Universität Trier

Spillover Use and Innovation Success: What Role Does R&D Play?

Uwe Jirjahn

Research Papers in Economics
No. 4/12

Spillover Use and Innovation Success:

What Role Does R&D Play?

Uwe Jirjahn

Abstract: Based on data from Germany, this study finds a positive link between using knowledge spillovers from rivals and innovation success in establishments without R&D but not in establishments with R&D. This supports the hypothesis that rivals' knowledge is more valuable to establishments that are below the frontier of technology and product development.

JEL: L60; O31; O32

Keywords: Spillover asymmetry; R&D; Learning; Product innovation.

Address: Prof. Dr. Uwe Jirjahn, Universität Trier, Lehrstuhl für Arbeitsmarktökonomik, Universitätsring 15, 54286 Trier, Email: jirjahn@uni-trier.de.

1. Introduction

Knowledge spillovers play an important role in economics. Endogenous growth models assume that if the knowledge produced by individual firms spreads industry-wide, firm performance throughout the whole industry is enhanced (Grossman and Helpman 1990, Romer 1986). However, it is not clear that all firms benefit from knowledge spillovers. The relationship between spillover use and innovation success may vary according to circumstances and types of firms. This study examines whether R&D plays a moderating role.

Theory suggests two contrarian hypotheses on the moderating influence of R&D. Cohen and Levinthal (1989) argue that R&D enhances a firm's absorptive capacity so that the firm is more able to exploit outside knowledge. This implies that the use of knowledge spillovers from rivals should have a stronger effect on innovation success if the firm undertakes R&D. Transferred outside information may be fragmentary and incomplete. To the extent R&D helps the firm fill the gaps, it makes it easier to use rivals' knowledge for successfully launching new products.

In contrast, contributions by Jovanovic and MacDonald (1994) and Eeckhout and Jovanovic (2002) imply that using rivals' knowledge should have a stronger effect on the innovation success of firms without R&D. The basic hypothesis is that knowledge spillovers from rivals are less valuable to research-intensive firms that are closer to the frontier of technology and product development. The more a firm knows the less it has to learn from other firms. Firms without R&D are below the frontier. They have to learn a lot from other firms. Therefore, knowledge spillovers from rivals are more valuable to firms without R&D. Jirjahn and Kraft (2011) argue that these firms primarily exploit

outside knowledge for incremental innovations that are closely related to their existing products. Learning from rivals is less difficult when a firm already produces products which embody know-how similar to that of its rivals. Thus, complementary experience may ensure absorptive capacity even without R&D.

Using data from manufacturing establishments in Germany, this study uses the percentage of sales generated by new products as a measure of innovation success. The estimates show that using spillovers from rivals is a positive determinant of innovation success in establishments without R&D. No significant influence can be found in establishments undertaking R&D. The findings support the hypothesis developed by Jovanovic and MacDonald (1994) and Eeckhout and Jovanovic (2002). This study complements an examination by Jirjahn (2007) who shows that research intensity is negatively associated with the use of spillovers.

2. Data and Variables

The analysis is based on the Hannover Firm Panel, a four-wave panel with representative data from manufacturing establishments in the federal state of Lower Saxony (Gerlach et al. 2003). Interviews were conducted by Infratest Sozialforschung, a professional survey institute. The data were collected on the basis of a questionnaire in personal interviews with the owner or top manager. The Volkswagen Foundation provided financial support. A nucleus of themes was addressed annually. Additional topics were sampled in successive waves. This study uses the second wave which was conducted in 1995.

The dependent variable is the percentage of the establishment's sales in 1994 generated by new products launched by the establishment in the same year. The variable

is equal to 0 if the establishment did not launch any product innovation in 1994. The advantage of the dependent variable is that it not only measures the establishment's innovation activities but also the success of these activities. If new products meet the demands of customers, they generate higher sales so that the share in the establishment's total sales is larger. The average percentage of sales generated by new products is 4.78 percent. It is 2.78 percent for establishments without R&D and 7.47 percent for establishments with R&D.

The first key explanatory variable is a dummy equal to 1 if the establishment observes rivals to get ideas for product development. 39 percent of the establishments report that they get innovative ideas by observing rivals. This indicator has two advantages. First, it is a firm-specific measure, allowing for heterogeneity among firms (Cassiman and Veugelers 2002). It captures the importance of incoming spillovers for the establishment and takes into account that establishments may differ in their use of spillovers. Usually spillovers are indirectly measured by the total pool of external knowledge that is potentially available. Such aggregate indicator ignores that firms are heterogeneous with respect to the use of the potentially available knowledge (Knott et al. 2009). Second, the total pool of external knowledge is typically calculated at the industrial level. Aggregated industrial codes often combine detailed industries with very different market structures. A firm-specific measure does not involve the problem of assigning firms to industries based on aggregated industrial codes.

