Role of Public Funding In R &D

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Abstract

The level of expenditure incurred on research and development plays a significant role on the overall health and long term sustainability of the economy of a nation. Public funding plays an important role in supporting and sustaining research and development. The role is more direct and feasible in case of basic research carried out primarily in academic institutions. Nevertheless, the impact of public funding can also be established through an indirect correlation with the research carried out in research laboratories and in industries. Similarly, the role of public funding could be more critical in case of R & D activities in a developing economy than in a matured economy.

1. Introduction

A high percentage of public spending on R & D goes to support work at the grass-root level. Hence, it is difficult to establish a direct and objective correlation with the output. Most of the open ended basic research in academic institutions is supported with public funding. This work results in intellectual output which either goes in public domain by way of published papers or is protected through IPRs. The very nature of this output is devoid of physical attributes like product or technology and hence its visibility remains rather diminished, particularly beyond the scientific community. Fortunately, the importance of public funding on R & D is amply appreciated in abstract sense and serious questions to justify this expenditure are seldom raised. Nevertheless, any reasonable attempt to correlate the input which goes into R & D and the output which fructify always makes an interesting reading. The present paper makes an attempt to provide an insight into the issues involved in the entire value chain of research & development and thereby trying to establish the contributions of public funding, for which an extended correlation is necessary. It is realized that complete objectivity may still remain an illusion, however, trying to see things at the micro level would facilitate a better appreciation of the overall perspective.

2. Classification

For the purpose of this analysis, broad term R& D has been classified as follows.

- Basic Research
  - Open ended
  - Reverse Engineered
- Applied Research
  - Routine Problems
  - Exploratory
  - Comprehensive Technology Development

It may be noted that there is nothing sacrosanct about the above classification. The purpose of this classification is neither to compartmentalize research nor to standardize the nomenclature. It is only for the sake of convenience that this classification is attempted so as to examine the issues involved in each one them and establish the role of public funding there- in. Their collective view would in-turn provide a better overall perspective to appreciate the role and impact of public funding over the entire landscape of research & development.

It is also important to see that a fully water tight compartmentalization is neither possible nor worthwhile in this case. The first category of 'basic research' is mostly concerned with the 'R' (Research) portion of R&D. The second and third components of 'applied research' are predominantly concerned with 'D' (Development) in the ascending order. Many a times, we see a mix of both 'R' & 'D' in such cases. Nevertheless, the balance is normally skewed towards 'D', in the later two cases at least in terms of physical effort. In a typical extreme case of technology development, it assumes the dimension of purely engineering challenge, needing enormous effort and integrated approach.

However, it is quite obvious to visualize and common to see basic research as a feeder line to applied research and technology development. The findings and outcome of basic research become obvious starting point for process development and scaling-up. Similarly, the basic research is quite often inspired by the needs of applied research and product & technology development. In that sense, strong interfaces do exist between the categories and their complimentary nature is fairly evident.

We may now attempt to analyze each individual element of the above classification to examine their respective attributes, issues involved and the role of public funding therein. The same analysis is also presented in summarized form in Table -1 underneath.

Table- I: Research & Development Matrix

Category	Type	Environment	Motivation	Impact	Support
Basic Research	Open Ended	Academic	Natural Curiosity	Low-Moderate-High	Public
	Reverse Engineered	Academic Research Labs Industry	End Application	Moderate- High	Public Public – Private Private
Applied Research	Routine	Industry Research Labs Academic	Immediate Problem Solving	Low- Moderate	Private
	Exploratory	Industry Research Labs Academic	Improved Product, Process or Practice	Moderate- High	Private Private- Public Public
	Technology Development	Industry Research Labs (Academic – specific top up role)	New/ Improved Technology	Significant	Private Private- Public Public

3. Basic Research

Open ended basic research is purely guided by the natural curiosity of man into the mysteries of nature and natural phenomenon. This may or may not lead to some meaningful conclusion, particularly in terms of material utility or commercial value. Even in the case of success, the short term application potential or commercial value can not be predicted. However, there is always a possibility that the basic findings may lead to a vast number of applications, although over a long time horizon. The immediate contribution is of course in terms of enriching the existing knowledge base in the concerned area. This kind of research is normally seen in academic institutions and remains entirely in the domain of public funding. Research laboratories may contribute in a marginal way depending upon their institutional priorities and availability of resources for exploratory work.

Reverse engineered basic research is guided by some end application in mind and that determines the issues to be investigated and resolved. This type of research could be prevailing in academic institutions, research laboratories and industry. In fact, there is a good reason for industry to take initiative into the research of this kind because this may lead to major breakthroughs in terms of process, technology and product development. However, this type of research is likely to be taken up only by those industries which are market leaders in their own segments and have some sort of core competence in that area. The following are obvious reasons.

