Contract enforcement and R&D investment☆

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ABSTRACT

Motivated by the differences in innovation across countries, this paper evaluates the role of contract enforcement for R&D investments. We find empirical evidence that weak contract enforcement is associated with lower R&D investment: R&D intensity in an industry increases with the quality of the judicial system. This effect is particularly strong in industries that cannot buy inputs on competitive markets and thus depend more on contracts to acquire inputs. In line with this, we show that contract enforcement is particularly important in industries in which vertical integration is not a viable option.

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1. Introduction

There is a general agreement that the quality of the legal system influences economic growth and that the proximate cause for economic growth is innovation. Yet, there are only very few empirical studies connecting different legal institutions to innovation. The two major exceptions are the literature on the effect of the patent law for the incentive to innovate and the literature on antitrust and innovation (Lerner, 2009b; Budish et al., 2016; Aghion et al., 2005; Segal and Whinston, 2007). Whether other parts of the legal system affect the extent of innovation in an economy is less well understood, especially empirically. This gap in our empirical knowledge is particular unfortunate given that policy makers around the world try change the legal institutional set-up to increase entrepreneurship and innovation but often fail (Lerner, 2009a).

In this paper we provide evidence that a company's ability to enforce written contracts is an important determinant for its investment in Research and Development (R&D). A company might be unwilling to invest in the development of a new product if a supplier delivering an essential input can ex-post extract all the rents

resulting from a successful research effort. This incentive to under-invest in R&D is mitigated if active markets for the input good exist or if the two companies can write enforceable contracts. In both cases, no hold-up situation can occur and the investment in R&D is optimal (Klein et al., 1978; Williamson, 1979; Grossman and Hart, 1986). In line with this theoretical reasoning we empirically show that the quality of contract enforcement plays an important role for the innovative performance of a country.

To measure the effect of the legal system on innovation we exploit the fact that industries which cannot buy all their inputs on competitive markets rely more on the enforcement of contracts than industries which can. For example, a food producer can buy grain from any company because grain is traded on an active market. If one supplier breaches its supply contract and fails to deliver for the agreed price, the food producer can easily buy its inputs from another source for the market price. In contrast, a car company might only have one or two suppliers to acquire suitable brakes because they are customized and require specialized knowledge to produce. Thus, without contract enforcement, the car company has no other option than to bargain with the supplier because no competitive market for the input exists. As a consequence, the lack of competitive markets opens the possibility for a hold-up type problem, potentially reducing the incentive to invest in innovation for the car company.

As an empirical measure for the degree of contract dependency, we use the share of inputs that companies in a particular industry can buy on an organized exchange or that are reference priced in trade journals. This gives us an indication of how many inputs a company can only source from a few suppliers which might – in the

absence of effective contract enforcement – extract rents from the company after a successful product development. To calculate the contract dependency measure we use a classification of imported and exported goods of Rauch (1999) together with an industry specific input–output matrix. Although the data is for the US only, it seems reasonable to assume that product markets are sufficiently integrated such that all companies in all OECD countries can buy input commodities on the markets in the US. Thus, the degree of contract dependency of an industry is the same for all countries. To proxy the quality of the legal system in a country we mainly use the "rule of law" index of Kaufmann et al. (2007). Data on R&D intensities for 21 industries in 22 countries over 11 years are from the OECD.

In our empirical analysis we find that companies invest more in R&D in countries with better contract enforcement. This effect is stronger in industries that have to rely relatively more on contracts to source inputs. Descriptively, industries in countries with a good legal system have a higher R&D intensity compared to industries in countries with a weaker legal system and this difference is increasing with our measure of contract dependency. In our regression analysis we follow the identification strategy of Rajan and Zingales (1998) and explain R&D investment in an industry by the interaction between the quality of legal institutions and contract-dependency, various control variables and year-, industry- and country fixed effects.

Calculating the effect sizes, we find a quantitatively large impact of the legal system on R&D investment. To illustrate this, suppose that Italy were to improve the quality of its judicial system to the level of Germany. According to our estimates, R&D intensity in the highly contract-dependent car industry would increase by 0.84 percentage points or US$ 400 million while in the low contract-dependent industry of producing food products, R&D intensity would only increase by 0.19 percentage points, or about US$ 240 million.[1] This result is robust for a wide variety of measures for the quality of rule of law, other indicators for innovative activity, different subsamples, and data sources.

