E C O N O M I C S B U L L E T I N

Heritage and Firm Survival - An Analysis of German Automobile Spinoffs 1886-1939

Kristina von Rhein
Max Planck Institute of Economics

Abstract

The theory predicts that spinoffs of successful parents are more successful than others. The success of the parents can be measured in two ways, either in terms of their survival duration or concerning their innovative activity. In this paper, the survival chances of spinoffs in the German automobile industry regarding the success of their parents will be investigated. Therefore it is differentiated between spinoffs of old parents and spinoffs of innovative parents. The results of the Cox regressions show that spinoffs of old parents have better survival chances than those of innovative parents.

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1 Introduction

The evolution of an industry can be theoretically explained by the model of Klepper (1996). In this model the knowledge of firms is considered the crucial criterion of firm survival. It is therefore important to examine knowledge as a determinant of firm survival. Following Klepper (1996), Cantner et al. (2005, 2008) investigate the influence of three different knowledge components, namely pre-entry experience, post-entry experience, and innovative activity. Pre-entry experience is the knowledge that diversifiers and spinoffs already have at the time of entry. Post-entry experience is the experience that firms accumulate during their operation in the market (measured by their survival duration) and innovative activity can be measured by the number of patent grants of a firm.

The focus of this paper is on spinoffs. In this context Klepper (2001) differentiates four theoretical perspectives. Of these, only employee learning theories are relevant for our discussion that address the role of spinoffs learning. Agarwal et al. (2004) point out that spinoffs of successful parents are more successful than other spinoffs. Klepper and Sleeper (2005) argue that spinoffs inherit knowledge and skills from their parents. The inherited knowledge is related to the market, the technology, and possibly an innovation. Furthermore, it is assumed that spinoffs adopt efficient routines from their parents which in turn improve their survival chances even more (Klepper, 2007; Boschma and Wenting, 2007). For a better understanding of spinoffs' higher survival chances (compared to other entrants, see Klepper (2002*a*)) it is necessary to distinguish between different kinds of inherited knowledge. However, to the best of my knowledge no empirical study exists that does this. The present paper aims to close this gap.

2 Routines vs. Innovative Activity

Klepper (2001) suggests that inherited knowledge can be divided into two categories. The first is the post-entry experience of the parent firm. For a firm to survive a long time, it must be profitable and endowed with efficient routines, for example, concerning organizational structures or the production process. According to Nelson and Winter (1982, p.124), such routines are: *"... the skills of an organization."* and can be interpreted as the know-how to make a decision depending on the state of the environment and to guarantee an efficient work-flow. For the Danish manufacturing industry in the period 1984 to 1996 Dahl and Reichstein (2007) found that spinoffs with still existing parents have higher survival chances. One possible explanation is that all parents inherit routines, but that surviving parents provide the more efficient ones. Therefore, more efficient routines will be inherited from successful parents.

Moreover, Klepper (2001) proposes that spinoffs of innovative parents inherit the innovative knowledge of their parents. Thus, it is also possible that spinoffs learn to innovate or develop innovative routines (Pavitt, 2002; Nelson and Winter, 1982) and conceivable that a spinoff exploits an innovation the parent does not produce itself (Klepper and Sleeper, 2005).

This paper examines the survival chances of different kinds of spinoffs in the German automobile industry between 1886 and 1939. The used data set is the same as in Cantner et al. (2005, 2008). To estimate the influence of parents' success on the survival duration of their spinoffs, the Cox regression model (Cox, 1972) is applied. As explained above, the success of the parents can be measured either in terms of their survival duration[1] or in terms of their innovative activity. In the German automobile industry, 37 spinoffs existed between 1886 and 1939, but unfortunately information about the parent firm is only available for 33 of them.[2] Of the 33 spinoffs with complete data sets, 24 firms originate from innovative parents with 66 patents on average.[3] The average survival duration (truncated in 1939)[4] of the parents is 24.7 years.

In this paper an analysis that based on the complete data set of all firms in the German automobile industry between 1886 and 1939 is presented. The results of the Cox regressions are reported in table I. There are eight explanatory variables in the analysis. The experience variables (E_1 to E_3 and P) are chosen according to Klepper (2002*b*) and Cantner et al. (2006). To measure the influence of the time of entry, the firms are divided into several entry cohorts.[5] The first three explanatory variables E_1 to E_3 are dummy variables for the first three entry cohorts. Furthermore, dummy variables P for the pre-entry experience in general and Sp for the spinoffs are included.

A further explanatory variable is the survival duration of the parents, denoted by Y_{PARENT}. Given the survival duration as an indicator of firm success, efficient routines will be inherited from long-living parents. Therefore, the whole duration (up to and including 1939) of the parent is taken into account and not only the duration up to the market entry of the spinoff. The last two variables measure the innovative activity of the parent firm. These are the number of patent grants of the

[1] Relevant for the duration analysis is the number of years a firm actually produced automobiles and not the years it actually existed.

