Valuation of Patents-Comparative Analysis

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ABSTRACT

Introduction: There has been a common notion worldwide that more investment into research and development leads to more knowledge production as well as more technological advancement. Thus in last one century there were various scholars like Karl Marx, Karl Polanyi, Max Weber, Joseph Shumpeter, Christopher Freeman etc who tried to collect data at different level to understand the relationship of investment with economical advancement of the society through knowledge production and technological capability enhancement. In this process of studying the economical change, need to indentify common indicator that can connect the dots with Research & Development, Investment, Production as well as Technological advancement was felt . As a result of which various scholars started considering Intellectual Property Rights in form of Patents as an indicator to study economical advancement, since the patent data was comparatively easily available and initial correlation between investment and patent could be established. But there were two schools of thoughts one who argued that if patents help technological advancement of the society then at what rate and does this advancement helps in knowledge production. On the other hand other school of thought argued that patents limits technological advancement of the society by creating artificial scarcity through introducing market restriction for others. **Objective & Methodology:** Scholars like Jacob Schmookle , Grilliches & Pakes, F.M.Scherer, Edwin Masfield as well as Freeman and Pavitt carried out pioneer work in field of quantitative analysis of patents to understand its impact over knowledge production, technological advancement and finally to the economy at large. Though they all tried to work with different methodology which has been discussed in the paper, they were all concerned about the fact that how rate of technological advancement in a society can be quantified and most importantly to understand that does patents really help technological advancement or rather simply supports monopoly. **Conclusion:** After doing comparative analysis of their work one thing which is very clear that all the early research pointed to the fact that 'instead of considering reforms to strengthen patents, we should move in opposite direction to strengthen technological advancement.'

Key words: Intellectual Property Rights, Patents, Technological Advancement, Economy Growth, Monopoly

INTRODUCTION

Since last one century there has been various studies to understand how economy works and comparative analysis of various economies have been carried out by scientists like Karl Marx, Karl Polanyi, Max Weber, Joseph Schumpeter, Christopher Freeman, Heiner Flass beck and other scientists.

By the end of First World War, there was huge investment flowing into research and development with the assumption that it will lead to knowledge production and technological advancement. Yet by the end of Second World War scientific community started realizing the need of consolidated study to verify the fact that investment in research and development has positive impact

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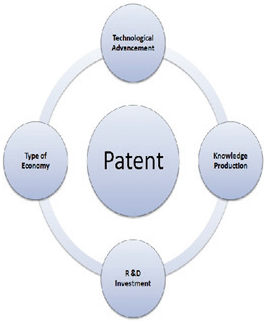
over nature of economy which in return is decided by technological advancement and knowledge production.

Now to understand change in economy because of technological advancement in any society there was need to identify a common indicator that can connect the dots with Research and Development Investment, Knowledge Production, Technological Advancement and finally with nature of economy.



"In the desert of data patent statistics loom up as a mirage of wonderful plenitude and objectivity" thus scientists focused upon patents statistics for their further research.

Technology Advancement Equation-All most all the econometric analysis that were carried out initially were based upon below mentioned assumptions, which we will see further in the paper.

If
Research and Development Investment = r
Knowledge Production = k
Reduced cost of Product and services because of technological advancement = c
Development cost of new product and services = d
Patents granted = p

Thus

$\because \quad k \propto r; r \propto 1/C; r \propto d$

$\& \quad P \propto k; P \propto 1/C; P \propto d$

Thus $k = r + e_1$ (e_1 = observational error)

$\& \quad P = k + 1/C + d + e_2$ (e_2 = observational error)

$\Rightarrow \quad \boxed{P = r + 1/C + d + e_1 + e_2}$

Saying so patented products and services goes through test of novelty hence showing resources and investment efforts put into its development by its parent organization, thus patents were considered as indicator by almost all the school of thoughts working in this area.

Patents are forms of immaterial "property" that grant their owners exclusive control over the production and sale for given time period, preventing others from producing and selling the patented products.

Although term "intellectual property" is commonly used in legal fields, it is complex in economics since it becomes difficult to justify intellectual property rights with the same arguments that are used to justify private property in tangible goods.

Ipso facto from the time property rights were being granted to intellectual properties, there has been discussion and research going on over the scope of these rights. Wether they really help technological advancement of the society, if yes with what rate and does this advancement helps in knowledge production. On the other hand there is a school of thought that's says that Intellectual Property Rights like patents actually curb the technological advancement of the society rather creates artificial scarcity and supports monopolistic market.

As a result of which scientists have started working upon rate of technological changes, which could in return help them answers of the above mentioned questions and help the society at large. Another reason was that scientist wanted to know economic process that causes reduction cost of existing products and services, and leads to development of new set of products and services.

