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Comment on:
Strategic innovation and technology adoption in
an evolving industry[☆]

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1. The model

Models of firm dynamics usually take a very boring view of innovation. Firms innovate to become more productive. Productivity and size are related one-to-one: more productive firms have a higher marginal product (or lower marginal cost), and so they hire more inputs. In reality, innovation and the marketing or use of the product that results from innovation might be taken up by different firms entirely. Filson and Gretz contribute to our understanding of firm dynamics by showing how innovation and marketing might be allocated to different types of firms in equilibrium.

Filson and Gretz study a repeated racing model. The winner of the race has a choice: to market the product or license to another firm. Although firms do not differ in their abilities to produce, licensing may still be attractive. Firms with different portfolios of existing products have different pricing incentives on new products; a leader may be very interested in acquiring a license to a new technology, so that he can set the joint-profit maximizing price, rather than be forced to compete with a new firm. This same force affects the decision of how much to invest in innovation. Leaders are not eager for a new product to arrive, so they are less willing to innovate, especially to the extent that they can simply license the new product from the innovator once it does arrive.

The model is an appealing merger of the racing literature with the industry dynamics literature, allowing firms to specialize in innovation or in marketing.

[☆]Comment on “Strategic Innovation and Technology Adoption in an Evolving Industry” by Darren Filson and Richard Gretz for the April 2003 Carnegie–Rochester Conference.

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1 Unfortunately, the model is sufficiently complicated that analytic results are not
 3 available. Fortunately, the authors deliver numerical solutions that are said to be
 5 robust, and that have intuitive appeal. The most important implications are for how
 young and old, leader and laggard firms vary in their innovative effort and their
 desire to license innovations.

7 Laggards are interested in innovating, since the arrival of a new product is not
 likely to reduce their profits as much as it would if they were a leader. Leaders, on the
 9 other hand, have an incentive to license innovations in order to keep competition
 low. The model has interesting and ambiguous predictions for the welfare effects of
 11 licensing: on the one hand, licensing makes innovations more valuable for laggards,
 since they can be sold to someone with a relatively high value. On the other hand,
 13 they may decrease the value of innovations for leaders, since leaders prefer the status
 quo and can license the innovations when they arrive. Since this is a racing model,
 15 innovation can be too high or too low in equilibrium, so the welfare effects of these
 countervailing effects on innovation are nontrivial. Moreover, licensing can have the
 17 usual effect that worries the Justice Department: they may decrease competition by
 allowing leaders to “buy off” products that might be competitors.

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2. How should a model like this be taken to the data?

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23 The authors relate the results of the model to data from the hard drive industry.
 The industry has a variety of features that make it well suited to the model, such as
 well defined product generations and useful quality measures.

25 The data approach that the authors take is common in the literature, but it lacks
 parsimony. They highlight some predictions of the model. In this case, those
 27 predictions come from simulations. Then, to compare these predictions to the data,
 they run regressions with proxies related to variables of interest in a variety of the
 29 hypotheses. The lack of parsimony comes from the fact that a variety of independent
 hypotheses are tested within the same regression, so that the regression coefficients
 31 have a conditional flavor that is not easy to interpret.

For instance, the probit regression of Table 10 is said to “test” Hypotheses 1–3.
 33 The hypotheses are statements about predictions of the model, such as when firms of
 various ages and technological sophistication are most likely to innovate. Other than
 35 the firm’s technological level (Hypothesis 1), the age of the young generation
 (Hypothesis 2), and the relative quality of the young generation (Hypothesis 3), the
 37 statements are *unconditional*. The probit regression includes proxies for innovation
 by firms of various technological levels for various ages and qualities of the young
 39 generation. Since all of the proxies for the three hypotheses are in one regression,
 however, the coefficients are measuring *partial* correlations, where, in each case,
 41 conditioning variables from the other two hypotheses are being used to test the third.
 For instance, when the authors look to see whether laggard firms are more or less
 43 likely to innovate, they are implicitly “controlling” for the age of relative quality of
 the young product generation, since proxies for these are also regressors. However,
 45 Hypothesis 1 does not make the statement that if you *control* for age and quality of

1 the young generation you should observe a particular relationship between a firm's
2 quality and the likelihood of innovation; it just makes a statement about the
3 relationship between the firm's quality and the odds of an innovation arriving.

