GOLDEN RESEARCH THOUGHTS

ISSN: 2231-5063
IMPACT FACTOR : 4.6052(UIF)
VOLUME - 7 | ISSUE - 7 | JANUARY - 2018

ARUN JOSHI'S NOVELS: SHADOWS OF HIS TIMES

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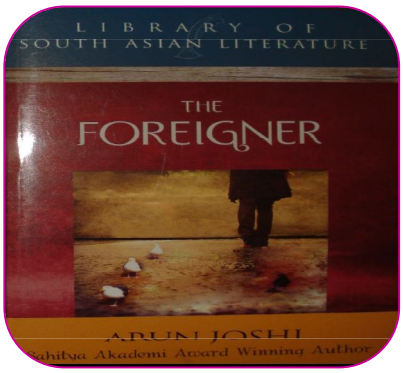
INTRODUCTION

An important problem in the managing of technology is the financing of technological development and innovation. Even in large firms, technology managers often report that they have more projects they would like to undertake than funds to spend on them. There are a number of reasons for this



phenomenon: low expected returns due to an inability to capture the profits from an invention, the uncertainty and risk associated with the project, and over-optimism on the part of managers. This chapter reviews these arguments in more detail and considers the evidence, both theoretical and empirical, on the extent of the Problem

RESEARCH AND DEVELOPMENT AS INVESTMENT

From the perspective of investment theory, innovation investments have a number of Characteristics that make them different from ordinary investment. First and most importantly, in practice fifty per cent or more of the R&D portion of this investment is the wages and salaries of highly educated scientists and engineers. Their efforts create an intangible asset, the firm's knowledge base, from which profits in future years will be generated. To the extent that this knowledge is "tacit" rather than codified, it is embedded in the human capital of the firm's employees and is therefore lost if they leave or are fired. This fact has an important implication for the conduct of R&D investment. Because part of the resource base of the firm itself disappears when such workers leave or are fired, firms tend to smooth their R&D spending over time, in order to avoid having to lay off knowledge workers. This implies that R&D spending at the firm level typically behaves as though it has high adjustment costs (Hall, Griliches, and Housman, 1986; Latch and Schankerman, 1988), with two consequences, on substantive and one that affects empirical work in this area. First, the equilibrium required rate of return to R&D may be quite high simply to cover the adjustment costs. Second, and related to the first, is that it will be difficult for empirical studies to measure the impact of changes in the costs of capital on such investment, because such effects can be weak in the short run due to the sluggish response of R&D to any changes in its cost. The natural starting point for the analysis of any type of investment financing is the "neo-classical" marginal profit condition, suitably modified to take the special features of R&D into of capital equal to the pre-tax rate of return on

The user cost formulation directs attention to the following determinants of R&D financing:

1. Tax treatment such as tax credits, which are clearly amenable to intervention by
2. Policy makers.
3. Economic depreciation δ, which in the case of R&D is more properly termed

4. Obsolescence. This quantity is sensitive to the realized rate of technical change in the industry, which is in turn determined by such things as market structure and the rate of imitation. Thus it is difficult to treat has an invariant parameter in this setting.
5. The marginal costs of adjusting the level of the R&D program.
6. The investor's required rate of return. The last item has been the subject of considerable theoretical and empirical interest, on the part of both industrial organization and corporate finance economists.

CAPITAL STRUCTURE AND R&D

In the view of some observers, the leveraged buyout (LBO) wave of the 1980s in the United States and the United Kingdom arose partly because high real interest rates meant that there were Strong pressures to eliminate free cash flow within firms (Blair and Litan, 1990). For firms in industries where R&D is an important form of investment, such pressure should have been reduced by the need for internal funds to undertake such investment and indeed Hall (1993, 1994) and Opler and Titman (1993) find that firms with high R&D intensity were much less likely to do an LBO. Opler and Titman (1994) find that R&D firms that were leveraged suffered more than other firms when facing economic distress, presumably because leverage meant that they were unable to sustain R&D programs in the fact of reduced cash flow.

TAXES AND SOURCES OF FUND

Tax considerations that yield variations in the cost of capital across source of finance havebeen well articulated by Acerbic (1984) among others. He argued that under the U.S. tax system during most of its history the cost of financing new investment by debt has been less that of financing it by retained earnings, which is in turn less than that of issuing new shares. If dividends are taxed, financing with new shares is more expensive than financing with retained earnings because the alternative use of such earnings is paying out as taxable dividends. And except for the unlikely case where the personal income tax rate is much higher than the sum of the corporate and capital gains rates, debt financing will be the expensive source of funds because the interest is deductible at the corporate level.