HISTORICAL BACKGROUND

Property Theory Difference-Even though scientists started taking patents as common indicator for analysis of above mentioned questions. There existed basic anomaly with regards to whole concept of Property Theory. According to economic theory of property, safeguard of private property rights only for goods which are scarce benefits the society at large, thus there is no such needs to define property rights over goods which are present in abundance.[1]

The same concept of property rights was used in structuring the whole Intellectual Property Rights, yet there was very little emphasis given upon the fact that IPR does not necessarily arise from scarcity of objects, rather their only purpose has today become to create artificial scarcity and thus generating monopoly for holders of those rights. Hence in a way here law itself is creating artificial scarcity is creating abundant value for people holding rights for

these scarce resource leading to market economy rather than making a free market economy.[2]

Joseph Schumpeter proclaimed *"carrying out innovations is the only function which is fundamental in history."*[3]

Growth in any economy comes from 3 sources : increase of input of production, efficiency improvements and innovation. Of these, innovation is the biggest difference between development and developing economics thus making it an important area of further research.'

Hayek argued that "it seems to me beyond doubt that in these fields, a slavish application of the concept of property as it has been developed for material things has done a great deal to foster the growth of monopoly, and the here drastic reforms may be required if competition is to be made to work."

According to ***Joel Mokyr*** "*A patent system may have been s stimulus to invention, but it was clearly not necessary factor."*[4]

Doguhlass North argued that *"failure to developed systematic property rights in innovation up until fairly modern times was a major source of the slow pace of the technological change."*[5] Again it is important to stress that technological change is not the only source of productivity growth, and sometimes it is not even the major source. North's work where he shares his study of productivity changes in ocean shipping, which found the major source of rise in total factor productivity from 1600 to 1850 were not technological development, but the decline of piracy in number of voyages and an increased load factor on return trips.

Thus at the end of day following questions remained unanswered in absence of quantitative and qualitative research. These were

1. How to calculate rate of technological advancement?
2. Analyzing process that causes reduction in cost of existing products and services.
3. Analyzing process that causes development of new set of products and services.
4. Do patents really help technological advancement and in return support free market economy or supports monopoly.
5. What is the cost benefit analysis of patents over technological advancement?

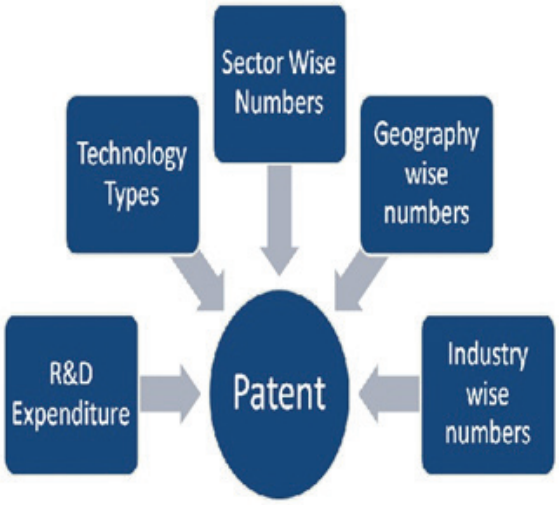
PATENT VALUATION

Following group of scientists were the pioneer in field of quantitative analysis of patents to understand its impact over knowledge production, technological advancement and finally to the economy at large.

1. Jacob Schmookler
2. National Bureau Of Economic Research (NBER) (Grilliches & Pakes)
3. Scherer & Yale Group (F.M.Scherer)
4. Edwin Masfield
5. Science Policy Research Unit Group (SPRU)(Freeman and Pavitt)

Before discussing in detail about their work, I would like to share the issues that must have came up in front of these scientists while thinking about which methodology to choose while using patents as an indicator to gauge economy.

First and major issue must have been data collection.



Till date when we talk about patent statistics, there is lot of complexity with regards to its arrangement. Point is for any given product or process type, which method to be chosen. Wether one should go for statistics based upon technology type, sector wise, geography wise, industry wise, or on the basis of research and development investment.

Methods of Evaluation-To resolve this problem basically four methods have been tried for the econometric analysis till date. Point worth mentioning here is that, econometric analysis techniques and tools those were not developed at the same time patent statistics as well as R&D investment statistics were scattered and needed enormous amount of efforts for compilation itself. Further more in all the

econometric analysis number of samples were decided based solely upon their availability and method of sampling used was mostly convenient sampling. All most whole patent statistics worked upon initially were taken from countries like America, Japan and UK etc.

Hence these methods were:

1. By analyzing variation in R&D expenditure and comparing it with number of patents applied and granted through time series analysis.
2. By analyzing number of patents granted company wise and comparing it with number of new technologies/ products launched by the company.
3. By segregating patents sector wise say Agriculture and then comparing it with expenditure over that particular sector.
4. By segregating patents industry wise say Manufacturing and then comparing it with expenditure over that particular industry.