- They have strong motivation to undertake basic research, achieve significant breakthroughs and stay ahead from competitors & followers to retain their position of leadership.
- They have adequate resources and the risk capacity to right – off investment in case of failure.
- They also have adequate resources and critical mass to exploit the full potential of the discovery and reap the windfall gains, it may accrue.

There is no guarantee that each such endeavor will yield expected results. However, an optimal mechanism is worthwhile to institutionalize to capture the possibility of reasonable number of successes with the help of a carefully designed –"organized research programme". The other dimension is of the possibility of few spin-offs of commercial value towards an overall justification for investments in such a mechanism.

4. Applied Research

Applied Research corresponds to the use and application of established knowledge to demonstrate a new process, product or technology or optimize/improve an existing process, product or technology. The first element of applied research is concerned with day to day problems of routine nature pertaining to a specific industry. One can also use a less sophisticated term "trouble shooting" for this activity. These problems do not justify deployment of public funds and they ought to be handled by the industry itself.

The second category of applied research could be of more challenging and exploratory problems, involving altogether new or significantly different approach or methodology to develop a process or product. Since the commercial angle is evident in such cases, the primary objective of quick results and their rapid deployment into commercial

practice most often overshadows the entire plan. Time and speed of delivery rather become the benchmark. That leaves little scope for extensive investigations into at least few basic issues with the aim to impart substantial value into the entire effort. However, this approach may be self-limiting in the holistic sense. Trying to find quick fix solutions using engineering intuition may be alright in short term but does not complete the entire research loop in its logical conclusion. Deeper insight into the problem may not always yield substantial advantage in commercial term. However, it is good to institutionalize such practice for the overall health of a research outfit.

Most of the private funding in industry on research and development is directed towards the two aforesaid categories. Private funding goes into this kind of research either by way of in house R& D or through sponsored projects to academic & research institution. The mode of execution will depend upon the availability of in house expertise and the overall priorities. Normally, an industry would go for research outsourcing for any one or all the following reasons.

- For the want of highest end intellectual inputs at the most fundamental level.
- Work/activity is relatively trivial as compared to their overall scale of operations.
- An intense exploratory effort in a new area or of altogether different kind may by a serious distraction to their core activities.

Public funding is available for this activity as well, if it is has enough substance to make significant impact at the sectoral level. There could be a strong case for public- private partnership in this category, depending upon the kind of challenges and risk involved and the significance of the outcome in terms of the entire industry sector and the economy. Research laboratories participate in this activity in a significant manner, if it comes under their area of core mandate. Support for this may come either by way of public funding or industry sponsorship.

There could be a third dimension to applied research in terms of a comprehensive effort to develop a cutting edge technology towards a new product or significant improvement in properties/ attributes of existing product or cost of production. This kind of effort would

naturally involve significant deployment of resources and an integrated coherent team approach, involving interdisciplinary expertise from different functions. Industry is ideally suited and organized for this activity, may be with the help of academic institutes and research laboratories for specific inputs and expertise. Leadership and managerial resources assume equal importance for successful realization of such endeavours, besides the technical expertise. This kind of activity is again confined to the market leaders in their respective areas for the same reasons as explained before in case of reverse engineered basic research. We do see a parallel activity along these lines in case of strategic areas like space, atomic energy and defence where public funding is exclusively used to support research and development. Nevertheless, the character of approach for the execution of such tasks remain the same.

5. Role of Public Funding

In the foregoing text, we have seen the role of public funding in various facets of research and development. While the open ended basic research is exclusively supported by public funding, major portion of application oriented basic research is also supported by public funding. As an extension, the influence of public funding can be indirectly established in applied research, since it is based on the foundation of sound basic research.

Public funding assumes the role of an arterial lifeline to create and sustain a live environment for research and development in academic and research institutions. The manpower which is eventually deployed by industry for research and development is trained with the use of public funding in these institutions. The skills acquired by students in higher end academic programmes (post graduation, doctoral and post doctoral) in handling sophisticated instruments, designing & conducting advanced experiments, proper analysis & interpretation of experimental data to gather meaningful conclusions and modeling & simulation would make them suitably qualified & trained to take up research and development in the corporate sector. Public funding is also deployed to initiate work in areas which are exploratory and involve high degree of risk, till basic feasibility is established, market sensitized and industries are willing to take it forward.

The role of public funding is more critical in developing economies to sustain research and development. In developed economies, the industry is matured and there are several market leaders in each segment to take a bigger initiative on their own, not only in applied research but even in basic research, to counter competition and retain their position of leadership.

6. Conclusion

We have come a long way since the time when R & D support was near exclusively the domain of public funding. Today, the R & D expenditure in industry is expanding both in absolute terms as well as a percentage of their top-line & bottom-line. In the present world order, when more and more nations are adopting the model of market economy, the industry is bound to be a more active partner in the overall scheme of things. Nevertheless, the role of public funding will continue to remain important for supporting basic research and in high risk or strategic areas. We may also see greater number of public-private-partnerships for supporting R & D activities in the times to come.