The second key explanatory variable is a dummy equal to 1 if the establishment conducts R&D. 43 percent of the establishments conduct R&D. Even though establishments can undertake innovation activities without R&D (Brouwer and

Kleinknecht 1997), a positive influence of R&D on innovation success can be expected as R&D reflects more systematic innovation activities. Most importantly in our context, R&D may moderate the relationship between using knowledge spillovers and innovation success. This moderating role can be examined by running separate regressions for establishments with and without R&D.

The dataset provides a rich set of control variables. Variables for innovative suggestions from customers and suppliers capture the use of other sources of outside information. Furthermore, a variable for a market strategy of focusing on a special customer group is taken into account. The percentage of sales generated by exports is also included. The managerial environment is accounted for by variables for managerial profit sharing and innovative ideas from managers. Further training, employer-provided pensions, piece rates, non-managerial profit sharing, and workers' participation in investment decisions capture the HRM strategy. Moreover, industrial relations variables for the presence of a works council and the coverage by a collective bargaining agreement are included (Askildsen et al. 2006). The structure of the workforce is accounted for by the shares of women and blue-collar workers. General establishment characteristics are controlled for by variables for single-establishment status, establishment size, and the legal form. Finally, 13 industry dummies are included.

3. Results

Table 1 provides the estimates. As the dependent variable is a share variable, the Tobit procedure is used. The initial regression (1) with the combined sample of establishments shows that export activities, managerial profit sharing, innovation ideas from managers

and customers, employees' participation in investment decisions, establishment size, and the share of female workers are positive determinants of innovation success. The provision of pensions by the employer is a negative determinant.

Most importantly, the variables for R&D and the use of knowledge spillovers from rivals emerge with significantly positive coefficients. The positive influence of R&D reflects increased and more systematic effort in innovation activities. It confirms that establishments conducting R&D are closer to the frontier of technology and product development. The marginal effect implies that R&D is associated with a 2.6 percentage point higher share of sales generated by new products. For an establishment that would otherwise have the average share of 4.78 percent, this would be a 54 percent increase in innovation success. The positive coefficient on the spillover variable indicates that the use of rivals' knowledge can indeed increase the establishment's innovation success. The question is now whether rivals' knowledge is more valuable to establishment with or without R&D.

Column (2) and column (3) show the results of separate regressions. Using rivals' knowledge is a significantly positive determinant of innovation success in establishments without R&D. No significant influence can be found in establishments with R&D. These findings conform to the hypothesis that rivals' knowledge is more valuable to establishments that are below the frontier of technology and product development. The influence of spillovers in establishments without R&D is not only statistically but also economically significant. Using spillovers from rivals is associated with a 1.4 percentage point higher share of sales generated by new products. Taking into account that the average share is 2.78 percent for establishments without R&D, this implies a roughly 50

percent increase in the success of product innovation.

4. Conclusions

This study finds that using knowledge spillovers from rivals contributes to innovation success in firms without R&D. No influence of knowledge spillovers can be found in firms with R&D. The results support theoretical analyses by Jovanovic and MacDonald (1994) and Eeckhout and Jovanovic (2002). Firms conducting R&D are closer to the frontier of technological and product development. As they have less learn from others, knowledge spillovers are less valuable to them. In contrast, firms without R&D are below the frontier. As they have to learn a lot from others, using rivals' knowledge is important for increasing their innovation success.

The implication is a specialization of firms. Some firms take a leadership role by investing in R&D and producing new knowledge. Other firms take a follower role. Instead of investing in R&D, they specialize in learning from technological leaders. Leaders and followers can coexist if the diffusion of knowledge is incomplete.

