Most of the financing of small firms and start-ups comes from private sources: own savings, family, friends, venture capitalists and so called "angels" (individuals investing in small private enterprises that are unable to get sufficient financing from other sources). All these lenders typically have some private information either about the entrepreneur or the line of business he is in. Whether they monitor firms in the exact way assumed in the model is less relevant; I could have written the model so that monitoring involves knowledge about the investment alternatives, rather than the ability to exclude some of them (though venture capitalists certainly keep a tight reign on the firms that they finance).

Another key prediction is that financing may often come from several sources. As part (b) shows, those firms that use informed capital will do so to the minimum extent possible, relying on the uninformed to supply the balance. In such a package deal, the uninformed come along only on condition that the informed take a large enough stake in the firm; the informed must invest their own capital to certify that the firm does not misuse the invested funds.¹⁵ This arrangement is reminiscent of the deals commonly struck in

¹⁴See Hoshi et al (1992) for supporting evidence from Japan.

¹⁵Note that the uninformed investor is not interested in the amount of informed capital as such, but rather in the payoff that the informed receive (R_m), since it is this payoff that determines whether the informed actually wish to monitor. An investment is a sunk cost without direct incentive

financing low-grade investments, for instance, leveraged buy-outs. In leveraged buy-outs, informed capital is represented by a combination of equity, junior debt and convertible debt (so called mezzanine financing). The less informed capital is held by institutional investors mostly in the form of senior debt.

Of course, the model is so abstract that one could give a lot of alternative interpretations to mixed financing. Informed capital could represent bank loans and uninformed capital could be public debt, for instance. If one were seriously interested in understanding the use of specific kinds of capital — venture capital, bank loans, public debt, public equity, and so on — the model would have to be expanded substantially. Here I'm simply interested in making the point that different sources of finance, representing different levels of monitoring, will be used, and that the degree to which more information intensive (monitoring) capital is used, depends on the amount of own capital that the firm has.

To underscore this point, let me briefly mention an extension in which the informed can monitor at different levels of intensity. In the present set up there is monitoring only at one level; monitoring reduces the private benefit to B_M . Assume instead that monitoring can be varied so that the private benefit can be set to any level B at a cost $c(B)$.¹⁶ Naturally, $c(B)$ is a decreasing function of B . In this set-up, the informed will provide

effects. So why would the uninformed investor look at the level of informed investment? Because the level of investment signals that the payoff to the informed (which may well be unobservable to the uninformed) is high enough to induce the informed to monitor.

¹⁶The example I have in mind is that the firm can abscond funds in varying degrees, measured by B . A given level of monitoring intensity assures that at most B can be absconded.

capital in the amount $I_m = p_H c(B) / \beta \Delta p$ and the uninformed will provide $I_u = p_H (R - (B + c(B)) / \Delta p)$.¹⁷ It is relatively easy to see that a firm with own capital A will choose to be monitored at the minimum level necessary to attract the balance of funds $I - A$ (some firms may still be unable to attract funds, because at high enough levels of B , the cost of financing becomes prohibitively expensive). This way they can minimize the use of informed capital, which costs more. The upshot is that better capitalized firms will choose less information intensive financing and intermediaries which engage in less intensive monitoring will hold a smaller stake in the firms they monitor.¹⁸ Despite the fact that it is impossible in this abstract model to associate varying degrees of monitoring with different types of intermediation observed in the real world, this result points out an important logical association between a firm's net worth, the information intensity of its financing, and the intermediary's stake in the firm. Whatever the precise forms actual financing takes, this general principle is a useful guide.

While the model above is static, I don't think it is imprudent to speculate on how a dynamic version of the model would play itself out. Firms starting off with little wealth will initially have to depend on more informed capital and more intensive monitoring. As firms mature and accumulate wealth,

¹⁷The reader can check that even though monitoring intensity varies across firms, the return on informed capital is β , independently of the level of monitoring intensity.

