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Comment

Jeffrey L. Furman

I have learned many things from reading this chapter. One key lesson is that my public high school biology course was sadly inadequate to the task of understanding sexual reproduction in roses. In case there are others in the room with similar challenges in basic plant biology, I include in the talk a slightly extended primer on rose propagation. As a second note before I begin, I should also apologize that there are an embarrassing number of opportunities for word play on this project, so I ask for your tolerance if I

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weaken and engage in the occasional pun. If you have read the chapter, you may have noticed that the authors hide a pun in one of the footnotes. With that in mind, I would like to title this discussion, with apologies to Shakespeare, "A rose by any other IP policy."

What the authors are trying to do here is to try and understand the impact of the 1930 Patent Act on a number of outcomes. The chapter involves elements of a case study as well as elements of policy evaluation. This chapter would have fit right into the original *Rate and Direction* volume in the Case Study section of the book.

The chapter addresses one of the fundamental questions in the economics of innovation, namely, how the provision of intellectual property rights affects innovation. It considers the context of the 1930 Plant Patent Act, which established intellectual property rights for asexually propagated plants. One of the key points of context is that prior to the Act, the United States lagged behind Europe in the development of rose varieties and the production of roses. This is true to some extent with respect to the hobbyists, but especially with respect to the commercial breeders. Imports of roses are around 12 million roses per year in the 1920s and that falls following the Act.

What the authors ask, then, is, "What was the impact of the Act on innovation in roses, on the growth of the US industry?" With their approach, the authors could also ask about a number of other issues. For example, they could examine how the Act affects rose variety, how it affects rose quality, whether a market for plant ideas develops after the Patent Act. And then how did the Act change the identities of those organizations or individuals that engage in rose innovation? And do we see worries materialize about intellectual property rights stifling innovation? So Moser and Rhode's chapter addresses the classic question of what happens to innovation, and what happens to industries after IP rights are extended.

I am not sure how important the primer on plant reproduction is. I guess the key thing to remember is that plants that are propagated through sexual reproduction have variety, as a consequence of obtaining two types of DNA. Thus, you can experiment on how to create new plants through sexual reproduction in plants.

Generating new plant varieties also, however, has some properties that are similar to the process of coming up with new drugs. Approximately one out of 1,000 seedlings turn out to be successful in some way. And then the commercial firms, even in the early days, could do this in very, very large numbers.

One way that I thought about this process was similar to the way drug companies would go about developing drugs, around a similar time period. That analogy is going to break down and I think a number of other analogies may be more complete, but that is one of the things that I kept in the back of my mind, thinking about comparisons between this industry context and another.

It is relatively easy to enable asexual reproduction in plants. One can simply take a cut of a rose, replant it into the stem of another rose, and the complete DNA will transfer. The problem with this, as Paul pointed out, is if you can take one cut from anyone who has already created a new plant variety, you can completely appropriate their IP. Hence, the picture that Paul presented of the guarded apple tree. The argument on the part of the growers is therefore clear: if there is no way to prevent the theft of IP, we will not invest in innovation. This is a classical issue in agriculture innovation and begins to explain why the returns to agricultural R&D are historically so high.

I think Paul also pointed out quite well what the different varieties of intellectual property protection are for plants. Asexually produced plants are covered by the Plant Patent Act. Sexually reproducing plants are not covered until 1970. Utility patents can cover the techniques associated with creating new tools for genetic engineering, but this protection was not until recently.

Hybridization creates its own form of intellectual property protection, because the second generation of hybridized seeds does not yield as well as the first. So if you have created hybridized seeds, you can sell those, but then the folks who use them cannot use the resulting seeds from the first generation of crops to create a second generation.

Consistent with the classical tensions in the provision of IP rights, one issue we may worry about as a consequence of the 1930 Act and subsequent expansions of IP over plant innovation is whether these policies complicate and possibly restrict downstream innovation. Stated differently, should we worry about rose thickets? A current concern among agricultural economists is that patent thickets entwine some of the plant technologies. This is a concern that Brian Wright has expressed about public sector research on plants, but it seems to be a growing concern in the plant community overall.

What is the approach that Petra and Paul take? They begin by tracking rose patents. Rose patents are expressed desire to protect intellectual property over rose varieties. They also track rose registrations. By contrast, rose registrations do not confer any property rights. They are simply declarations of having developed new rose varieties. Registrations are something that hobbyists will do to demonstrate their pride and to signal that other people can come to them to talk about those varieties. They therefore confer some prestige and allow coordination among the hobbyists.

