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How national and international financial development affect industrial R&D [☆]

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ABSTRACT

We examine the impacts of both domestic and international financial market development on R&D intensities in 22 manufacturing industries in 18 OECD countries for the period 1990–2003. We take account of such industry characteristics as the need for external financing and the amount of tangible assets. Multiple forms of domestic financial development are important determinants of R&D intensity but only foreign direct investment is significant among alternative measures of international financial development. We find the strongest effects for private bond-market capitalization, while FDI, private credit by banks, and stock-market capitalization have similar effects in terms of magnitude.

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1. Introduction

One of the most fundamental issues in economic development is how important the maturation and deepening of financial markets are for growth. This issue has been much debated since its reintroduction into the literature by King and Levine (1993). According to Levine (2005), a consensus has been reached that more developed domestic financial markets stimulate economic growth. Presumably this linkage stems from firms gaining better access to credit, which allows easier financing of investment projects, in turn leading to productivity growth. At a deeper level, however, it is important to study the specific channels through which access to finance enhances economic growth. In this paper we consider one particular type of investment, namely research and development (R&D), and its association with national and international financial market development. It is prominently argued in the literature that more investment in R&D stimulates technological progress, which provides the foundation for the bulk of economic growth (Griliches, 1998; Acemoglu, 2009).

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Our specific focus is to study how endogenous research intensities, defined as industry-level R&D as a share of output, respond to country-wide financial development in industries that rely heavily on external finance or have limited tangible assets. This approach sheds light on whether financially dependent companies are more likely to have higher R&D intensities when national capital markets develop or when there is greater access to international financial markets. If so, financial development and financial access provide key reasons why enterprises in countries with deeper markets invest more in R&D than do their counterparts in other nations. Additionally, industries with low proportions of tangible capital tend to be those with higher proportions of intellectual capital. If the R&D intensities of those sectors also rise with capital-market sophistication then financial development supports higher innovation in knowledge-based endeavors.

Prior work on financing investments at the firm level helps motivate our study (Aghion et al., 2004; Hall and Lerner, 2010). This research has demonstrated that firms first tap internal funds in order to maintain control rights over their innovations. As they need additional capital to fund R&D expenditures; however, they turn to external funds, first accessing bank credit and then equity markets.¹ This apparent hierarchy of finance specific to innovation motivates our explicit consideration of both credit and equity measures, such as liquid liabilities, private credit, stock-market and private bond-market capitalization.

We also include variables that describe international financial market development (portfolio investment, foreign direct investment (FDI) and foreign debt), which has been ignored in this line of research. This is an important consideration as recent work has documented a positive link between the integration of financial markets across countries and economic growth (Eichengreen, 2001; Kose et al., 2009). Nevertheless, very little focus has been placed on whether openness to international capital markets may affect innovation and growth through financing R&D. The standard conception is that FDI is a direct source of technology transfer and may induce greater local innovation through learning spillovers (He and Maskus, in press; Keller and Yeaple, 2010). However, there has been considerable growth in the internationalization of R&D as multinational firms establish research affiliates abroad (Gammeltoft, 2006). Further, affiliates may be financed via a mix of ownership and debt (Kesternich and Schnitzer, 2010). It is therefore of interest to study how access to international financial sources may affect innovation.

Financing constraints may be particularly restrictive for R&D relative to other forms of investment.² According to Brown et al. (2009), innovative firms (those with high R&D expenditures) tend to have few tangible assets that can serve as collateral for credit. R&D expenditures largely go to salaries and wages for scientists and researchers. These human-capital investments cannot be collateralized. Further, firms may wish to protect their proprietary information over innovation, and thus may be unable or unwilling to offer sufficient signals about the effectiveness of their intended R&D programs to credit providers. These issues motivate the inclusion of a measure of asset tangibility into our analysis.

The relationships between innovation and economic growth, and between financial development and economic growth, have been explored in a wide swath of literature. However, there are far fewer studies of the effects of financial development on innovation as a specific channel by which the former may stimulate growth. Aghion et al. (2010) provide one such link with a theoretical model that explores the impact of financing constraints on the composition of investment. Financial frictions may limit economic growth by reducing long-term investment in R&D during economic downturns. Aghion et al. (2008) provide related firm-level evidence. They show that R&D investment is pro-cyclical, rising with firms' sales in the presence of firm-specific credit constraints. This link is particularly pronounced for enterprises with greater external financial dependence and fewer tangible assets.

Using aggregate data, Carlin and Mayer (2003) study the relationship between R&D intensity at the industry level and national institutional variables describing the structure of countries' financial systems. In particular, these authors interact accounting standards, bank concentration and control of voting rights with equity finance dependence, bank finance dependence and skill dependence to look at the effects on growth, fixed investment and R&D investment. They provide initial evidence on the relationship between domestic financial institutions and R&D expenditures, showing broadly that better accounting standards and more developed credit markets positively impact investment in R&D for those industries that rely more on external equity. They find little impact on R&D from the development of equity markets.

Our paper contributes to this literature in several ways. First, we deploy alternative measures of financial development to describe more fully the impacts on R&D intensities of such different dimensions as private credit, stock markets, private bond markets, portfolio investments and foreign direct investment. Second, we derive novel findings based on two classifications of the data: a differentiation between national and international sources of finance and a categorization of financial systems as bank-based or market-based. Third, we calculate the implied impacts of financial development on R&D propensities.

To preview, our findings point to a strong association between domestic financial market development and R&D intensity. However, among sources from the international capital markets only FDI seems to be a major factor in financing research and development. We find significant effects for varieties of both bank-based and market-based financial systems. However, we obtain the strongest effect for market-based (direct) forms of finance. Quantitatively, the R&D intensity of an industry that is heavily dependent on external sources of finance in a country with well-developed

¹ See Myers (1984), Myers and Majluf (1984) and Leland and Pyle (1977) regarding this pecking-order logic for general investments. Harris and Raviv (1991) offer a useful review.

² See Hall (1992), Himmelberg and Petersen (1994), Mulkey et al. (2001) and Bond et al. (2005).

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