¹⁸In the original model with just one level of monitoring, firms with assets above $\underline{A}(\beta)$ but below A , were all forced to take on the same minimum level of informed capital $\underline{I}(\beta)$. Here the level of informed capital varies inversely with the firm's assets.

they can be expected to switch to cheaper forms of financing.¹⁹ Informed capital will exit as the financial condition of the firm improves. Thus, firm financing will have a life-cycle in which over time and assuming success, firms shift from using more information intensive to using less information intensive capital. This is consistent with the fact that established firms tend to rely more on public debt as well as self-financing. It also fits the typical pattern of venture capital deals, where after a fixed period of time the venture capitalist liquidates his position, usually thorough an initial public offering. A related phenomenon is observed in financial markets, where arbitrageurs hold their capital tied in investments only as long as they enjoy an informational advantage.²⁰ In all cases the intuition is the same, namely that expert capital should be used only where its monitoring value warrants the extra cost.

The logic of the static model indicates that in a dynamic extension, intermediary capital will grow along with firm capital. As firms succeed, not only will firms become better capitalized, but intermediaries will, too. As K_m increases, the cost of informed capital (β) will be reduced, lowering the minimum level of assets needed for investment ($\underline{A}(\beta)$) and increasing the demand for uninformed capital. Whether the interaction between intermediary capital growth and firm capital growth will be able to explain the well known fact that intermediation and credit grow disproportionately with the size of the economy is an open question. The main point I'm making here is that the demand

¹⁹Diamond (1991) describes a dynamic model in which firms switch from bank lending to bond issues as they acquire a higher reputation. Reputation, of course, is a form of capital, so the idea is very similar.

²⁰See Shleifer and Vishny (1990) for a related explanation of the short horizon of arbitrageurs. They do not explain why arbitrageurs have limited capital, a necessary ingredient in explaining their desire to exit.

for information services depends on the level of capitalization, not just of firms, but also of intermediaries, and that balanced growth requires them to expand in tandem.

Let me illustrate some of these ideas by applying them to the current situation in Finland.²¹ In the recent severe Finnish recession banks and firms lost large portions of their own capital. This came about because real interest rates were pushed sky-high by the central bank in an effort to defend the currency (its efforts failed, of course). As a consequence, asset prices experienced a catastrophic drop; real estate values fell by 50% and the stock market by 60% in less than two years. All the major banks had to be bailed out by the government as a large number of firms went bankrupt or were unable to service their debts. This sad episode caused a massive redistribution of funds from the informed (equity holders) to the uninformed (debt holders), putting Finland in a situation of capital shortage that is somewhat reminiscent of that in Eastern Europe. As the principles described above suggest, firms have had a hard time getting new funds, because banks have been reluctant to lend against insufficient collateral. Small, poorly capitalized firms have suffered the most. They have been bitterly complaining about being left to their own devices (mostly going bankrupt), because of the banks' stringent collateral requirements. This is precisely what the basic model would predict; when K_m and A fall, $\underline{A}(\beta)$ will go up, squeezing small firms out. A second development is that banks have come to realize that they must shift to more information intensive financing, now that firms are capital poor. They are hiring corporate analysts and expanding their corporate departments in order to be able to investigate which risks are worth taking and which are not,

²¹The description applies also to Sweden.

recognizing that lending against less collateral will be necessary in the future.²² This shift in monitoring also accords with the model logic.

A final issue worth discussing is this: what determines the supply of intermediary capital? Why can't intermediaries raise as much funds as they want from the uninformed market and thereby expand their financing capacity?²³

In Diamond's (1984) original model on intermediation, intermediaries face no capital constraints. Even if they have no initial capital of their own, they can attract as much deposits as they need to in order to finance all firms in the economy. The reason for this is that intermediaries in his model are assumed to invest in small, stochastically independent projects. By the law of large numbers, diversification overcomes the restrictions placed by limited liability.²⁴ This sounds like a good model of banking, since banks are indeed highly diversified and attract large amounts of deposits.

