Entry and innovation: an analysis of the fabless semiconductor business

Published: 08 September 2009

Volume 37, pages 87–106, (2011) Cite this article

Small Business Economics

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Abstract

The relationship between pre-entry experience and patenting for a sample of 133 firms active in the fabless semiconductor business between 1984 and 2005 is studied. Controlling for variables such as venture capital, post-entry experience and parent involvement in the creation of the new venture, it is found that firms with better educated founders have a higher hazard to patent soon after entry. Additionally, firms whose founders have a longer tenure in the parent firm have a relatively higher hazard of patenting. Finally, firms whose founders have innovated in the past are more likely to innovate. Results suggest that both general and specific human capital are important preconditions of pre-entry experience.

Notes

1. See the reviews contained in Santarelli and Vivarelli (2007) and Helfat and Lieberman (2002).

2. The majority of firms (92.4%) in our sample are located in the USA or Canada, a minority of them in Europe (5.2%) and the rest in Asia or Israel (2.4%).

3. Matching inventors' names can be problematic and likely to generate false matches. In order to minimize this problem we used a matching algorithm developed at KITeS-CESPRI (Bocconi University, Milan). Further controls were carried out by manually checking each individual in our final group.

4. Concerning the variables describing the individual characteristics of companies' founders, their construction was not problematic for the 65 companies in our sample with a single founder. For the remaining companies, the variables were constructed with reference to the founder with the highest number of granted patents up to the founding year.

5. A small number of founders in our sample (13) actually obtained a PhD after the founding of the company. To control for these individuals we have included in the regressions a dummy equal to 1 if the degree was obtained after the founding but before the innovation occurred.

6. Engineering includes: general engineering, mineral metallurgy and materials, electrical and electronic engineering, chemical engineering, and electrical engineering and computer science. Hard science includes: physics, mathematics and chemistry. Business includes: economics, administration and management.

7. Many theories of spin-off formation exist. See Klepper and Thompson (2006) for a review and a model.

8. The distinction between technology and application was made on the basis of the Standard International Classification (SIC) code of the parent company. In particular, we consider 'semiconductor companies' those belonging to the electronic components and accessories group (SIC 367). 'Application companies' are those belonging to industry group 366 (communications equipment), 357 (computer and office equipment) and 371 (motor vehicles and motor vehicle equipment).

9. Here opportunity spin-offs are defined as: "spin-offs triggered by an increase in the expected future benefits of spin-off formation, which is caused by the recognition of a new entrepreneurial opportunity that is deemed viable" (Buenstorf 2007b, pp. 12–13).

10. For each specification we tested for the joint significance of the entry dummies. In each case we rejected the null hypothesis that all the dummies are null.

11. All marginal effects refer to the final specification (model 4). For the dummy variables marginal effects have been calculated for a change from 0 to 1 holding the other variables constant at their mean (for the binary variables) or median (for the continuous variables). For the continuous variables, marginal effects are calculated for 1 standard deviation around the mean.

12. This result should not imply that possession of technical knoweldge is irrelevant for innovating. Indeed, around 50% of the firms whose founder had a business degree had at least a co-founder with a technical degree to conribute to the pool of required relevant knowledge.

13. Similar results were obtained by using the stock of patents granted to the founder up to the year in which the spin-off was founded.

14. Similar results were obtained by using the number of firms founded up to the year in which the spin-off was founded.

15. Further checks on model 4 were carried out by adding a dummy for foreign firms. Our sample includes 21 firms (or 15.78%) that are not US based. It may be that the presence of foreign firms introduces a bias in the measurement of patenting given that we are relying on USPTO patent applications. Our results turn out to be robust to the inclusion of this dummy.

The only major change is in the coefficient of SERIAL INNOVATOR, which is no longer significant. Running the regression only on the subsample of US-based firms also confirms our previous results. In this case the coefficients of PHD and OPPORTUNITY SPIN-OFF lose significance. It is interesting to note that the coefficient of the dummy, when included, turns out to be positive and significant, suggesting that foreign firms have a relatively higher probability than US firms to file their first patent soon after entry. All in all, we think this result reinforces our argument that early patenting for young fabless firms acts as a signal of firm quality. We thank an anonymous reviewer for suggesting to perform this further check.

16. It may be argued that having more innovations or innovations of higher quality (as captured by the weighted count of patents with forward citations received) is generally more important for firm performance than having a single patent early. Even though tackling this issue goes beyond the scope of this paper, as an additional explorative investigation, we performed this analysis for the 133 firms in our sample. In particular, data on the number of patents granted at the USPTO and the number of citations received by these patents were collected. Between 1984 and 2005 a total of 18,628 patents have been granted to the firms. Results from a series of pooled negative binomial estimations, controlling for exposure time, suggest that, with some limitations, the same determinants seem to account also for the firm total patent output. We do not report these results here. They are available from the authors upon request.

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Acknowledgements

Previous versions of this paper were presented at the 12th International Joseph A. Schumpeter Society Conference, Rio de Janeiro, the EARIE 2008 Conference, Toulouse, and the Academy of Management 2008 Annual Conference, Anaheim. We are grateful to the participants for useful comments and remarks. We acknowledge the financial support of the Italian Ministry for Education, Universities and Research (FIRB, Project RISC—RBNE039XKA: “Research and entrepreneurship in the knowledge-based economy: the effect on the competitiveness of Italy in the European Union”). We also thank Ed Steinmueller for providing many useful insights and suggestions on the specificities of the fabless semiconductor business, and Rinaldo Castello and Guido Torelli for helpful discussions on the technology. Alessandro Passannanti provided useful research assistance. The usual disclaimers apply.

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Appendix

See Table 9.

Table 9 Correlation matrix

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About this article

Cite this article

Balconi, M., Fontana, R. Entry and innovation: an analysis of the fabless semiconductor business. *Small Bus Econ* **37**, 87–106 (2011). https://doi.org/10.1007/s11187-009-9231-5

Received
20 November 2008

Accepted
28 July 2009

Published
08 September 2009

Issue Date
July 2011

DOI
https://doi.org/10.1007/s11187-009-9231-5

Keywords

Pre-entry experience | Patenting | Fabless semiconductor business

JEL Classifications

L26 | L63 | O31 | O34

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