Bernd Ebersberger / Sören Simon Petersen

Fail(ed) to succeed

110 - Failure

Abstract

The following paper analyzes failure and its impact on a firm's innovation success in greater detail. While there has been a substantial discussion on failure and innovation, failure has often been treated as a "binary" concept: hence, a firm simply succeeded or failed. Nevertheless, in most cases a certain degree of failure will be an immanent aspect of a firm's business. Under the assumption that innovation always goes along with an element of failure, we analyze how a firm's failure rate affects its innovation performance. By analyzing the German wave of the 2011 Community Innovation Survey (CIS) we find robust evidence that failure has a positive impact on a firm's innovativeness up to a certain degree and decreases afterwards. This finding is striking as it shows that a certain level of failure is inevitable to maximize a firm's innovation success.

1. Introduction

Failure is an immanent part of our daily life. Edison's famous quote "I have not failed. I've just found 10,000 ways that won't work" highlights the necessity of failure to succeed. Decades later and rather recently "Fail fast, fail often" has become a Mantra of innovators and entrepreneurs. Interestingly, although failure has lost a lot of its bitter aftertaste, it has received comparatively little attention in academia. Not unlike success, failure can be regarded as a highly complex phenomenon. Consequently, research has addressed the topic from a variety of angles. Deichmann & van Ende (2013), for example, find that failure doesn't necessarily result in a loss of momentum on the individual level, if a person approaches new projects enthusiastically driven by prior success. Ederer & Manso (2013) even show that supporting failure in the beginning of the innovation process combined with the goal of long term success seems to be fruitful in order to foster innovation. Finally, on a more general note, learning from failure might even be more valuable than learning from success (Madsen & Desai 2010).

Taking those findings into account, failure seems to be a fast lane rather than a dead end. Nevertheless, if failure is a necessary part of a firm's success, the question suggests itself: how much should a firm fail in order to maximize its innovative performance? Recently, Leoncini (2016) shows that failure per se has a positive impact on a firm's innovativeness. In this paper we build on Leoncini's findings by deviating from his binary concept of failure. We analyze the percentage of innovation projects that have failed and its impact on a firm's innovative performance. To the best of our knowledge, we are the first to contribute detailed empirical evidence to the topic of how the intensity of failure affects innovativeness. From a managerial point of view, this question is of paramount importance, as it might help managers to evaluate and appreciate the benefits of failure in greater detail. In case of the ongoing academic discussion, a more differentiated picture of failure will help researchers consider failure from a new perspective.

In order to analyze the interrelation of failure and innovative performance, we use the German wave of the 2011 CIS. The CIS provides rich firm level data on innovation behavior and innovation success and has been used by other studies addressing failure related questions (e.g., Lhuillery und Pfister 2009; Leoncini 2016). For the analysis we employ a Tobit-regression model to estimate the effects of a firm's failure rate on its turnover from innovative products controlling for several traditional factor such as size, R&D intensity, and sectoral affiliation that are typically considered to affect innovation performance. In order to do so, the paper is organized as follows. Section 2 discusses the interrelation of failure and innovative performance from a theoretical point of view. Section 3 presents the method and data. The results are presented in Section 4. Finally, Section 5 closes with discussion and conclusion.

2. Theoretical Framework

Failure can be regarded as a substantial part of organizational learning (e.g., Argote & Minor-Spektor, 2008). As discussed in context of their literature review, Madsen and Desai (2010: 453) highlight: "[…] while organizational success leads to stability in organizational knowledge, failure challenges it". In line with this, Madsen and Desai (2010) show that firms actually benefit more from failure than from success. In this paper we build on the positive perception of failure on a firm's success. Hence, we implicitly assume that failure is an essential part of a firm's innovation strategy necessary to leverage its resource base. In this context, Leoncini (2016) empirically shows that failure has a positive impact on a firm's innovation experience as he argues that firms learn from prior events. Nevertheless, it would be naïve to assume a general linear relationship between failure and innovative performance: given the positive effect this would assume that the more a firm fails the higher will be its innovation performance over the whole domain of failure.

While failure seems to be an important resource, high rates of failure might indicate a lack of resources. More precisely, if a firm is failing too much it might not command the capabilities and resources to learn from its prior experiences leading to a lower innovative performance. This argument provides the basis for hypothesizing a non-linear relationship between failure and innovative

performance. Just focusing on the fact that failure is beneficial for a firm without asking why a firm has failed overestimates the benefits of failure in context of a firm's innovative performance. Failure mostly depicts that a firm did not possess the resources, capabilities etc. to successfully complete an innovation project. Hence, failure always comes along with a certain amount of costs (cost directly linked to the failed project but also opportunity costs). Taking that into account, it seems logical to assume that failure has a positive impact on a firm's innovation performance but only up to a certain point until the costs from failure take over. From a theoretical point of view this means that a firm has to push itself and its innovative performance up to a certain point where the positive effects of learning outperform the costs of failure. We also have to bear in mind that a firm's resources are limited. As learning from failure is not an effortless process, firms have to spend resources in order to learn from failed projects. If the number of failed projects exceeds a firm's resources necessary to learn from those, failure is reduced to its costs. Summing up the arguments above, failure and innovative performance should not be characterized as a linear relationship which leads to our main hypothesis:

Hypothesis: The effect of a firm's failure rate (in terms of percentage of innovation projects failed) on its innovation performance is characterized by a curvilinear (inverted U-shape) relationship.

In the following section we will have a closer look at the effects of failure on innovation performance while answering what percentage of a firm's innovation projects should fail in order to maximize its innovation performance.

3. Data and Method

For the analysis of our research question, we use the 2011 CIS. By doing so, we follow previous studies addressing topics in the realms of failure and innovation (e.g., Lhuillery und Pfister 2009; Leoncini 2016). The German version of the CIS is conducted on an annual basis including firms from the manufacturing and service sector with more than four employees. For our analysis, we only focus on innovative firms in the manufacturing sector. Taking into account missing values, this adds up to 1,286 observations. To measure a firm's innovation performance we use the sales share of products new to the world (**INNO.PERF**). This is a standard measure in the literature (Laursen and Salter 2006; Cassiman and Veugelers 2006; Schmiedeberg 2008; Love et al. 2014; Leiponen and Helfat 2010; Garriga et al. 2013; Ballot et al. 2015; Leoncini 2016).

While Leoncini (2016) uses a binary variable to control for failure, we use the percentage of failed innovation projects (**PERC.IPF**). We do so by dividing the number of innovation projects failed by the total number of innovation projects conducted. Furthermore, we control if a firm outsourced its research activities (**EXT.RD**). As shown by Lhuillery and Pfister (2009) as well as Leoncini (2016), R&D cooperation is a relevant determinant when discussing the aspect of project failure/success. We control for innovation collaboration with a dichotomous variable (**KOOP**). Finally, we control for a firm's innovation intensity as the sales share of R&D expenditure (**RD.INT**), its size as the total number of employees in logarithm (**EMP**) and its sectoral affiliation (**SECTOR**). The descriptives are shown in

Table 1 and the correlation statistics are presented in Table 2. On average 8 per cent of the innovation projects of the firms in our sample failed and around 7 per cent of the turnover was generated due to new products introduced to the market.

Table 1 Descriptives

	N	Mean	St. Dev.	Min.	Max.
INNO.PERF	1,286	0.07	0.16	0.00	1.00
EMP	1,286	4.23	1.59	0.69	11.07
RD.INT	1,286	0.09	0.17	0.00	1.29
KOOP	1,286	0.51	0.50	0.00	1.00
EXT.RD	1,286	0.41	0.49	0.00	1.00
PERC.IPF	1,286	0.08	0.14	0.00	0.90

Table 2 Correlation Table

	(1)	(2)	(3)	(4)
(1) INNO.PERF	1.00			
(2) EMP	-0.10	1.00		
(3) RD.INT	0.26	-0.21	1.00	
(4) PERC.IPF	-0.01	0.05	-0.04	1.00

As depicted in Table 2, no obvious correlation between a firm's innovation performance (**INNO.PERF**) and its failure rate (**PERC.IPF**) can be observed. Hence, for more detailed analysis of this relationship we conduct a Tobit-regression controlling for the factors discussed above. The reason why we and other studies (e.g., Laursen and Salter 2006; Schmiedeberg 2008; Love et al. 2014; Leiponen and Helfat 2010; Garriga et al. 2013; Ballot et al. 2015) rely on a Tobit model is that our dependent variable is censored from below at $y_L = 0$ and from above at $y_U = 1$. Taking into account the variables in Table 1 the final model can be described as follows:

$$y^* = \beta_0 + \beta_1 EMP + \beta_2 RD.INT + \beta_3 EXT.RD + \beta_4 KOOP + \beta_5 PERC.IPF + \beta_6 PERC.IPF.2 + \varepsilon$$

where:

$$INNO.PERF = \begin{cases} y^* & y_L < y^* < 1 \\ y_L & y^* \leq y_L \\ y_U & y^* \geq y_U \end{cases}$$

In order to test for an inverted U-shape we include the percentage of innovation projects failed to the power of two (**PERC.IPF.2**).

4. Results

In this section the results of our analysis will be briefly discussed. Table 3 displays the results of our Tobit regression. The dependent variables are the amount of revenue generated by new products (**INNO.PERF**). The results show that the R&D intensity has a positive impact the firm's innovation performance. Likewise, outsourced R&D (**EXT.RD**) positively affects a firm's innovation performance. Surprisingly, firm size has no significant effect.

The variables **PERC.IPF** and **PERC.IPF.2** support our hypothesis that a firm's innovation performance and its failure rate are characterized by an inverted U-shape with a peak at approximately 20% failure.

Table 3 Results Tobit Regression

	Dependent Variable INNO.PERF
EMP	-0.006 (0.006)
RD.INT	0.289*** (0.063)
EXT.RD	0.046** (0.019)
PERC.IPF	0.459*** (0.158)
PERC.IPF.2	-0.974*** (0.354)
Constant	-0.197*** (0.041)
Sector controls	YES
Obs.	**1,286**
Log Likelihood	-449.781
Wald Test (df = 19)	142.914***

Note: Table reports the parameter estimate. Standard errors are in parentheses. *** (**, *) indicate significance at 1% (5%, 10%). Sectoral effects are not reported.

5. Discussion and Conclusion

The main goal of this paper is to analyze how much a firm should fail in order to increase its innovation efficiency. Previous research shows that failure can be regarded as beneficial for a firm's innovative output (e.g., Leoncini, 2016). Building on the 2011 CIS, our results give evidence that failure is beneficial for a firm's innovation performance up to a certain degree (around 20% here) and decreases thereafter. Our results support the recent findings of Leoncini (2016) indicating that failure is an indispensable part of a firm's innovation process. This finding should be of high importance for ongoing academic discussion, and further research has to take into account that failure is a rather

flexible phenomenon which must be operationalized accordingly. From a managerial point of view, our results highlight the importance of supporting failure up to a certain degree in order to be innovative.

One major drawback of our paper is that we are not able to differentiate between the degree of innovativeness of the innovation projects in our analysis. Furthermore, as van der Panne et al. (2003) show in context of their literature review, soft factors like a firm's innovative culture and its experience as well as product and market related factors might have a significant effect on innovation success too. In the context of this study we are not able to control for those. Apart from that, our analysis is based on cross-sectional data which does not allow us to draw strong causal relationships between a firm's failure rate and its innovative performance. In order to do so we have to extend our database by conducting longitudinal data. This would be especially beneficial to strengthen organizational learning. As mentioned by Argote and Miron-Spektor (2001:1123) "[…] organizational learning occurs over time, studying organizational learning requires time-series or longitudinal data". Further research should take those points into account.

References:

Argote, L., & Miron-Spektor, E. (2011). Organizational Learning: From Experience to Knowledge. Organization Science, 22(5), 1123-1137.

Cassiman, B., & Veugelers, R. (2006). In search of complementarity in innovation strategy: internal R&D ann external knowledge acquisition. Management Science, 52(1), 68–82. doi:10.1287/mnsc.1050.0470

Deichmann, D., & Ende, J. Van Den. (2014). Rising from Failure and Learning from Success: The Role of Past Experience in Radical Initiative Taking. Organization Science, 25(3), 670–690. doi:10.1287/orsc.2013.0870

Ederer, F., & Manso, G. (2013). Is Pay for Performance Detrimental to Innovation? Management Science, 59(7), 1496–1513. doi:10.1287/mnsc.1120.1683

Garriga, H., von Krogh, G., & Spaeth, S. (2013). How constraints and knowledge impact open innovation. Strategic Management Journal, 34(9), 1134–1144. doi:10.1002/smj.2049

Laursen, K., & Salter, A. (2006). Open for innovation: the role of openness in explaining innovation performance among U.K. manufacturing firms. Strategic Management Journal, 27(2), 131–150. doi:10.1002/smj.507

Leiponen, A., & Helfat, C. E. (2010). Innovation objectives, knowledge sources, and the benefits of breadth. Strategic Management Journal, 31(2), 224–236. doi:10.1002/smj.807

Leoncini, R. (2016). Learning-by-failing. An empirical exercise on CIS data. Research Policy, 45(2), 376–386. doi:10.1016/j.respol.2015.10.006

Lhuillery, S., & Pfister, E. (2009). R&D cooperation and failures in innovation projects: Empirical evidence from French CIS data. Research Policy, 38(1), 45–57. doi:10.1016/j.respol.2008.09.002

Love, J. H., Roper, S., & Vahter, P. (2014). Learning from openness: The dynamics of breadth in external innovation linkages. Strategic Management Journal, 35, 1703–1716. doi:10.1002/smj.2170

Madsen, P. M., & Desai, V. (2010). Failing to learn: The effects of failure and success on organizational learning in the global orbital launch industry. Academy of Management Journal, 53(3), 3–5. doi:10.5465/AMJ.2010.51467631

Schmiedeberg, C. (2008). Complementarities of innovation activities: An empirical analysis of the German manufacturing sector. Research Policy, 37(9), 1492–1503. doi:10.1016/j.respol.2008.07.008

van der Panne, G., van Beers, C., & Kleinknecht, A. (2003). Success and Failure of Innovation: a Literature Review Gerben. International Journal of Innovation Management, 7(3), 309–338. doi:10.1142/S1363919603000830