In line with the idea that companies try to mitigate the effect of weak contract enforcement, we find that the total effect of the legal system on R&D spending is stronger in industries in which it is harder to vertically integrate. Companies faced with weak legal institutions might choose to vertically integrate with its suppliers, thus substituting legal arbitration with hierarchies. If this approach were to work perfectly, we would find no effect. In practice, there are barriers to mergers and acquisitions. For example, it might be more difficult to completely integrate a value chain if a wide variety of inputs are required compared with the case where just a few inputs are necessary.[2] In line with this reasoning, we find in our data that the influence of rule of law increases with the number of inputs an industry requires.

Using legal origin interacted with contract dependency as an instrumental variable, we show that the measured effect of the legal system is not driven by reverse causality. Glaeser et al. (2001) and Djankov et al. (2003) suggest that common law countries are better at enforcing complicated contracts compared with countries with civil law origin. Legal origin, which was determined hundreds of years ago, might therefore cause exogenous variation in the quality of rule of law independent of R&D investment from 1995 to

2005. The resulting estimate is positive and statistically significant, underlining the importance of the contracting environment for R&D. In line with the expected bias of the OLS estimates, the IV estimates are a smaller than the OLS estimates.

Our study is the first to empirically highlight the importance of contracting institutions and the availability of integrated markets along the supply chain for innovation. It thus offer an additional lever for policy makers around the world trying to change the legal institutional set-up to increase entrepreneurship and innovation (Lerner, 2009a). Thus the study adds to our understanding how the legal system influences innovation through other channels than intellectual property and antitrust law.

The rest of the paper is structured as follows: In the next section we discuss the large literature in economics that documents the systematic relationship between a country's legal system and a large variety of other important factors related to growth. Section 3 describes the dataset as well as the definition and construction of our key variables. In Section 4 we explain the empirical strategy and present the results. Section 5 concludes.

2. Related literature

Closely related to our paper is Nunn (2007) that uses the interaction of contract-dependency with rule of law to study the effect of the legal system on the comparative advantage of nations. He finds that countries trade significantly more if they are able to enforce relationship specific contracts.[3] We extend Nunn's method to study the effect of contract enforcement on the determinants of innovation intensity across countries and thus offer a complementary view on the determinants of the comparative advantage.

Starting with Porta et al. (1997, 1998), a large literature in economics and finance has documented the systematic relationship between a country's legal system and the development and liquidity of its financial markets. This might confound our result, because better financial development lowers capital costs and this might translate into larger incentive to invest in R&D. Indeed, Maskus et al. (2012) use the interaction term of financial development at the country level and external dependence in an industry to identify the positive impact of more advanced capital markets on R&D. However, even after controlling for measures of financial constraints, our effect stays quantitatively the same, pointing again to the distinct causal mechanism of the contracting environment.

Two recent studies in the finance literature also examine the connection of particular legal provisions and innovative activity. Acharya and Subramanian (2009) argue that a more creditor-friendly bankruptcy code creates an environment which is tolerant to failure. Such an environment promotes innovation by encouraging experimentation. Acharya and Subramanian (2009) use the interaction between patent intensity of an industry and creditor rights of a country to identify the effect of bankruptcy laws on patents. Furthermore, Acharya et al. (2014) show that strong employment protection against unfair dismissals leads to more innovative efforts by employees, because it limits employers' ability to hold up employees after an innovation has been successful. Our paper offers a distinct causal mechanism by investigating the effect of the contracting environment, which is quantitatively stable and statistically significant after accounting for differences in creditor rights and employment protection across countries.

More generally, this study adds to the literature on the effect of hold-up type problems on different kinds of investments. A large empirical literature tests and finds the resulting underinvestment problems in a variety of industries such as trucking (Baker

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[1] These numbers are calculated using the IV coefficient with all controls of 1.5. The rule of law index in Italy has the value of 7.46 and in Germany of 8.26. Contract dependency is 0.7 for the car industry and 0.16 for the food industry. In 2005 the investment in R&D of the Italian car industry was US$ 1.05 billion (2.21% R&D intensity) while the food industry invested US$ 100 million (0.08% R&D intensity).

[2] Vertical integration reduces scale and thus increases average costs if its production is associated with some fixed costs. With several inputs produced in-house, the cost position of the company could soon become unfavorable (Nunn, 2007).

[3] In a follow-up study Essaji and Fujiwara (2012) showed that this results holds not only for the quantity but also for the quality of traded goods.