4 This inconsistency between the model's predictions and the regressions used to
5 investigate the predictions is common in the industrial organization literature, but it
6 is not easily justified, nor is it simply a technical issue. There is no reason to be
7 assured that the sign of the unconditional correlations need line up with the results of
8 a regression of this sort. While it might be arguable (but still questionable) to include
9 in a regression controls for variables outside the model but relevant to the data, it is
10 another matter to include variables accounted for by the model, but not included in
11 the statement of the hypothesis to be tested.

12 Once the model's predictions become disconnected from the empirical implemen-
13 tation, one can easily fall down a slippery slope to the point of a fishing expedition,
14 where the goal is to find some conditional statement in the data that seems to
15 support, in a loose way, the model. Note that, for instance, it isn't obvious how these
16 partial correlations would change if a right hand size variable was interchanged with
17 a left hand size variable; in this case, the choice is obvious, but in some cases it might
18 not be, further leading to the opportunities for fishing.

19 What is a better approach? The authors answer that question in several places,
20 such as when they discuss new product generations. Here they report unconditional
21 correlations from the data. Do pioneers tend to be spinouts? Do pioneers tend to be
22 laggards? They show that, in the data, the number of pioneers who are spinouts or
23 laggards is too high to be due to luck. It must be the case that something about
24 spinouts and laggards make them pioneer new product generations; the model
25 provides a rationale for the fact.

26 In order to be completely parsimonious, the authors could generate simulated data
27 from their model (much as they generate simulated outcomes to form hypotheses
28 from numerical outcomes) and compare the *same* statistics from the data and model.
29 Regression output might be the relevant set of statistics for comparison, but to do
30 the comparison we need to see the same conditional statistics from the model and the
31 data.

32 The discussion of the role of licensing in the hard drive industry underscores the
33 benefits to this sort of approach. Hypothesis 10 states that licensees are typically
34 large. The authors report that large firms are statistically overrepresented in the
35 sample of licensees; however, their overrepresentation is far short of the large firms'
36 share of sales. Is this support for the hypothesis or not? It is hard to say. The model
37 would predict that large firms are relatively intensive in licensing (which they are
38 not), but at least they are doing more licensing than small firms. If we had
39 comparable statistics from a parameterized version of the model, it would be easier
40 to see to what extent these numbers represented a success or failure of the model.

41 Of course one parsimonious approach, one which is perhaps most preferable,
42 would be structural estimation of the parameters of the model. Despite the lack of
43 price data, the availability of both quality and quantity¹ data could be enough to

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45 ¹Or at least total firm sales.

1 identify the parameters. Since a parameterized version of the model could be a useful
2 policy tool, there seems to be value added in figuring out what parameters are
3 identified. Moreover, some sort of parameterized model is going to be needed to
4 answer quantitative questions. Taking the results in the paper as qualitatively
5 supportive, we still do not know to what extent the forces introduced here can be
6 quantitatively explained. The authors have taken an important first step, but
7 additional steps will enhance the value of the authors' contribution.

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3. Policy

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12 The model is potentially well suited to studying policy questions: a parameterized
13 version could be used to measure welfare implications of policies, such as limits to
14 licensing, that are commonly used. Welfare implications are not obvious here, since
15 the racing game can lead to too much or too little innovation, and licensing
16 agreements impact both innovation and the subsequent degree of competition.
17 However, in its current form, the authors do not have much to say about welfare,
18 only innovation, since they are not willing to stand on any one particular
19 parameterization. Moreover, the model as it stands seems ill suited to studying
20 policies concerning covenants not to compete (CNCs) that the authors discuss.
21 CNCs are a fundamentally ex-ante contract; they allow the employer to limit what
22 the employee can do with future innovations. This is an uncomfortable fit with the
23 model developed here, which relies on an inability of firms to write ex-ante
24 agreements, such as ex-ante licensing agreements. Studying the implications of other
25 contractual possibilities within the framework of this model might be an interesting
26 topic for future study, and might make the model more appealing as a way to think
27 about contractual arrangements like CNCs. Such a model is surely warranted, as the
28 introduction of the racing aspect provides a new richness not present in state-of-the-
29 art models of industry dynamics with worker mobility, such as [Franco and Filson \(2000\)](#).

30 In the long run, the development of models like this one is essential to a coherent
31 discussion about innovation and licensing policy. Filson and Gretz have provided us
32 with an empirically useful framework to use in that discussion.

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References

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38 Franco, A.M., Filson, D., 2000. Knowledge diffusion through employee mobility. Staff Report 272,
39 Federal Reserve Bank of Minneapolis.

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