But on second thought the result is problematic. It suggests that a single bank could handle the whole economy and that collateral plays no role in financing investments. Both implications are counterfactual. More troubling still, it doesn't explain why firms couldn't diversify themselves

²²In addition to commercial banks, investment banks and venture capitalists have also responded to the call for more information intensive financing.

²³An alternative interpretation of the model I have described has the uninformed invest their money indirectly via the intermediary rather than directly in the firm. The amount of uninformed capital that an intermediary can raise is constrained just as before by the intermediary's own capital.

²⁴It is easy to see that if the firm in section 3 could invest in two independent, half-sized projects (I/2) rather than in a single full-sized project (I), then the required amount of own capital in (5) will be smaller. As the number of projects grows large, the required amount of capital goes to zero.

and avoid intermediation altogether; or why the whole economy couldn't be a single firm.²⁵ I can think of two reasons why reality looks different from Diamond's prediction. One is that different intermediaries specialize in different information, determined by their location (regional banks) or by their expertise in a particular industry (the case with firms). The other is that the diversification argument breaks down if one assumes that the intermediary can choose to concentrate its investments and not in fact diversify.²⁶ The two arguments are, I believe, related. Where firms and banks invest depends on what they are experts on. Firms that develop expertise in a particular industry, will be induced to invest in that industry. Their investments will tend to be correlated, preventing them from taking advantage of diversification (at least fully). By contrast, banks invest in more shallow, but general expertise, allowing them to diversify.²⁷ Thus, banks and firms divide the tasks of intermediation and information gathering in a way that complements each other.

Nothing of this sort is going on in the model I have described. In my model intermediaries don't diversify. All their investments are perfectly correlated, which is why they need to put their own capital at risk. Diamond's

²⁵As Diamond recognizes, a firm is itself an intermediary.

²⁶Again, this can be easily verified. In the earlier described case where the firm invests in two half-sized projects, if these half-sized projects are perfectly correlated, then the required amount of own capital rises back to the level in (5). Interestingly, the same is true if the firm can observe the outcome of the first project before it makes its investment decision on the second project.

²⁷Bank regulations affect the degree of diversification. Some regulations require that banks not hold too much of their loan portfolio in risky ventures. Other regulations restrict banks from entering certain segments of the market. These regulations appear to be driven by the presence of deposit insurance and by anti-trust concerns.

and my assumptions are equally extreme. It would be important to analyze intermediate cases that would test the consistency of the logic I just described, where the tasks of monitoring are divided between intermediaries and firms and the division of tasks is matched by the degree of diversification.

The relevance of this discussion for the subject at hand is that the division of tasks may well be ambiguous. As seems to be the case in reality, there are many viable hierarchies of intermediation, some where banks take a more active role and some where they are more passive. Over time, and across economies, different systems have been used. The important thing may not be which choice is made among many, but that whatever choice is made, is made in a way that recognizes the complementarities between information acquisition, task division and contractual forms used to provide incentives.

6. Summary and some lessons for Eastern Europe.

In this final section I want to reflect briefly on the funding problems facing Eastern Europe from the viewpoint of the preceding analysis. What lessons might one draw?

Certainly, the models are not designed to give detailed advice on policy; for that they are far, too stark. Instead, they are meant to provide a simple conceptual framework, which can give a sense of the likely direction of developments, can help identify key areas to focus on, and can be used as a general sounding board for judging specific issues. I have argued that for this, traditional finance theory is inappropriate, or at least insufficient,

because it doesn't appreciate the difference between financing real investments that are illiquid and buying claims in markets that are liquid. The information economic approach, which focuses on the sources of illiquidity, seems to provide a better alternative.

In the information economic view, the fundamental problem of financing is an information gap between those who have more money than ideas and those who have more ideas than money. Indeed, without any information gap, every asset would be as liquid as money and individual imbalances between money and ideas would be inconsequential; there would simply be no need to seek financing.

