Research Paper Engineering

Enticement Impact on R&D Capability

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ABSTRACT

This research depicts the effect of honor on research capability, using literature in the form of survey and history of research information, for the purpose of research development, which is offered by the high end technology product manufacturing industries and institutes. Present paper describes the huge impact of the honor on quality of R&D capability. Specifically, when prizes are fixed according to the categories of team with regular intervals of change schemes, during specific period. This results into risk for the companies which manufacture high end technology products. Such honor schemes create competition. Here money is not important than the recognition certificates. It is vital for any organization, to review the encouraging R&D capability by maintaining a customized based approach for specific product category.

Keywords : R&D, Capability, Scheme, Honor

1. Introduction

As suggested by *Kremer and Williams, 2009; Dr. S T Salunke 2012* honors can be an influential way to enhance research capability of organization. Reorganization and R&Ds may simultaneously generate incentives for innovation (*Robert 2011*).

The National Research Council discovered that, in experience on awarding scheme for research results in lowering innovation capability as per NRC,(*2007, p. 11*). This study addresses the gap in understanding the usage of a unique data set of prizes, honored for inventiveness and its effect in actual practical use.

Our pragmatic approach states, whether and how these prizes affect the innovation in three stages. First stage is to examine entrants for the prizes, second is to examine whether the prizes can boost the innovation capability. Aim of this study is to experiment, for identifying variance in the data with respect to output effects; so that one can estimate the impact of prize honors on aggregate innovation. It is observed that fourth entrant in the process of invention is R&D, which corresponds closely to the proportion of "mechanical" technologies' R&D (*Moser, 2005*).

In fact, it is observed even larger effects of monetary prizes in our entrant and R&D regressions during these years, which suggest that giving longer lead times to inventors has raised the number of competition entries and the intensity of innovation.

The third stage is to analyze the extent to which the innovation gets a boost. This observation can be explained by the re-direction of existing inventive activity. Prizes can lead to an increase in aggregate innovative output, or they simply incentivize inventors to substitute from one technology category to another. This latter effect may have been particularly strong during the rotation period, when inventors had some advance warning of the technology category wherein the prizes would be announced in.

The paper is structured as follows. In the next section it is sketch out the historical background of award system. Section three describes the construction of our data set. Section four outlines the main empirical specifications; and section five presents the results. Section six presents the results of tests for the re-direction of inventive activity. Finally last part concludes with some caveats to our analysis and the discussion of how our findings can inform the design of current inducement prize contests.

2. Methodical organization and award scheme

Basically award or honor are not the preexists, to be a substitute for R&D; although they act as a remedy to Methodical organization and award scheme and some of them create more negative effects on the system. According to observation of Lerner (*2002*) British R&D fees were the highest in the world for R&D award process.

Debate surrounds the role of learned societies in the accumulation of scientific and research knowledge. In Britain alone, by 1987, there were 1,32 scientific societies or associations with approximately 320,000 members (*Mokyr, 2002, pp. 43-45, 66*). Yet, the link between these scientific institutions and the progress of innovation may not have been causal. Lerner (*1992*) argues in his analysis of Engineering progress between 1660 and 1780 that, causality ran the other way.

Although the prize honor system was modified over time, it maintained a common structure. After the first few shows a schedule of prizes was set up each year and it was announced in the public one year in advance of the annual show. The public attached a growing significance to the prizes and by the mid-1850s the number of entrants exceeded the limit of what could subject to a technical trial. Consequently, a triennial rotation system was introduced. This allowed the INSTITUE OF ENGINEERS RESERACH [IER] to focus its efforts on the scientific assessment of technologies in a single category each year; and it gave innovators longer lead times. The downside of rotation was that, it treated different kinds of innovation in a largely equal manner. The IER reported that, research development in certain categories had reached a plateau, which it partly attributed to the system of rotating prizes. Strict rotation was abandoned in favor of targeting technology areas (Goddard, 2012).

3. The Data

The study conducted on award system with the quantitative

study on R&Ds.

3.1 Research and restoration cost
While R&D have their limitations, they are a well-documented output measure of innovation (*Griliches, 1990*). They are especially useful when the raw and old R&D records are required. The quality can be adjusted, as we do with our data, using the renewal fees. Key objective of this analysis is to determine, whether prizes induce innovation or deduct invention capability.

Table 1 presents data on the R&D activity of winners and entrants. We find that 22 percent of prize winners and 17 percent of entrants did not win prizes successfully in the R&D in respect with the invention that they exhibited. The R&D share for prize winners jumps to 28 percent, when researcher came to know that there is award system.