Major Issues in quantification:

There were basically two major issues associated with quantification of patent statistics by above mentioned ways.

1. Classification
2. Intrinsic Variability

Talking about classification, even when scientists used a formulated structure and worked over limited data type for patents limiting their research to particular sector, or industry etc they had to face issues of patent classification and sub classification. So even if one selected particular industry, sector or company one has to decide how to arrange different sub classes of those statistics.

Another major issue was to decide upon the intrinsic variability of different patents, meaning how one can decide which patent is more valuable than other one. We will now see how these scientists carried forward their work.

Jacob Schmookler was first scientist to work upon econometric analysis of technological advancement at industry level along the time span of 1800-1950.He raised two questions, first being 'what are the determinants of variation in the rate of technological progress over time and between industries?' and second being 'how technological changes fits into the process of economic growth?' For his research he focused upon capital goods based industries and collected 934 important inventions from industries like paper making (185), railroad (230), agriculture (235), and petroleum refining (284). Though he was looking for 'input indicator' meaning indicator that could trace creation of new technologies, but since he left out upon important areas like basic research, development of all-ready made inventions as well as retail industry he ended up finding 'output indicator' for technological advancement.

Because inventive activity basically refers to work done to come up with a novel product or process *(Schmookler 1966,p.8)* which is referred as input index. Even after so many hurdles Schmookler was the first scientist to publish 'total factor productivity growth' i.e correlation between total factor productivity and total patent granted and found that correlation was minimal.

Yet he found strong correlation between levels of inventions as measured by Patent Statistics and level of investment in Capital goods where Inventions preceded rather than following investment. Thus he concluded that patented inventions are in response to rising demand in an industry.[5]

Zvi Grilliches was an economist at Harvard University while ***Ariel Pakes*** is the Steven McArthur Heller Professor of Economics at Harvard University. Both worked together upon ***'Knowledge Production Function'***. They raised two important questions, first being 'wether patent statistics measure anything at all or not?' and second being 'how will one arrive at indicator of inventive output?'

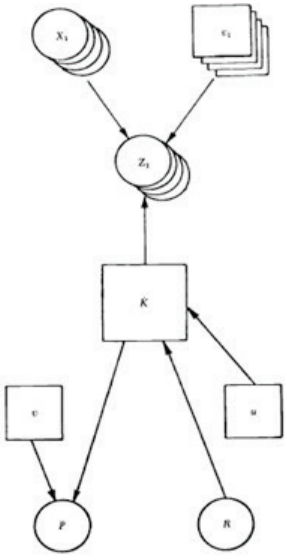


Fig. 13.3 Knowledge production function: a simplified path analysis diagram
Source: Pakes and Griliches (1984), figure 3.1.
Notes: R = research expenditures.
K = additions to economically valuable knowledge.
P = patents, a quantitative indicator of the number of inventions.
Z's = indicators of expected or realized benefits from invention.
X's = other observed variables influencing the Z's.
u, v = other unobserved influences, assumed random and mutually uncorrelated.

K here is net acceleration of economically valuable knowledge used as measure of inventive output and Z's are various level of Z that could be various measure of growth, productivity as well as profitability.

Thus:

$$\dot{K} = R + u,$$
$$P = a\dot{K} + v = aR + au + v,$$
$$Z = b\dot{K} + e = bR + bu + e,$$

Hence for any given research work whose success is linked with expectations of economic benefits for the inventor, only when this expectation exceeds a particular threshold level patent will be applied for else not.

Hence number of patents applied for depends upon number of successful projects with economic value of patents exceeding threshold limit.

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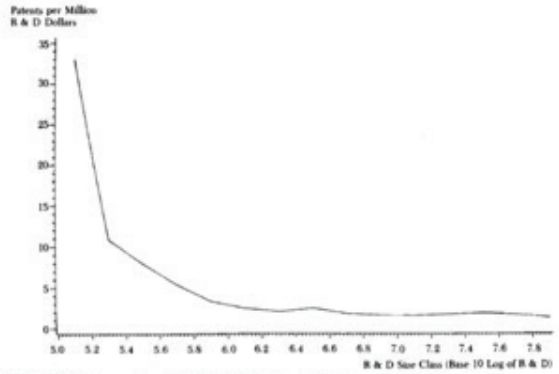

Fig. 13.5 Patents per million R&D dollars by R&D size class for firms with both R&D and patents
Source: Bound et al. (1984), figure 2.6.