There are two main vehicles for matching money and ideas: collateral, which serves to secure investor's funds, and intermediation, which helps bridge the information gap between the two. The value of collateral is determined by its liquidity. The more symmetric the information about the future returns of an asset, the more liquid the asset is, and the better it can serve as collateral. There must be better information about the assets that are pledged as collateral than there is about the ideas that seek funding. Capital formation can be envisioned as a process in which firms (with the help of other intermediaries) keep transforming illiquid prospective returns into liquid proven returns, using collateral as the means of transformation. This view accords well with Knight's conception of the nature of the entrepreneurial firm. Knight argued that the entrepreneur's main function is to take uncertainty and transform it into risk. In the modern language of information economics he would have said that the entrepreneur takes asymmetric information and transforms it into symmetric information, that is, transforms illiquid assets into liquid ones.

Given this vision of investment dynamics, the first message is that an economy short of capital (collateralizable assets), will have particular difficulties in funding investments. Low labor costs, and promising projects are not sufficient to attract funds. A project that can be undertaken by a well capitalized Western firm may be impossible to undertake in a capital poor Eastern European firm, even if labor costs are lower. (Note well: this is not possible according to the traditional theory of finance.) As this example suggests, it isn't just the economy wide amount of capital that matters, either. The distribution of capital is equally important. If capital and ideas are poorly matched, growth will be slower. In the transitional economies of Eastern Europe, this is a major problem, since much of the capital is still in the hands of government, which presumably has little idea of how to employ it efficiently. Redistributing existing capital by privatizing it is therefore a critical and urgent step.

The question how best to privatize productive assets is too large an issue to discuss here at any depth. But there are a few points worth bringing up. The intermediation model suggests that since capital is so scarce, financing of investments will have to be more information intensive. This means that whichever intermediaries will be involved in channeling funds to firms, they will have to take a more active role in monitoring these firms. To give the intermediaries the proper incentives to do so, one has to make sure that they hold a large enough stake in the firms they invest in. I think it is essential that managers of the intermediaries be given substantial rewards for doing well. It is also important that these intermediaries are sufficiently well capitalized. Intermediaries that are poorly capitalized will have distorted incentives to monitor and invest. Even banking is likely

to involve more personal and closely monitored lending than one observes in the West. Consequently, banks need to be better capitalized than the 8% BIS rule requires. Most importantly, though, their permissible range of lending should be restricted to conform with the responsibility that they have for the investment outcomes. If deposit insurance is provided, as I think it should be to improve liquidity, banks must be constrained by regulation.

A big problem with privatizing assets quickly is that there is little information on who the able managers are. Competitive bidding may not be very effective in getting the assets in the right hands, if the most able managers have little capital to offer. Distributing ownership rights widely through vouchers does little to eliminate the problem. In this situation it seems reasonable to rely on many small investment companies rather than a few large ones, since this at least allows experimentation. As evidence comes in, the successful ones will be able to accumulate more capital, or perhaps even be entitled to additional privatized assets as a direct reward. Of course, small intermediaries will not be able to fund large investments. But that seems worth sacrificing for the benefit of more competition and more experimentation.

The fact that collateral plays such an important role in attracting funds suggests that much can be achieved by developing collateral lending. The first step, a seemingly trivial, but in practice quite demanding one, is to put in place a system that records collateral claims.²⁸ The second step is to focus on improving the market liquidity of those assets that can best serve as collateral. The most common form of collateral in the West, the dominant form really, is real estate. Real estate is a good form of

²⁸This was pointed out to me by David Dod.

collateral, because information about its future returns is quite symmetric. It is one of the most potent sources of wealth for entrepreneurs starting up new business. Privatization of real estate will do a lot to make this market more liquid. But also, taxation that favors real estate transactions and investment could have a significant impact. The same goes for stock and bond markets, though I suspect that it will be much harder and of less significance to raise the liquidity in these markets. Note that a rationale for subsidizing asset transactions is the externality between investments discussed in section 4.²⁹

