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Investment, Capital Market Imperfections, and Uncertainty

Theory and Empirical Results

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Robert Lensink Hong Bo Elmer Sterken

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1. Introduction

1.1 FIELD OF INTEREST

Both firm-specific and aggregate investment are central objects of study in economic theory. Investment plays a pivotal role in explaining persistent growth. Production growth depends on the growth rate of inputs and the improvement of the quality of inputs, apart from the growth rate of total factor productivity. Accumulation of capital and R&D as the main cause of improvement of the quality of inputs are the most important accountable sources of growth in developed countries. Investment is also important for the explanation of business cycles. About 90 per cent of the fluctuations of output are driven by investment behaviour, although investment barely exceeds 20 per cent of GDP.

Empirical models of investment are notoriously troublesome. For instance, in macroeconometric systems the private investment equations perform badly in terms of variance explained. But also on a microeconomic level it is hard to get a grip on the determinants of investment. The successful empirical determinants of investment are often variables that are not suggested by theoretical models. Liquidity is typically a variable that performs well although it should not according to the traditional investment models. On the other hand, the user cost of capital or Tobin's q is often found to be insignificant although many theoretical models emphasize its importance.

Investment is an old object of study in economics. Important contributions are given for instance by Fisher (1911) and Keynes (1936). There is even an old interest in financial variables explaining investment (see Tinbergen, 1939). But the influential work by Modigliani and Miller (1958) focused the attention of investment models on the asset side of the corporate balance sheet. Neoclassical investment models were developed in the 1960s (see Jorgenson, 1963) and extended to q models by Tobin (1969). But even these models did not provide a proper explanation of firm investment.

In the last decade new insights into investment theory centered around two themes: the effects of uncertainty on irreversible investment and the role of capital market imperfections.

Arrow (1968) addressed the impact of uncertainty on irreversible investment thirty years ago, while Bernanke (1983) is one of the early revivers. The main insight from this literature is that a firm, being uncertain about the future and knowing that it might be hard to resell capital, may benefit from waiting. Waiting can be profitable since it reveals part of the uncertain future states. However, there are also costs of waiting in the form of lost returns on immediate investment. If the gains of waiting exceed the costs of waiting, there is an option value to postpone investment. The seminal recent contributions in this field are by Dixit and Pindyck (1994) in microeconomics and Trigeorgis (1996) in a firm-specific setting.

The second promising new group of investment theories deals with the impact of capital market imperfections on investment. If capital markets are perfect, the financial structure does not affect the costs of investing. However, capital market imperfections due to *e.g.* asymmetric information or agency problems probably cause a wedge between the costs of external and internal wealth. In such a situation firms prefer to finance investment by internal funds. The seminal paper in this line of research is the one by Fazzari, Hubbard and Petersen (1988a) and the review article by Hubbard (1998).

There is a vast amount of literature on both of these new lines of investment theory. However, with the exception of a few empirical studies (*e.g.* Scaramozzino, 1997, and Peeters, 1997), there are virtually no studies available that deal with both new groups of investment theories, let alone try explicitly to combine these two strands of literature. This book tries to partly fill this gap by presenting an extensive overview of both new types of investment theory.

1.2 OUTLINE

The first part of the book deals with investment and capital market imperfections. Chapter 2 reviews the theoretical literature. The aim is to identify the sources of capital market imperfections and to explain how they may affect investment. It is shown that corporate investment becomes sensitive to internal funds in the presence of capital market imperfections. First, the Modigliani-Miller proposition, which assumes perfect capital markets, will be explained. Next, the focus will be on different models of capital market imperfections, such as the contributions by Stiglitz and Weiss (1981), De Meza and Webb (1987), Myers and Majluf (1984), as well as the agency theory. Chapter 3 deals with empirical studies on investment and capital market imperfections. The main problem in the empirical literature is to determine to what extent capital market imperfections cause corporate investment to be sensitive to internal funds. Several classes of reduced form models will be discussed: the accelerator-type and q models, Euler equation models and VAR models. The empirical contributions confirm the importance of internal funds for firm investment. However, there are serious discussions about the relevance of many of the empirical studies. An up to date survey of this discussion will be presented.