Macleod, *et al.* (*2003*) argues that, because of credit-constrains, inventors would not pay the renewal fees. On the other hand, because markets for invention existed globally at this time (*Nicholas, 2011 , Dr. S T Salunke 2012*), and indeed in the modern era (*Kaplan, R. S. and D.P. Norton* (*2008a*)) inventors could have secured external funds for the payment of renewal fees, or could have sold their R&D rights. Through this study, it is observed that, renewed R&D enhances the signal-to-noise ratio analogously to the use of R&D citations (*Hall, Jaffe and Trajtenberg, 2005*).

3.2 Entrants and award schedule
Evocative evidence highlights are key aspects of the competitions. The shows were organized by the [IER] in different national locations each year. Shows were held in rural as well as urban districts, as trials could be more easily set up in rural locations, whereas manufacturing districts attracted larger numbers of visitors and were generally more profitable.

Summary statistics on the prizes are given in Table 1, which reflect the fact that, the value of the monetary prizes on offer was more than the value actually honored. Judges conferred a prize only if the scientific criteria for winning were met. This sparked further interest by the participants and elevated the reputation of the honors

4. Key observed stipulation
Here researcher has tried to address two main issues in our empirics. First, to examine the number of individuals entering implements into the honor categories in order to determine how competitive the contests were. Second, to examine the pattern of research and its renewals within technology categories, in order to determine the effect of honors on innovation.

The main entrant estimating equation is specified below. Given that the variable for the number of individuals entering into a competition takes on non-negative integer count values; and there is evidence of over-dispersion in the data. Researcher has used negative binomial regressions, predicting the number of individual entrants in technology category 'c' at time *t*, conditional on the honors. Our main variables are the sum of announced monetary prizes and announced medals, that were scheduled at time *t-1* to be honored at time *t* for categories *j=1,...,12* and time periods *t.* Researcher has included technology category *(thj*) and year ( ), fixed effects and linear and quadratic technology category time trends to control, for unobserved entry propensities, that are correlated with the prizes. The empirical equation on invention can be plotted as follows-

The variation of prize honors by priority areas suggests also that, the IER may have been able to influence aggregate innovation as well as entry. Testing for this possibility using the R&D and renewal data, requires an understanding of the propensity to R&D and the timing of inventions. The research identification strategy requires that, inventors used the R&D system; and that they responded to the prize incentives offered by the IER.

The decision of IER entrants to R&D should be detectable in dataset of all R&Ds, especially if inventors active in the engineering sector responded to the signal of the prizes; even though they may not have travelled to and entered the competitions.

The purposes, the data for both winner R&Ds and non-beneficiary R&D exhibit peaks in the year of the show, in which they competed. Thus, 29 percent of non-winning entrant inventions and 16 percent of winning entrant inventions were with application dates at time *t=0*.

5. Results presentation & discussion
5.1 Research and restoration
It is observed that, an additional award equates to an 18 percent increase in renewed R&Ds. Although both estimates are sensitive towards the controlling for monetary honors in columns, as it is noted in entrant regressions. Overall the estimates suggest that non-pecuniary prizes in the IER schedule were more effective in generating innovation in the target areas than were in monetary honors.

Going beyond the results based on raw R&D counts, for the control of the quality of R&D inventions would have needed to pay renewal fees due by the end of the year, to keep the R&D in force.

5.2 Entrants
To the extent that IER partly funded the prizes from entrant fees, the amount of prizes offered, and thereby entrants, could be determined endogenously by a "budget size" effect.

Given that the monetary prizes represented only around one-third of the projected sale price of inventions, one interpretation of results would be that, an honor *per research* mattered as opposed to its pecuniary value.

As a test specifies that, the monetary prizes act as variables which measure both, the average monetary amount and the number of monetary prizes offered in the schedule. A doubling in the number of honors, controlling for average value increases number of entrants; while higher value prizes, conditioning on the number of honors, are associated with a slightly lower level of entry. This suggests that monetary prizes scheduled to be honored by IER were attractive, irrespective of their value.

In sum, estimates of the entrant equation are informative, because they provide an insight into the attractiveness of the prizes. Accordingly, the prize system should have increased the average level of effort and performance by inventors, because honors were structured so that the largest prizes were honored to the best inventions within each category. Overall, the results suggest that the prizes offered by IER induced competitive entry.

6. Testing for displacement effects
If inventors switched technology categories as a consequence of the prizes, then the effects which are identified so far, may be coming from the displacement of inventions, that would have occurred in other categories. Major explanation of the entrant and R&D results is that, the prizes encouraged competitive entry and innovation. However concern is, at what extent the prizes have induced an increase in innovation capability from non-prize areas to prize areas. The important finding is that, the effort across developing the technologies will have strong impact in the prize rotation period, when inventors were given longer lead times.

