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Cost - Benefit Analysis of the Technological Intervention in OECD

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Abstract - When a successful technological policy is implemented effectively, it generates numerous benefits for the economic policy and for the economy. Therefore, policy makers have a responsibility to choose the correct and significant policy instrument, and they must use this in an appropriate way in the economy. In this paper we illustrate the implementation and empirical situation in these policies in the world. Specially, how do the technological policies differ in the countries of the world? What impacts do those differences have on the innovation performance and, more generally, inside the economies. The study is based on a secondary data method while secondary data is also taken for the analysis and repots. This means that both quantitative and qualitative methods are meaningfully integrated and present in the research. Finally, this work theoretically and empirically proves the importance technology in the economic growth theory and explained the role of technological and science policy along with implementations, policy instruments, and final cost-benefit analysis of these policies.

Keywords - R&D Policy, Labor, Human Capital, PPP, Cost- Benefit Analyze.

I. Introduction

How do the technological policies differ in the countries of the world? What impacts do those differences have on the innovation performance and, more generally, inside the economies? Let's discuss these policies in detailed.

As we already know, the technological innovations improve the quality of human capital, technology, and resources in the economies, generating economics scale for the economic growth. Moreover, a successful capital system is the engine of the economic growth. Through generating the resources for the innovations, it provides the effective and technological capital stock and it improves the rapid economic growth in the country. Therefore, countries have new products, new customers, new markets, in the long run and it is a must to complete technological capabilities for this. The government takes many responsibilities for governing this. This improves the R&D, education, efficiency of the market, skill development etc. In this section we illustrate these government policy actions using the OECD data in 6 different industrial countries in the world.

II. R&D Policy

The Research can be described as a science that was developed to meet crucial problems. It is basically relevant to the countries engage in the R&D, to international relationships and to technological arguments. It is solely depended on the government Expenditure of the R&D. Table 1 shows this government expenditure of the R&D in large six industrial countries in 1981.

Table 1: Government expenditure on R&D in 1981

Country	*%*
US	54
UK	49
France	39
Sweden	15
Switzerland	12
Germany	9
Japan	2

Source: OECD

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According to the data of the table 1, we can understand the dissection making policy actions in the government expenditure for the R&D fields in these countries. According to the data, the goal of the R&D is centrally deciding and clearly set out, generally in terms of complex systems meeting the needs of an agency. Specially, these expenditure needs and supervising the research implementations delivered strong technological powers and significant growth in these countries.

Table 2. Public funding for R&D in the higher, medium and low intensity R&D industries in 1981

Country	*Higher %*	*Medium %*	*Low %*
US	88	8	4
France	91	7	2
UK	95	3	2
Germany	67	23	10
Sweden	71	20	9
Japan	21	12	67

Source: OECD

Note: Numbers are Percentages of the total public funds, and defined as industries whose ratio of R&D expenditure to sales is respectively more than twice (higher intensity) between twice and one half (medium) and less

The research of these countries focuses on a small number of technologies of strategic importance, primarily in aerospace, electronics, and nuclear energy. Therefore, government R&D funding in these countries are heavily biased towered a few industries which are generally considered to be in the early stage of technology in OECD region. Table 2 illustrates this condition in these countries. But this type of research cannot be maintained in small countries. In summary, these two tables demonstrated that these research programmers concentrate the technological implementation and technological evolution in their countries. For this they have spent a large share of the cost that has affected the economy in the past century. Next, let's see the effectiveness of this research.

All of the above focused countries face several difficulties. Therefore, they involve in attempting cost benefit analysis of major research programs. They use three criteria to evaluate the success of these projects. First, they set product development goals. Second, they analyze the original time and the cost of these projects and finally, they consider the conditions of the market in these countries. Let's take one example in the US in 1981.

United States has shown significant efficiency with which the project is designed and implemented. The US policy is an intermediate between France policy and UK policy. But the US made greater advantages in their policies than the other two countries because they followed the three policy dimensions. First, US agencies (research organizations) draw on a large pool of the external technological expertise both in selecting and implementing the projects. They had much better research organizations collaborated with universities. Second, according to these research programs, the US rarely fall short of the critical mass required to complete the development stages, and they spend lager funding for these research programs than other countries. Third, these research programs are controlled by qualified supervisors in the country. However, the overall assessment of the direct effectiveness of these research projects must be oriented with several research mixed sources. But the immediate retunes on the research do appear to be higher in the US and France than in the UK. However, even in the US the products are directly conceived by these object-oriented research programs. These programs improve a significant rapid economic growth in US economy. Moreover, the US government gathered research knowledge through greatly financing researchers using government funds. In other words, the government spent a lot of R&D on research much more than other countries. NASA and a several other agencies have a long specific unit concerned with the technological development and its transfers. Also, the US government financed the private sector. In the 1980, the patent law Amendments Act established a stable policy allowing contracts and especially small businesses, universities, and nonprofit organizations to have funded and facilitated patent licensing by universities and other federal contractors to industry. Simultaneously, large industries also supported university research. Private companies such as Microsoft are best example for this. All of these policies contribute to the significant technological growth in US.