Paul and Petra engage in a matching exercise in which they link patents to the registrations to get a sense of how many of the new plant varieties end up getting intellectual property rights. They look over the long term from the 1930s to the 1970s. It is sort of like a differences and differences technique, but without some of the statistical features. They then attempt to compare at the end with carnations and fruit trees, to see how those trends differ. It

seems as though some of the data that will, ultimately, be included in the chapter are still in process.

The authors suggest the following: for rose patents, about 50 percent of total plant patents are roses. That seems to reflect the enjoyment of the population in buying roses, and a lot of those are concentrated among the small commercial breeders. We may consider this as evidence that the patents' rights led to patenting—does that lead to innovation and does that lead to improvements in welfare? That question is a little bit open.

The US patent share rises following the Act, but the US share of registrations does not rise appreciably. I think there is still work that could be done to identify how the carnations and fruit trees work. I fear the numbers are a little bit too small in the data to know whether we are going to get useful leverage comparing changes in the US output of roses to changes in the US output of carnations and fruit trees. There are also some questions about whether we can get a clear counterfactual from these.

I think that the chapter generates a number of interesting questions and it is worthwhile to think about what it can best demonstrate. One key question is, what are the most important outcomes on which to focus? What are the most important things that we would worry about happening following the Plant Patent Act? It would be wonderful to get data on innovation inputs. That does not seem like it is possible. So we have mostly data on innovation outputs, some related to the plant varieties themselves, some related to how the industry grows.

We might also ask ourselves how the industry structure changes over time. Is a primary outcome of the Plant Act a great deal of consolidation among the US growers, relative to what went on in Europe? We do not know that yet from the data, although it would be interesting.

We could also ask how the Act changes the plant varieties, how the Act changes the quality, and how the firms themselves begin to change in light of the new intellectual property rights. There is only a limited amount of data available, but those seem to be some of the additional questions that we might want to get at.

The comparisons to carnations and fruit trees seem like they could be—apologies for the pun—fruitful things to do, but the number of carnations and number of fruit tree patents might not be large enough to enable pre- and post-comparisons to have sufficient leverage. As well, I am not sure whether these qualify, conceptually, as ideal counterfactuals.

One somewhat open question is whether to think of this project as a large-scale data analysis project with the typical sorts of econometric outputs, or whether we should see this more as a case study that might generate insights for modeling these questions. At the moment, it seems like this comes out as a case study that can let us think about what the key issues are in this particular context.

Some other difficulties in thinking about how to assess causality are that

the US versus EU comparison is somewhat messy. World War II leads US firms to be able to appropriate German intellectual property, which—again, pardon the pun—seeds the US industry in roses. And then World War II disrupts the supply from Europe, giving another boost to the industry.

There are a number of reasons that we might think of this context as especially interesting. I think that the chapter could use these contextual factors to help motivate it and help it focus on the most interesting issues. The rose context is one with inherently weak property rights. It is extremely easy to copy innovations. There is also a very strong hobby community. As well, there is a very long development cycle and relatively low fixed costs for the innovation. Thus, it takes a long time to come up with a new rose, which is similar to the pharmaceutical industry. Unlike pharma, however, it does not require at a billion dollar investment to come up with a new rose. The other interesting feature of this context is that that these are very long-lived innovations and that very old and very new innovations compete in the marketplace. A bunch of the roses that are currently high in demand are eighty-year-old varieties.

One of the challenges, I think, for the chapter going forward is to identify the most interesting features of the rose context and to focus the analysis on those issues. One might ask about the impact of intellectual property rights in circumstances where there is a complementary hobby community. The hobbyists continue to trade their roses, often in connection with some of the commercial breeders. We might also ask about the impact of intellectual property rights on an industry with long development cycles and relatively low development costs.

Rose innovation seems to have some features of a number of other interesting contexts for innovation. Like the pharmaceutical industry, rose innovation has long development cycles and a very high experimentation-to-results ratio. There are also features of rose innovation that are similar to open source and software. Like open source software, rose innovations are easy to imitate. As well, there is a substantial amount of sharing in both contexts, and a great deal of participation in innovation from individuals who could be usefully described as hobbyists. There are other analogies to what happens in adventure sports, where there are user innovators, and hobbyists, and IP can also be protected by utility patents, although that does not occur until later on.

Overall, I think this is a case study examining the historical evolution of intellectual property rights in a specialized case, but with features that generalize to other cases, although in modestly different ways. It seems to be a pretty important case in its own right. This is not a trivial industry. It may be difficult to identify the causal impact of the Act on innovation and industry outcomes with extreme confidence. This chapter, in its current form, provides compelling and suggestive results that property rights did not necessarily lead to more progress, although they did lead to more patenting.