Since information asymmetries are the basic source of problems, another important objective is to narrow the information gap. Part of the gap comes from uncertainty about the future actions of the government: political and legal uncertainties. This is well recognized and I can only join those who have argued the importance of creating political and institutional stability. Given the central role of wealth in creating opportunities for new investment and growth, the right to accumulate wealth, without fearing confiscation, private or public, is surely priority number one. This includes the taxation of capital gains at predictable and reasonable levels, as well as the creation of a corporate legal code that provides understandable rules of conduct.

There are many other ways in which the informational burden on foreign investments can be reduced. One is to provide government guarantees for foreign loans. Intermediaries in particular can benefit from this. It is one of the few ways in which the government can intermediate foreign funds

²⁹The question whether to subsidize retained earnings is more subtle. The benefit is that firms will be induced to invest more of their retained earnings. But the cost is that it impedes transfer of funds across firms. If the allocation of capital is bad, retained earnings should not be subsidized.

effectively. The reason is not that the government has better information than foreigners about the use of funds, though it may. But guarantees eliminate some of the government induced risk that is of concern to foreigners. It is an action that ties the government's hands. Loan guarantees have been the favored approach in Scandinavian countries during their present financial crisis. Banks have been able to maintain their liquidity by obtaining foreign lines of credit, something that they may have found very difficult, or at least more costly, without guarantees.

Another important source of uncertainty is inflation. Money is the most liquid asset, but only as long as its value is predictable. A monetary policy that keeps inflation within acceptable levels is essential. I mention this, not because the recommendation is novel, but because the rationale for such a policy fits with the informational perspective being advertised here.³⁰ More interestingly, contractual models of this kind can be used to analyze the benefits of an active monetary policy that accommodates real, unexpected shocks. It is easy to see that monetary policy can have an effect if contracts are incomplete (which they surely are). As is evident from the current European crisis, monetary policy has dramatically redistributed wealth, a point that is quite relevant for the current discussion. It is much less clear that an accommodating policy can be used to improve matters systematically. Note, however, that parties may deliberately choose nominal contracts over real contracts to allow a third party (most naturally the government) to make implicit adjustments in their contract in response to major events that they cannot foresee at the time of contracting. This could provide a form of risk-sharing that is otherwise unavailable because of

³⁰See Banerjee and Maskin (1991) for more on this.

illiquid capital markets. Indeed, one interpretation of the devaluation policies followed by Scandinavian countries since the W is precisely this. The subject deserves further study.

The final, and perhaps most important message of the analysis is that capital formation is likely to be a slow, incremental process, at least in the beginning, because the capital base is so small. Given the small base, private investments will be geared towards smaller, safer and shorter-term projects. I think appreciating that this is the natural course of events is essential. It can prevent impatient, ill-considered actions, such as trying to force the rate of growth by way of large, glamorous investments backed up by government and foreign funds. There may be good political and distributional reasons for such actions, but on an efficiency basis, such investments are not ones that the preceding analysis would support. Estonia seems to me to be on the right track. The emphasis there is on small and medium sized business. Subcontracting for foreign firms is growing particularly well. Subcontracting does not have the highest potential returns, but it is an informationally less demanding activity and therefore relatively low in contracting costs; apparently an excellent way to attract foreign capital as well as expertise.

Estonia has complained about the funding it has received from the European Bank for Reconstruction and Development, arguing that these loans have been tied to large investments that the country isn't in urgent need of. Estonia would have appreciated the help more, if the funds could have been used for financing smaller firms. I think the instinct is right. As dire as the economic situation is, patience with the speed of recovery will pay off. The logic of liquidity constrained growth argues for letting small firms carry

the brunt of the responsibility for future prosperity.

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