The second part of the book deals with investment under uncertainty. Chapter 4 starts with a review of the orthodox studies on investment under uncertainty. The orthodox models assume that investments have to be made immediately: there is no possibility of delaying them. Attention is paid to both static models, without adjustment costs, and dynamic models with adjustment costs. In addition, it is explained what adjustment costs are and how they can be modelled. The chapter surveys three orthodox contributions to the investment under uncertainty literature: Hartman (1972), Abel (1983) and Stevens (1974)-Nickell (1978). It will be shown that investment by a competitive risk-neutral firm is positively affected by uncertainty as long as the marginal productivity of capital is a convex function of prices. Chapter 5 deals with the option approach to investment. In contrast to the orthodox investment models, the option approach to investment under uncertainty emphasizes that investment is irreversible and that there is a possibility of delaying the investment decision in order to obtain more information about the future. Attention will be paid to the contributions by McDonald and Siegel (1986), Bertola (1998), Caballero (1991), Abel *et al.* (1996) and Sarkar (2000). In contrast to the main conclusion of the orthodox models, the option approach to investment shows that an increase in uncertainty may have a negative effect on investment by a risk neutral firm. The main reason is that for irreversible investments an increase in uncertainty probably leads to an increase in the option value to wait and hence delays investment. Chapter 6 deals with empirical studies on the investment-uncertainty relationship by presenting an up to date overview of existing empirical studies. First, it is explained in detail which methods are used in the literature to measure uncertainty. A distinction is made between so-called *ex post* and *ex ante* approaches. Concerning the *ex ante* approaches, the following methods are used:

1. the variance of the normal distribution of the variable itself;
2. the variance of the unpredictable part of a stochastic process;
3. the variance from the geometric Brownian motion, and
4. the (General) AutoRegressive Conditional Heteroskedastic ((G)ARCH) model of volatility.

Ex ante methods derive the proxy for uncertainty from survey data. Next, an overview of empirical studies is presented. It appears that most empirical studies find a negative effect of an increase in uncertainty on firm investment.

Chapter 7 concludes with some suggestions for further research.

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PART ONE

Capital Market Imperfections

2. Investment and Capital Market Imperfections: Theory

2.1 INTRODUCTION

Due to the limited success of existing econometric models in explaining corporate investment, considerable intellectual attention has recently been paid to improving the theory of investment. Different routes are followed in an attempt to come up with more convincing theoretical explanations of corporate investment behaviour. One branch of the profession emphasizes the importance of costly reversibility and uncertainty, while capital market imperfections are the core of analyses within another line of research. This chapter reviews the theoretical work on the relation between financial market imperfections and investment.

The aim of this chapter is to identify the sources of capital market imperfections and to explain how these capital market imperfections may affect investment. Section 2.2 discusses the Modigliani-Miller (MM) irrelevance theorem in the classical world. The MM propositions form a landmark in the literature on corporate finance and have contributed considerably to the theory of investment. The theory of MM refers to the invariance of the value of the firm for its capital structure. However, for the subject matter of this chapter, its main contribution is that it is the theoretical underpinning of the literature arguing that financial structure does not affect the investment decision. In the MM world internal funds and external funds are perfect substitutes. The main assumptions underlying the MM invariance theory, and hence also the separability of the finance and investment decision, are perfect and symmetric information. In the case where information is no longer fully and perfectly available for market participants, the capital structure affects the market value of the firm, so that financial variables may become important determinants of investment. Section 2.3 discusses the economics of imperfection by focusing on information economics and, related to this, agency theory. We review *e.g.* the contributions of Stiglitz-Weiss (1981) and Myers-Majluf (1984). A common feature of all capital market imperfections models is that they result in internal and external funds becoming imperfect substitutes. Section 2.3 identifies the sources of capital market imperfections. How these capital market imperfections may affect investment is discussed in Section 2.4. Section 2.4 will show that the existence of capital market imperfections implies that corporate investment becomes sensitive to the availability of internal funds and that an increase in capital market imperfections negatively affects investment. Section 2.5 concludes this chapter.