Table 1: Determinants of Innovation Success

	Mean	(1) All establishments	(2) Establishments without R&D	(3) Establishments with R&D
Innovation success	4.78	-------	------	-------
R&D[+]	0.43	7.203 [2.600] (3.63)***	------	------
Innovative ideas from observing rivals[+]	0.39	3.758 [1.343] (2.13)**	7.295 [1.407] (2.21)**	1.373 [0.792] (0.69)
Innovative suggestions from customers[+]	0.69	8.849 [2.775] (4.25)***	10.67 [1.728] (3.10)***	9.051 [4.474] (3.26)***
Innovative suggestions from suppliers[+]	0.20	-3.080 [-1.009] (1.44)	-1.943 [-0.319] (0.49)	-2.362 [-1.137] (0.97)
Innovative ideas from managers[+]	0.44	3.017 [1.063] (1.73)*	5.455 [0.993] (1.71)*	1.133 [0.653] (0.56)
Profit sharing for managers[+]	0.42	3.480 [1.232] (1.94)*	9.013 [1.734] (2.64)**	2.258 [1.300] (1.08)
Profit sharing for employees[+]	0.37	-0.598 [-0.206] (0.27)	-2.784 [-0.444] (0.64)	1.209 [0.710] (0.47)
Pension[+]	0.40	-3.494 [-1.189] (1.98)**	-6.454 [-1.035] (1.96)*	-0.823 [-0.474] (0.40)
Piece rates[+]	0.38	-2.632 [0.867] (1.13)	0.641 [0.112] (0.14)	-4.608 [-2.492] (1.79)*
Employer provided further training[+]	0.55	1.695 [0.568] (0.88)	8.083 [1.472] (2.40)**	-2.921 [-1.741] (1.24)
Participation in investment decisions[+]	0.67	3.123 [1.051] (1.70)*	2.131 [0.358] (0.67)	2.859 [1.600] (1.29)
Works council[+]	0.57	1.989 [0.686] (0.87)	2.027 [0.352] (0.52)	5.808 [3.114] (1.91)*
Collective bargaining[+]	0.66	-1.524 [-0.539] (0.73)	1.301 [0.221] (0.37)	-4.428 [-2.664] (1.69)*
Share of blue-collar workers	0.64	-4.448 [-1.548] (0.88)	-6.051 [-1.040] (0.68)	-4.742 [-2.738] (0.75)
Share of women	0.28	14.40 [5.011] (3.14)***	4.286 [0.737] (0.53)	21.98 [12.69] (3.85)***
Number of employees	162.60	0.012 [0.004] (3.06)***	-0.028 [-0.005] (1.41)	0.014 [0.008] (2.37)**
Number of employees squared	48×10^4	-9×10^{-7} [-3×10^{-7}] (2.45)**	2×10^{-5} [3×10^{-6}] (1.84)*	-10^{-6} [-7×10^{-7}] (1.47)
No subsidiaries[+]	0.60	-0.933 [-0.327] (0.52)	-4.471 [-0.821] (1.35)	1.117 [0.645] (0.55)
Exports	13.07	0.099 [0.035] (2.23)**	0.092 [0.016] (0.71)	0.082 [0.047] (1.97)**
Specialization in particular customers[+]	0.29	-2.591 [-0.871] (1.39)	-2.891 [-0.477] (0.87)	-4.303 [-2.359] (1.97)**

Private limited company[+]	0.50	-3.580 [-1.247] (1.55)	-1.817 [-0.313] (0.46)	-5.465 [-3.141] (1.90)*
Limited commercial partnership with a private limited company as limited partner[+]	0.30	-1.835 [-0.624] (0.74)	-5.552 [-0.866] (1.19)	-1.482 [0.847] (0.49)
Constant	------	-23.71 (3.99)***	-21.52 (2.19)**	-15.72 (1.97)**
Industry dummies	------	Yes	Yes	Yes
Log likelihood	------	-1287.73	-499.20	-758.27
Number of observations	641	641	368	273

[+]Denotes dummy variables. Method: Tobit. The table shows estimated coefficients. T-statistics are in parentheses. Marginal effects are in square brackets. *Statistically significant at the 10% level; **at the 5% level; ***at the 1% level.

References

Askildsen, J.E., S.C. Smith and U. Jirjahn. 2006. "Works Councils and Environmental Investment: Theory and Evidence from German Panel Data," *Journal of Economic Behavior and Organization* 60: 346 – 372.

Brouwer, E. and A.H. Kleinknecht. 1997. "Measuring the Unmeasurable: A Country's Non-R&D Expenditure on Product and Service Innovation', *Research Policy* 25: 1235 – 1242.

Cassiman, B. and R. Veugelers. 2002. "R&D Cooperation and Spillovers: Some Empirical Evidence from Belgium," *American Economic Review* 92: 11169 – 11184.

Cohen, W.M. and D.A. Levinthal. 1989. "Innovation and Learning: Two Faces of R&D," *Economic Journal* 99: 569 – 596.

Eeckhout, J. and B. Jovanovic. 2002. "Knowledge Spillovers and Inequality," *American Economic Review* 92: 1290 – 1307.

Gerlach, K., O. Hübler and W. Meyer. 2003. "The Hannover Firm Panel (HFP)," *Journal of Applied Social Science Studies* 123: 463 – 470.

Grossman, G. and E. Helpman. 1990. "Trade, Innovation and Growth," *American Economic Review* 80: 86 – 91.

Jirjahn, U. 2007. "R&D and the Use of Spillovers," *Economics Letters* 96: 84 – 88.

Jirjahn, U. and K. Kraft. 2011. "Do Spillovers Stimulate Incremental or Drastic Product Innovations? Evidence from German Establishment Data," *Oxford Bulletin of Economics and Statistics* 73: 509 – 538.

Jovanovic, B. and G. MacDonald. 1994. "Competitive Diffusion," *Journal of Political Economy* 102: 24 – 52.

Knott, A.M., H. Posen, and B. Wu. 2009. "Spillover Asymmetry and Why It Matters," *Management Science* 55: 373 –388.

Romer, P.M. 1986. "Increasing Returns and Long-run Growth," *Journal of Political Economy* 94: 1002 – 1037.