III. Labor Force Effect Of The Policy

The US scientific and technological system consists of federal and private governing, objective-oriented research programs or R&D programs. This US system engine is the US labor force, because the US government inverted a large share of the funds to improve the quality of human capital.

Table 3. Number of research Scientists and engineers in 1981

Country	
US	6.2
Japan	5.4
Germany	4.7
UK	3.9
Norway	3.8
France	3.6

Sources: OECD

Note: Numbers are per 1000 of the labor forces in 1981

Table 3 shows that the share of secondary students going for university training in the US was about twice as high as that in France or in the UK. It shows powerful human capital investments in the US in 1981. Therefore, the share of the R&D scientists and the engineers in the US labor force was a one-third larger than that of the UK and of France.

Table 4 illustrates diplomas giving access to higher education as a percentage of age group and the proportion of those students choosing scientific or engineering training reasonably responding to economic conditions. For example, in 1982 foreign born scientists and engineers accounted for full 17 percentages of the all scientists and engineers employed in US.

Table 4: Diplomas giving access to higher education as a percentage of age group

Country	%
Japan (1981)	87
Sweden (1982)	82
US (1980)	72
Germany (1982)	26
Denmark (1980)	25
France (1983)	28
Italy (1981)	39
UK (1981)	26
Finland (1980)	38
Austria (1978)	13
Netherlands (1981)	44

Sources: OECD

The US labor market promotes the accessibility of its stock of human capital. Their link takes several forms of active efforts by the US universities to improve the technological skill of the labor force. Moreover, the scientists in the universities broadly consulted the engineers in the industry. Also, US facilitated co-authorship of journal articles by researchers in the universities and technological industry and academy. The government also donated industrial equipment to to university research facilities.

1. Human capital and education push policy

Capital markets in the US are depended on two systematic features; the depth and breadth of the equity market or simply how large and how expanded are the equity market in the US economy. Also, under this condition in the US market, the availability of the capital finance for new companies made it possible for them to have a broader entrance in to inverted technology markets. Over 15000 firms in the United States have R&D laboratories. This is a comparison between the 1500 in France and 800 in the UK. The number of firms with some technological capability in any given area is likely to reflect this deference of the capital markets. This generates a large capital stock and quality capital market, effective innovations, skill labors, and potential successful entrepreneurs in the US economy.

This strong capital stock motivated these countries to industrialize, and this process impacted on education push or countries establishing innovative education systems. Germany, US, and Japan specialized in the education development in the chemical, engineering electrical industries, mechanical ingenerating etc. For this they need a higher quality university system and an effective schooling system capable of training teachers and scientists for the industry. Therefore, US education policy motivated this strong capability for education.

The most significant feature is probably the depth and breadth of investment in the human capital. For this they used the strong secondary education system. It is shown in table 5. 6 and 7.

Table 5. Higher education greening qualification

Countrify	Frist degree	Per million population	Below first degree level	Per million population
Germany (1981)	7,000	110	16,000	260
US (1982)	80,000	350	--------	----

Japan (1982)	74,000	630	18,000	150

Sources: OECD and MSC

Table 6. Percentage of a generation entering higher education

Entrance to further education as percentage of generation (Around 1980)		Approximate growth %			
		1965- 1975		1970- 1980	
		U	FE	U	FE
Japan	62	153	170	45	50
US	62	-2	40	-10	10
Sweden	25	---	85	---	---
Germany	20	58	60	20	27
Denmark	33	136	---	23	---
France	34	----	---	---	---
Italy	25	----	130	---	8
Belgium	---	----	----	9	---
Finland	10	19	24	61	---
Netherland	26	39	----	12	---
UK	29	15	----	12	43

Source: OECD
Note U= universities FE= Further education

This system is characterized by a higher education participation rate. According to the OECD database more than 85 percent of 17-year-old children are in the education and training system and in comparison, to that, it is around 60 percent in the UK and 70 percent in France. All these countries relatively spend higher level of investment in education in comparison to the other OECD countries. Until this point, we discussed the general education condition in these economies. Now let's consider the vocational and technological education and how it affects the economies of selected countries.