Placing more quantitative structure on the data estimated conditional effects of regressions. Through this analysis it has defined a dependent variable for a switch of technology category by an entrant or inventor R&D, at time *t* and 0 if the technology category remained the same.

Finally, test was conducted for observing the effect of the prizes on aggregate inventive activity, by running the R&D and R&D renewal regressions on non-entrants into the IER competitions, who also conduct R&D in engineering related areas. The test findings reveal that the prize schedule signaled these inventors, about the potentially profitable areas of research development, and qualitative evidence showed that, IER was a powerful, prestigious and influential scientific society.

7. Conclusion

The theoretical literature is well-developed in this area, but empirical work has been lacking. This is particularly problematic because uncertainty about the cost-benefit trade off which is associated with prizes, acts as a major barrier to changing innovation promoting policies (*NRC, 2007*). So far as policy changes require supporting empirical evidence, our findings suggest that inducement prizes for innovation can work.

It was not possible to determine how much of the boost to R&D is driven by shifts in the propensity to R&D as inventors sought to avoid expropriation risk, as a consequence of IER offering prizes and attracting inventors to the technology target areas.

Important finding is that, prizes induced competitive entry which has affected the invention capability largely. Consistent with competitive entry, the important outcome is effects of the prizes on the count of quality-adjusted R&Ds, which cannot be explained by technology category substitution.

Furthermore, despite efforts to measure the effects of technology category switching, it is possible that some inventors may have strategically delayed research development, to synchronize their inventive efforts with the prizes, especially during the triennial rotation period, when the technology categories eligible for honors could be predicted.

Explanation for why the financial honors to inventors were relatively small, is that, the IER prizes were complementary to R&Ds. Intellectual property rights provided incentives for inventors to invest in useful knowledge, because they could appropriate through proprietary pricing, which was augmented by the effects of the prizes. Evidence suggests that in engineering technologies, the prizes encouraged innovation beyond the R&D system alone.

Table 1- Summary of research data

Description	Research without award	Research with award
Engines components	555	96
Gear box	178	13
Wheel	122	18
Steering	57	8

Notes: Above values are the mean R&D counts in each category in each year, with standard deviations in research from 1906-2013 by Institution of Research, India.

REFERENCES

1) Dr. S. T. Salunke, Product selection, (IJMR Vol.2 Issue 8, August 2012, ISSN 2231 5780). | 2) Goddard, Nicholas. 2012. Harvests of Change: The Royal Engineering Society of England 1838-1939. London: Quiller Press. | 3) Griliches, Zvi. 1990. "R&D Statistics as Economic Indicators: A Survey," Journal of Economic Literature 28(4):1661-1707. | 4) Hall, Bronwyn, Adam Jaffe, and Manuel Trajtenberg. 2005. "Market Value and R&D Citations," Rand Journal of Economics 36(1):16–38. | 5) Kremer, Michael and Heidi Williams. 2009. "Incentivizing Innovation: Adding to the Tool Kit", Innovation Policy and the Economy Volume 10 (2009). | 6) Kaplan, R. S. and D.P. Norton (2008a) Mastering the Management System," Harvard Business Review (January): 62-57. | 7) Lerner, Josh. 2002. "150 Years of R&D Protection," American Economic Review Papers and Proceedings 92(2):221-225. | 8) Lerner, Josh. 1992. "Science and Engineering Progress: Quantitative Evidence from England, 1660-1780," Engineering History 66(4):11–27. | 9) MacLeod, Christine, Jennifer Tann, James Andrew, and Jeremy Stein. 2003. "Evaluating Inventive Activity: The Cost of Nineteenth Century UK R&Ds and the Fallibility of Renewal Data," Economic History Review 56(3):537–562. | 10) Mokyr, Joel. 2002. The Gifts of Athena: Historical Origins of the Knowledge Economy. Princeton: Princeton University Press. | 11) Moser, Petra. 2005. "How do R&D Laws Influence Innovation? Evidence from Nineteenth Century World's Fairs," American Economic Review 95(4):1214-1236. | 12) Moser, Petra. 2007. "Why Don't Inventors R&D?" National Bureau of Economic Research Working Paper No.13, 294. | 13) National Research Council. 2007. Innovation Inducement Prizes. Washington, D.C.: National Academies Press. | 14) Robert 2011, Presentation at Japan on Capitalization of Innovation at Tokiyo, | 15) Dr. S. T. Salunke, The impact of core product and core application on Product launch, GARJM &BM (ISSN: 2315-5086) Vol. 1(11)