In the time series dimensions, they found that number of patents received per R&D dollar spent kept on decreasing. Which clearly showed that though small firms were most beneficiary when it came to receiving large number of patents, in case of larger firms main driver for innovation was something different which was keeping them alive with technological advancement along with economies of scale.*(William Baldwin & John Scott Ch.3)*

After extensive research both concluded that there is strong relationship between Research and Development and number of patents received across firms and industries. Yet both also concluded that all the productivity is not due to invention, and only limited growth can be attributed to patented inventions. Taking 1-2 % growth rate per year across industries in respect to total factor productivity, almost half of it was found to be due growth in the quality of labour force, capital allocation, economies of scales etc and hence they concluded that at most maximum quarter of total productivity can be attributed to patented inventions.[6]

Edwin Mansfield conducted two studies to find better insight into the relationship of patents and innovations. In his first study he took 31 patented innovations in 4 industries: chemicals. Pharmaceuticals, electronics and machinery. Major purpose of study was to answer that what proportion of innovations would be delayed, or not introduced at all, if they could not be patented?

In drug industry firms said half of patented innovations would not have been introduced without patent protection. Excluding drug innovations, the lack of patent protection would have affected less than 1/4th of the patented innovation in taken samples.

In his second test according to the obtained from random samples of 100 firms from 12 manufacturing industries, patent protection was judged to be essential for the development or introduction of 1/3rd or more inventions during 1981-83 in only 2 industries-pharmaceuticals and chemicals. On the other hand, in 7 industries (electrical equipment, office equipment, motor vehicles, instruments, primary metals, rubber, and textile), patent protection was estimated to be essential for the development and introduction of less than 10% of their inventions. Indeed in these industries patent protection was not essential for the development or introduction of any of their inventions during that period.

Fredric Michael Scherer is an economist at JFK School of Government at Harvard University. He studied pharmaceutical patents along with William Comanor and tried to correlate the statistics of all new products introduced by different firms in subsequent years and found close relationship between patent applications (not grants) with new products.

Taking further his own research he studied the incentive effects of compulsory licensing decrees. By reading literature he fanned out to interview 22 American corporations, most of which were under compulsory licensing decrees. He received mail questionnaires from 69 companies holding 45,500 patents, and conducted statistical analysis of patenting trends of those data.

On close analysis he discovered that with rare exceptions, whether or not well-established corporations could expect

patent protection was typically unimportant in their decisions to invest in research and the development of new products and processes.

He further concluded that for those 69 companies prior compulsory licensing decrees had little or no unfavourable impact on research and development decisions, although they had led to less patenting of the inventions actually made and hence greater reliance on secrecy, especially on (concealable) process as distinguished from readily observed product inventions.

CONCLUSION

After closed analysis of all the above mentioned econometric analysis few points are very clear.

- Creation of time series equation for finding relationship between patents and innovation is extremely complex process and has been proven to give ambiguous results.
- Cost benefit analysis of investment in patent regime and its impact over investment in research and development industry needs to be done.
- 'Patent are not always the savior of innovations.' Even in case of industries like pharmaceuticals patent protection was estimated to be essential for the development and introduction of less than 10% of their inventions.
- Though patent can be considered as 'input indicator' that to for limited capital goods industry yet it can't be considered as an indicator of output.
- In most of the cases correlation between total productivity and total patent granted is minimal, thus showing negative correlation.
- Taking 1-2% growth rate per year across industries in respect to total factor productivity, all most half of it was found to be due to growth in the quality of labor force, capital allocation, economies of scales etc.
- At maximum only quarter of total productivity can be attributed to patented inventions.
- Prior compulsory licensing decrees had little or no unfavorable impact on research and development decisions, although they had led to less patenting of the inventions actually made and hence greater reliance on secrecy, especially on (concealable) process as distinguished from readily observed product inventions.

Saying so, one thing which is very clear that all the early research point to the fact that ***'instead of considering reforms to strengthen patents, we should move in opposite direction to strengthen technological advancement.'***

ACKNOWLEDGEMENT

I would like to thanks scientists Jacob Schmookler ,Grilliches & Pakes, F.M.Scherer, Edwin Masfield as well as Freeman & Pavitt whose published work were pioneer in the patent evaluation studies and gave better insight to world regarding issues surrounding the concept of patent evaluation and how the impact the economy. Lastly I would like to thank my faculty members at Centre for Studies in Science Policy, JNU for continued support and encouragement.

CONFLICT OF INTEREST

This statement is to certify that author has seen and approved the manuscript being submitted. He warrant that the present manuscript where a detailed comparative analysis of patent evaluation methodology by different scientists in past has been presented is the Authors' original work and proper source of earlier published works if it has been used as reference has been mentioned in the manuscript. He warrants that the article has not received prior publication and is not under consideration for publication elsewhere.

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