EXAMPLES OF INNOVATION TO AVOID TAXES AND REGULATION

Miller (1986) places great emphasis on the role of taxes and government regulation in stimulating financial innovation. modigliani and miller (1958) explicitly considered taxes as a reason to prefer one type of security over another, despite that corporation and investors should be indifferent to capital structure in the fraction less world.

The development of checking accounts at U.S. bank was in order to avoid punitive taxes on state bank notes that were part of the national banking act.

Some investor use total return swaps to convert dividends in to capital gains, which are taxed at a lower rate.

Many times, regulators have explicitly discouraged or outlawed trading in certain types of financial securities. In the United States, gambling is mostly illegal, and it can be difficult to tell whether financial contracts are illegal gambling instruments or legitimate tools for investment and risk-sharing. The commodity futures trading commission is in charge of making this determination. The difficulty that the Chicago board of trade faced in attempting to trade futures on stocks and stocks indexes is described in me lamed (1996)

In the United States, regulation Q drove several types of financial innovation to get around its interest rate ceilings, including Eurodollars and NOW accounts.

The role of technology in financial innovation

Some type of financial innovation is driven by improvements in computer and telecommunication technology for example; Paul Volcker suggested that for most people, The creation of the ATM was a greater financial innovation than asset-backed securitization. Other types of financial

innovation affecting the payments system include credits and debit cards and online payments systems like PayPal.

These types of innovations are notable because they reduce transaction costs. Household need to keep lower cash balances- if the economy exhibits cash-in-advance constraints then these kinds of financial innovations can contributes to greater efficiency. Alvarez and Lippi (2009), using data on Italian household' use of debit cards, find that ownership of an ATM card result in benefits worth 17 annually.

These types of innovations may also have an impact on monetary policy by reducing real household balances. Especially with the increased popularity of online banking, household are able to keep greater percentages of their wealth in non-cash instruments. In a special edition of 'International Finance' devoted to the interaction of electronic commerce and central banking, good hart(2000) and Woodford (2000) express confidence in the ability of a central bank to maintain its policy goals by affecting the short-term interest rate even if electronic money has eliminated the demand for central bank liabilities, while Friedman (2000) is less sanguine.

CRITICISM

Some economists argue that financial innovation has little to no productivity benefit: Paul Volcker states that "that is little correlation between sophistication of a banking system and productivity growth, that there is no "neutral evidence that financial innovation has led to economic growth" and that financial innovation was a cause of the financial crisis of 2007-2010, while Paul Krugman states that "the rapid growth in finance since 1980 has largely been a matter of rent-seeking, rather than true productivity.

SMALL FIRMS,STARTUP FINANCEAND VENTURE CAPITAL

As should be apparent from much of the preceding discussion, any problems associated with financing investments in new technology will be most apparent for new entrants and startup firms. For this reason, many governments already provide some of form of assistance for such firms, and in many countries, especially the United States, there exists a private sector "venture capital" industry that is focused on solving the problem of financing innovation for new and young firms. This section of the paper reviews what we know about these alternative undoing mechanisms, beginning with a brief look at government funding for startups and then discussing the venture capital solution

CONCLUSION

Based on the literature surveyed here, what do we know about the costs of financing innovation investments and the possibility that some kind of market failure exists in this area?

Several main points emerge:

There is fairly clear evidence, based on theory, surveys, and empirical estimation, that small and startup firms in R&D-intensive and high technology industries face a higher cost of capital Than their larger competitors and then firms in other industries. In addition to compelling Theoretical arguments and empirical evidence, the mere existence of the VC industry and the fact.

That it is concentrated precisely where these startups are most active suggests that this is so. In spite of considerable entry into the VC industry, returns remain high, which does suggest a high required rate of return in equilibrium (Upside 2001). The effectiveness of government incubators, seed funding, loan guarantees, and other such policies for funding R&D deserves further study, ideally in an experimental or quasi-experimental setting. In particular, studying the cross-country variation in the performance of such programs would be desirable, because te outcomes may depend to a great extent on institutional factors that are difficult to control for using data from within a single country.

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