Table 7. Distribution of student in upper secondary education around 1980-82

Country	*General education*	*Vocational and technological*
Japan	70	30
US	76	24
Germany	21	79
France	40	60
Italy	34	65
Netherlands	40	60
UK	57	43
Switzerland	25	75
Austria	17	83
Belgium	44	56
Denmark	37	63
Finland	50	50
Sweden	30	70

Source: OECD

Particularly in the German-speaking countries the youth covers a large part of the skill certification. Because of that, most of the youth studied at the vocational centers in 1980-82. It shows that there were over 50 percent of 17-year-olds in vocational training education. They were coming from Germany, and Switzerland. But France and the UK showed only 10 percent in the young vocational education category. But, in comparison to the other countries, US demonstrated the lowest vacation education percentage in 1980.

Overall, this structure of the investment in the human capital yield two outcomes; a university system capable of keeping up with the frontiers of science, though not necessarily barking their experiments or research, and a higher level of intermediate skill in the working population. The fact that these skills are certified through a standardized system of examinations makes the internal labor market efficiency and informational efficiency of the human capital. Therefore, the human capital and technological policy depend on success of not only in the investment in human capital but also in examination of the policy process. Until this point, we discussed technological, human capital, and the R&D policies in different OECD countries in the world, focusing specifically on US, UK, and France.

IV. Public Privet Partnerships (PPP)

Mariana Mazzucato (2016) published very interesting paper called “From market fixing to market-creating a new framework for innovation policy”: This paper illustrates more important new policy dimensions in technological fields. She introduces impotency and the nature of (public and private) organizations that can welcome the underlying uncertainty and discovery process. According to her, having significant economic growth for any economics in the world, necessary to follower major technological investments in correct policies. In this section we introduce these recent policies in the world.

When public and private sectors joined together it creates new technological policy paradigms for the world, (Mowery, Nelson, and Martin 2010; Ruttan 2006). Crucially, the public side of such partnerships was not limited to incentivizing, facilitating, or de-risking the private sector. Rather, it required that (public) risks be taken through choosing a particular direction of change (Mazzucato 2013a). These understanding make significant technological outputs and the innovations in the economics.

Mazzucato (2016) explained market Market failure theory. According to her, this market failure based on the higher risk of the investment, evaluation criteria of the mission-oriented investment, and sperate market actions of the public and privet sectors in the economy. For the example, public investment in the market does not consider the externality; both negative and positive externalities generate different policy failure in both sectors in economy. Such as the market failure the theory suggests that governments intervene to fix markets by investing in areas characterized by positive or negative externalities. For example, positive externalities arising from public goods, but this affects will be characterized by underinvestment by the private sector. opposite side the privet sector does not consider the external cost of the negative externalities in private investment such as carbon cost, populations growth. This both actions make market failures in the economy. According to this condition, she expiated the importunacy of the PPP policy for the economic development.

For the successful PPP , she suggested, public investments must work in fields of technological revolutions (IT, biotech, nanotech) and new general purpose technologies (such as the Internet), basic research applied research in public health, Small Business Innovation Research and etc. thus public sector not only working this field but also it has a responsibility to understand such mission-oriented policies, and to guide future ones, it is essential to develop a framework that can take into account investments that direct/steer change in particular directions, de-risking, and taking risks and uncertainties as lead investor.

On the other hand, the private sector has to formulate and implement policies as a given solution for societal challenges. these solutions have to promote the transformation of the economy, by generating new dimensions for the technologies, sectors, and markets, the public sector has a responsibility, must clear the path itself and organize the possibilities for the privet sector.in other words, the public sector is essential to the generates and transforms the technological and socioeconomic change, and also this transformations mush explain the structure and shape of the social organization and innovations of the society. Innovation is subject to extreme uncertainty, which creates the need for both patients (“patient long-term capital”, Mazzucato 2013b).these public actions effect to the restructuring the privet sector and this restructure of the public agencies to learn in a process of investment, discovery, and experimentation, and see the policy as a process in the economy (Hirschman 1967).

Let’s we see how works this PPP policy in the economic field. this PPP policy must be to establish skills/resources, capabilities, and quality and effective structure of public organizations. Moreover, it has to make learning policy opportunity for both sectors in the field. Public and private organizations must re-rethink their roles when working together. both sectors have to understand their responsibilities and have to respect each other in working fields. but the more important thing is both sectors have to minimize the investment risk and maximize the probability of picking winners(Rodrik 2013). Furthermore, Block and Keller (2011) explained this partnership have to fix is failures of the investment projects and have to improve and renew future policies in research on the developmental in economies. Therefore we need to think benefit from looking at the ways in which public-private partnerships were created when seeking the joint creation of new products and services, including vaccines (Chataway et al. 2007).