2.2 THE NEOCLASSICAL WORLD: MODIGLIANI-MILLER

A company can finance its investment by issuing either equity or debt. However, the return characteristics of both types of finance are totally different. Equity represents ownership in a company. The equity holder receives an uncertain share of the future profit stream of the company. Debt represents a fixed payment to the lender. A debt contract has limited liability, implying that the debt is not fully repaid if the earnings of the firm are insufficient to cover the payments of the debt, *i.e.* if the firm goes bankrupt. Hence, the dividend flow must be non-negative. Due to the different return characteristics of both types of finance one would expect there to be an optimal level of the leverage ratio (debt to equity ratio), which would lead to a maximization of the value of the firm. Surprisingly, however, this is not necessarily the case in a neoclassical world, as was shown for the first time by Modigliani and Miller (1958).

Before explaining the main elements of the theory of Modigliani and Miller, some basic issues related to the neoclassical theory of finance will be discussed. Moreover, we will briefly refer to Fisher's theory of interest since this is one of the most important theories prior to MM.

2.2.1 Neoclassical Principles

In the modern neoclassical theory of finance three pillars are usually mentioned: *arbitrage, optimality*, and *equilibrium*. Arbitrage refers to the notion that the same good or asset has to have the same price in each period in absence of any restrictions, optimality refers to the fact that rational investors strive for optimal returns, and equilibrium relates to the neoclassical idea that markets are cleared by price adjustment at each moment in time. Usually, the Arrow-Debreu economy is seen as the ideal classical world. The Arrow-Debreu world is based on the paradigm of complete markets, implying that there are no restrictions on the amount of contracts people can enter into, and hence any type of risk can be insured. Each possible future state is covered by a so-called Arrow-Debreu security (or state security, state contingent claim).

In case markets are complete, present value prices of investment projects are well defined. In such a setting all shareholders are unanimous and agree that the firm should take the investment decision that maximizes the value of the firm. If markets are not complete, however, present-value prices are not unique: the market alone does not provide a well defined signal for the value of the investment.[1]

2.2.2 Fisher's Theory of Interest

Fisher's (1930) *Theory of Interest* gives the first classical result on finance and production in a one-good economy. Fisher presents a model of a sequence economy without uncertainty over a finite number of periods. There is a short-term bond in each period which enables agents to redistribute their income across time. Each agent is both a consumer and an entrepreneur and has access to a production set. Fisher's main result is known as the *Fisher Separation Theorem*. This theorem states that a firm should determine its production plan so as to maximize the present discounted value of its profit, which implies that the firm's objective function is independent of the preferences of the owner. Furthermore, the theorem implies that the production decision is independent of the financing decision.

2.2.3 The Modigliani and Miller Propositions

The first extension of Fisher's separation theorem to a setting with uncertainty is made by Modigliani and Miller (1958). They show that a firm's financial policy is irrelevant. More precisely, they prove that the market value of a firm depends only on its profit stream and is invariant to its capital structure. Their basic argument is that arbitrage precludes the market value of a firm to be altered by a change in a firm's financial policy when the profit flow is given. In the case where investors have the same financial opportunities as firms, investors can always undo the actions of firms on the financial markets. The following example, which closely follows the original 1958 article of Modigliani and Miller, explains matters.

Assume that there are two companies. Company 1 is an unleveraged firm that finances its expenditures only by common stock. Company 2, on the other hand, finances its expenditures by both common stock and debt. An investor, holding a fraction α of the total outstanding stock of shares (S_2) of company 2, receives a return of:

$$Y_2 = \alpha(X - rD_2) \tag{2.1}$$

where Y_2 is the return from the portfolio, X the expected return on the assets (expected profit before deduction of interest) owned by the company, r the interest rate on debt, and D the market value of debt of company 2. Assume now that the investor sells his shares in company 2, borrows an amount of money on his own account and buys from the proceeds shares of company 1. If the investor borrows an amount equal to αD_2, money available for company

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