[2] For firms with more than one parent the most successful parent firm is chosen for the analysis.

[3] The high number of patents can be explained by the fact that the most successful firms, holding many patents, spawn more than one spinoff.

[4] It is necessary to truncate the data in 1939 because some firms were destroyed in World War II: their survival duration was limited, but not for economic reasons. Therefore, to avoid biased results, it is valid to truncate the survival duration of all firms that survived beyond 1939.

[5] Here the 15/15 rule of Klepper (2002*b*) is chosen to classify the firms. Accordingly, in every entry cohort no less than 15 firms survived at least 15 years.

parent, denoted by PAT_{PARENT}, and the associated dummy variable, denoted by $DPAT_{PARENT}$, for parent firms that hold at least one patent. The dummy variable merely indicates if a parent firm is innovative or not.

In table I, six models with different explanatory variables are estimated. Model (A) contains variables for the entry cohorts, for pre-entry experience and for the spinoffs. As reported in Cantner et al. (2006), the coefficients for the entry cohorts are significantly negative and show decreasing magnitudes from E_1 to E_3. This indicates that firms which entered the market earlier experience a reduction of the hazard rate and exhibit better survival chances. The older the entry cohort, the higher are the survival chances of firms that belong to that cohort. Firms that entered the market with pre-entry experience gain a further reduction of their hazard rates, as shown by the significantly negative coefficient for P. The coefficient for the dummy variable Sp is also negative but weakly significant (p-value slightly above 5 percent). Thus, spinoffs have an additional advantage compared to diversifiers.

In the following regressions the coefficient estimates for E_1 to E_3 and P show the same pattern as in model (A). The dummy variable Sp is excluded.

Model (B) contains the survival duration of the parent firm as an explanatory variable.[6] Its coefficient estimate is negative and highly significant, indicating a reduction of the spinoffs´ hazard rate. The results imply that the hazard rate of a spinoff $\hat{h}_{Sp}(t)$ which parent survived one year is 4.4 percent[7] lower than the hazard rate for other firms $\hat{h}_{NonSp}(t)$.[8] This implies that the longer the survival duration of the parent, the better are the survival chances of the spinoffs. Therefore, it can be concluded that efficient routines will be inherited, and that successful parents breed more successful spinoffs (compared with other spinoffs).

The next two regressions assess the influence of the innovative activity of the parents on the spinoffs´ survival duration. In model (C) the variable for the number of patent grants of the parents PAT_{PARENT} exhibits a significantly negative value and has a positive effect on survival duration. In model (D), the variable PAT_{PARENT} is replaced by the associated dummy variable $DPAT_{PARENT}$. The associated coefficient estimate shows a negative but weakly significant influence (at the 10 percent level). So we suppose that parents innovative activity has only a weak but positive influence on firm survival.

The results of models (E) and (F) show the same pattern for the survival duration of the parents as the results of model (B), but also indicate that their innovative activity of the parents has no influence on the spinoffs' survival chances. The co-

[6] The number of firms decreases to 330 due to the fact that we have no information about the parents of 3 spinoffs. We just know that the firm is a spinoff.

[7] $\frac{\hat{h}_{Sp}(t)-\hat{h}_{NonSp}(t)}{\hat{h}_{NonSp}(t)} = exp(-0.045) - 1 = -0.044$.

[8] For a more detailed explanation of the calculation see Klepper (2002*b*).

efficient estimates for the number of patents PAT_{PARENT} as well as the associated dummy variable $DPAT_{PARENT}$ are both statistically insignificant. Hence, having an innovative parent brings no advantages for a firm (regarding its survival chances). In contrast, to be the spinoff of an experienced firm improves the spinoffs' survival chances. The results for the variables of the entry cohorts and the spinoffs are very robust across all regressions. We can therefore conclude that the results are robust. Only the post-entry experience of the parents is relevant for the survival of the spinoffs, whereas the innovative knowledge has no influence.

3 Conclusion

This paper contributes to the research on knowledge flows between firms, especially between parents and spinoffs. Starting from the empirical observation in some U.S. industries and in the British automobile industry that spinoffs have the highest survival chances (Boschma and Wenting, 2007; Buenstorf and Klepper, 2004; Klepper and Sleeper, 2005), this paper investigates the performance of German automobile spinoffs in the period 1886 to 1939.

In investigating the question what kind of knowledge is inherited, the paper distinguishes between post-entry knowledge (routines) and innovative knowledge.[9] Based on the Cox regression model, the results show that post-entry knowledge that spinoffs inherit from their parents improves the former's survival chances. In contrast, innovative knowledge has no influence. Thus, there is an indication that successful spinoffs inherit efficient routines as suggested by Dahl and Reichstein (2007). The same routines that affect the survival of the parents exert a similar impact on the survival of their spinoffs.

There are two open questions for further research. The first one is to investigate the probability that a firm spawns spinoffs depending on the post-entry and innovative knowledge of the parent firm. The second question, which might also be very instructive, is to examine if the spinoffs of innovative parents are also more innovative than other spinoffs. The argument in this paper is that successful parents also have successful spinoffs, with one indicator of success being the number of patent grants. The dependent variable is the survival duration of the spinoff, though it might be equally important to analyze the number of the spinoffs' patents as a dependent variable.

[9] As sugested by a referee, it is naturally possible that the better performance of the spinoffs of successful firms is also caused by the fact that successful firms are able to engage better employees (Abowd et al., 1999).

References

Abowd, J. M., Kramarz, F. and Margolis, D. N. (1999), 'High wage workers and high wage firms', *Econometrica* **67**, 251–333.

Agarwal, R., Echambadi, R., Franco, A. M. and Sarkar, M. (2004), 'Knowledge transfer through inheritance: Spinout generation development and survival', *Academy of Management Journal* **47**, 501–522.

Boschma, R. A. and Wenting, R. (2007), 'The spatial evolution of the british automobile industry :does location matter?', *Industrial and Corporate Change* **16**, 213–238.

Buenstorf, G. and Klepper, S. (2004), 'Why does entry cluster geographically? evidence from the u.s. tire industry.', Papers on Economics and Evolution 0407, Max Planck Institute of Economics, Evolutionary Economics Group (as "The Origin and Location of Entrants in the Evolution of the U.S. Tire Industry").

Cantner, U., Dreßler, K. and Krüger, J. J. (2005), 'Knowledge compensation in the german automobile industry', Jenaer Schriften zur Wirtschaftswissenschaft, FSU Jena, 11/2005.

Cantner, U., Dreßler, K. and Krüger, J. J. (2006), 'Firm survival in the german automobile industry', *Empirica* **33**, 49–60.

Cantner, U., Krüger, J. J. and von Rhein, K. (2008), 'Knowledge and creative destruction over the industry life cycle: The case of the german automobile industry', *Economica* (forthcoming).

Cox, D. R. (1972), 'Regression models and life tables', *Journal of the Royal Statistical Society, Series B* **34**, 187–220.

Dahl, M. S. and Reichstein, T. (2007), 'Are you experienced? prior experience and the survival of new organizations', *Industry and Innovation* **14**, 497–511.

Klepper, S. (1996), 'Entry, exit, growth, and innovation over the product life cycle', *American Economic Review* **86**, 562–583.

Klepper, S. (2001), 'Employee startups in high-tech industries', *Industrial and Corporate Change* **10**, 639–674.

Klepper, S. (2002*a*), 'The capabilities of new firms and the evolution of the u.s. automobile industry', *Industrial and Corporate Change* **11**, 645–666.

Klepper, S. (2002*b*), 'Firm survival and the evolution of oligopoly', *Rand Journal of Economics* **33**, 37–61.

Klepper, S. (2007), 'Disagreements, spinoffs, and the evolution of detroit as the capital of the u.s. automobile industry', *Management Science* **53**(4), 616–631.

Klepper, S. and Sleeper, S. (2005), 'Entry by spinoffs', *Management Science* **51**, 1291–1306.

Nelson, R. R. and Winter, S. G. (1982), *An Evolutionary Theory of Economic Change*, Cambridge (Mass.).

Pavitt, K. (2002), 'Innovating routines in the business firm: What corporate tasks should they be accomplishing', *Industrial and Corporate Change* **11**, 117–133.

Table I: Results of the Cox regressions

	(A)	**(B)**	**(C)**	**(D)**	**(E)**	**(F)**
E_1	-1.439	-1.390	-1.398	-1.413	-1.408	-1.381
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
E_2	-1.210	-1.182	-1.208	-1.209	-1.202	-1.174
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
E_3	-0.797	-0.743	-0.826	-0.797	-0.763	-0.738
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
P	-0.872	-0.858	-0.905	-0.873	-0.848	-0.865
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Sp	-0.453					
	(0.052)					
$Sp{\cdot}Y_{PARENT}$		-0.045			-0.038	-0.048
		(0.007)			(0.021)	(0.017)
$Sp{\cdot}PAT_{PARENT}$			-0.003		-0.002	
			(0.042)		(0.160)	
$Sp{\cdot}DPAT_{PARENT}$				-0.492		0.097
				(0.084)		(0.790)
R^2	0.309	0.315	0.305	0.304	0.318	0.315
LogL	-1366.373	-1355.884	-1358.256	-1358.567	-1355.131	-1355.843
n	333	330	330	330	330	330

Note: p-values in parentheses below the coefficients