This PPP policy is significantly working in USA, Japan, UK, Singapore and more industrial develop countries in the world for the example

US Department of Energy recently provided guaranteed loans to two green-tech companies: Solyndra ($500 million) and Tesla Motors ($465 million). Those all companies are privet and US government invert these privet partnerships, because of that, "if the public sector is expected to compensate for the lack of private VC money going to early-stage innovation, it should at least be able to benefit from the wins, as private VC does. Otherwise, the funding for such investments cannot be secured" As argued in Mazzucato and Wray (2015)

For example, the US Department of Energy recently relisted loans to two major private companies: Solyndra ($500 million) and Tesla Motors ($465 million).bacuse of the previously these two companies faced some industrial fliers in the market and the US government wants to help reduce this ricks and restructure these companies in the market. because of that, these public sectors are expected to compensate for the lack of private money going to early-stage innovation, it should at least be able to benefit from the wins, in present. Otherwise, these companies and their expensive experiment will die without any benefits for the society. Mazzucato and Wray (2015), therefore this PPP policy works in major role in current technological policy. In the next section we explain benefits and costs of these all policies.

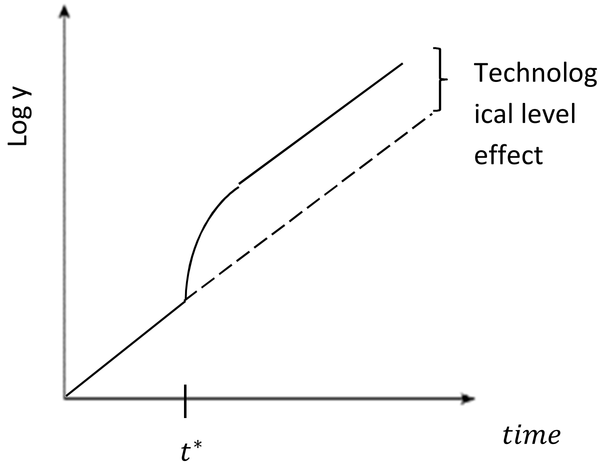
5.8 Cost Benefit analyze in technological policy

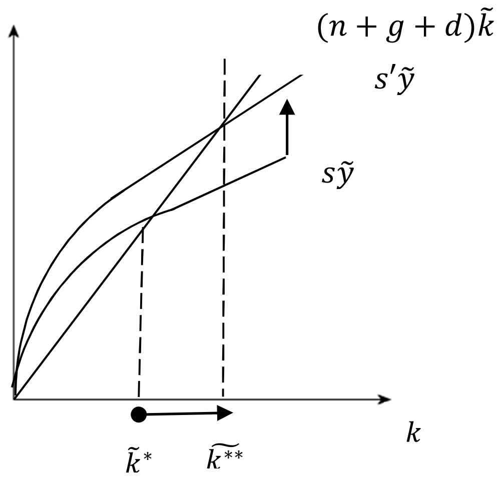
Table 8. Cost Benefit Analyze

Benefits	*Cost*
• *Experiencing fundamental technical progress; the ability to produce more output in the form of faster processors expanded storage capacity and increased capabilities in the economy. This affects both industry and aggregate productivity.*	• Technology is an expensive project of R&D
• *Technology is the cost, time, and money saving option for the economy.*	• Technological experiment consumes larger amount of economic resources
• *Information technology and capital accumulation appear entirely consistent with the neoclassical model. Massive input substitution and rapid capital accumulation*	• Inside the priority rule of technological policy, there is does no pay for the “runners up”. Winner takes all. It demotivates the other scientists in the economy
• *Information technology inputs have a substantial impact on growth and labor productivity at the aggregate level*	• The technological patent system makes the same discovery later and share the rent. Therefore, this is a much expensive condition for the instructors and the economic
• *Technology also concerns with the physical capital and the quality of the capital stock*	

- *The technological policy changes in the Solow model increase the growth rates, and this is also a long run growth effect. Policy changes can have technological level effects, which is a permeant policy change that can permanently raise the level of per capital output.*

- *The technological changes in investment rate or population growth rate affect growth of the long run output level per worker but do not affect the long run growth rate of the output per worker. It affects the investment rate in the economy.*





- *Includes technology for the labor in different economic conditions and educational skills. Extending* agents in the economy.

- Patent system holds the knowledge and prevents monopolistic power for the inventor, and it makes an imbalanced knowledge market.

- