



## Do financing constraints matter for R&D?

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### ABSTRACT

Information problems and lack of collateral value should make R&D more susceptible to financing frictions than other investments, yet existing evidence on whether financing constraints limit R&D is decidedly mixed, particularly in the studies of non-U.S. firms. We study a large sample of European firms and also find little evidence of binding finance constraints when we estimate standard investment–cash flow regressions. However, we find strong evidence that the availability of finance matters for R&D once we directly control for: (i) firm efforts to smooth R&D with cash reserves and (ii) firm use of external equity finance. Our study provides a framework for evaluating financing constraints when firms rely extensively on external finance and endogenously manage buffer stocks of liquidity to keep investment smooth, and our findings show that controlling for this smoothing behavior is critical for uncovering the full effect of financing constraints. Our findings also indicate a major role for external equity in financing R&D, highlighting a causal channel through which stock market development and liberalization can promote economic growth by increasing firm-level innovative activity.

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### 1. Introduction

R&D is a critical input for innovation and is thus a main driver of economic growth. One key feature of R&D is that knowledge spills across firms and even countries, suggesting that socially optimal rates of R&D are likely much higher than privately optimal levels (see the survey by Hall et al., 2010).<sup>1</sup> A second important feature of R&D is susceptibility to financing constraints: for several reasons—including lack of collateral value and asymmetric information problems—R&D may face significant adverse selection and moral hazard problems, particularly in younger and smaller firms. For such firms, financing constraints can drive R&D investment below the privately optimal level in a world of no financing frictions. If financing constraints are binding for a sufficient number of firms, country- and world-wide R&D levels will be depressed, leading to lower levels of innovation and growth than would be possible in a world without financing frictions.

Despite R&D's critical role in economic growth and susceptibility to financing difficulties, comparatively few studies evaluate how financing frictions affect R&D, and the results in these studies are decidedly mixed. Furthermore, the evidence supporting economically important financing constraints on R&D is much stronger for U.S. firms compared to European firms, which is a puzzle, as capital markets in the U.S. are at least as developed as those in Europe. For example,

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<sup>1</sup> R&D is now a central element of the endogenous growth literature (e.g., Romer, 1990; Aghion and Howitt, 1992). For evidence on R&D spillovers across countries, see Coe et al. (2009).

early studies by Hall (1992) and Himmelberg and Petersen (1994) report a strong positive relation between R&D and cash flow in U.S. manufacturing firms, and recent studies by Brown et al. (2009) and Brown and Petersen (2009) find a strong link between R&D and *both* internal and external equity finance for young publicly traded U.S. firms. On the other hand, Bond et al. (2003b) find that neither German firms nor U.K. firms display a correlation between the level of R&D and cash flow, and Harhoff (1998) finds a statistically significant but weak relation between R&D and cash flow for small and large German firms. Hall et al. (1999) find that R&D is much more sensitive to cash flow in U.S. firms than in French and Japanese firms, and Mulkey et al. (2001) report a much stronger R&D–cash flow sensitivity for U.S. firms relative to French firms. Finally, Bhagat and Welch (1995) report no evidence of a positive R&D–cash flow link across firms in the U.S., Canada, U.K., Continental Europe and Japan. Hall and Lerner (2010) provide a comprehensive summary of the literature and conclude that it remains an open question whether financing constraints matter for R&D.

In this study, we highlight two issues that are crucial for understanding and identifying financing constraints on R&D. The first issue is firm use of external equity issues to finance R&D. Stock issues have several advantages over debt (e.g., no collateral requirements, investors share in upside returns) for financing risky, intangible investments, consistent with the well-known fact that R&D-intensive firms make little use of debt finance (e.g., Hall, 2002). As a consequence, even though external equity finance may be considerably *more expensive* than internal finance, stock issues are the main marginal source of R&D finance for many firms. Given that firms make heavy use of stock issues primarily during the early stage of their life cycle (when cash flow is low and often negative), stock issues and cash flow tend to be negatively correlated. This implies that not controlling for stock issues will lead to a *downward* bias in the estimated link between R&D and cash flow.

The second issue is that high costs of adjusting R&D spending lead firms to aggressively buffer R&D from transitory volatility in internally generated cash flow. The most plausible way for firms to maintain a smooth path of R&D spending is to build and employ buffer stocks of liquidity (e.g., cash reserves).<sup>2</sup> We emphasize that a firm can display relatively little R&D sensitivity to finance shocks in the short-run (because of smoothing), yet over a longer time horizon be just as constrained as firms not engaging in smoothing. The intuition is that smoothing does not change the long-run availability of finance: cash holdings depleted in the current period to buffer R&D must be rebuilt in future periods, displacing future finance for R&D. If firms do actively smooth R&D from transitory shocks to finance, then within-firm regressions that ignore endogenous liquidity management will very likely generate downward biased estimates of the impact that shocks to finance have on R&D. The potential for downward biases is particularly relevant in Europe, where labor laws can make adjustment costs for R&D especially large. To address this potential bias we directly control for firm smoothing efforts by including *changes* in the firm's stock of liquid assets (cash and equivalents) in the regression specification.

To our knowledge, no previous studies explore how use of external finance and active R&D smoothing with cash holdings impact tests for the existence and importance of financing constraints on R&D.<sup>3</sup> One contribution of our study is to show that accounting for these factors provides a more accurate measure of whether financing constraints matter for R&D and can dramatically alter the conclusions concerning whether financing constraints are important. A second contribution is to provide sharper and more conclusive tests for the presence of binding financing constraints on R&D investment. In particular, if financing constraints matter for R&D, then we should observe: (i) a negative within-firm link between R&D and changes in cash holdings as firms draw on cash reserves for R&D smoothing and (ii) a substantial increase in the estimated impact that *other* financial factors have on R&D when changes in cash holdings are controlled for (revealing more of the long-run impact that access to finance has on investment). As we discuss in detail in the following section, collectively these findings are not subject to standard critiques of financing constraint studies, such as difficulties controlling for R&D investment opportunities.

We study a large panel of R&D reporting firms across 16 European economies for the time period 1995–2007. The summary statistics show that R&D investment is large (e.g., comparable to physical investment), and stock issues are substantial, particularly for younger firms. In addition, young firms maintain large stocks of cash and equivalents. R&D intensity and cash holdings are particularly high for young firms in the U.K. and Sweden, two countries with highly developed stock markets where firms rely heavily on volatile stock issues.

To explore the impact financial factors have on R&D, we modify a dynamic structural model that Bond and Meghir (1994) develop to study fixed investment. We estimate the R&D model using a “systems” GMM estimator that accounts for unobserved firm-specific effects and allows us to address the potential endogeneity of all financial variables. We find little or no evidence that the availability of internal finance matters for R&D in standard specifications that include only cash flow (i.e., the estimated R&D–cash flow sensitivity is near zero), which indicates that a positive link between R&D and cash flow is not occurring simply because of poor demand controls. However, when we include stock issues, and particularly

<sup>2</sup> Several studies show theoretically that cash reserves can benefit firms facing financing frictions. In particular, Acharya et al. (2007) show that firms with “high hedging needs” will prefer building stocks of cash rather than debt capacity as a hedge against cash flow shortfalls. Also see Kim et al. (1998) and Almeida et al. (2004).

<sup>3</sup> This is not to say that prior studies have entirely ignored the importance of external finance for R&D or completely overlooked the potential for firms to smooth R&D. For example, Brown et al. (2009) document a strong connection between public stock issues and R&D investment during the 1990's U.S. R&D boom, and several studies note the potential for adjustment costs to limit the R&D response to transitory finance shocks (e.g., Hall and Lerner, 2010). Brown and Petersen (2011) is the only other study we know of that directly examines the connection between cash reserves and R&D investment in U.S. firms. Their study, however, has nothing to say about the implications of R&D smoothing for identifying the impact that internal and external finance has on R&D. Nor do they (or any other study) discuss how active cash management can generate additional tests for the existence and importance of financing constraints on R&D.

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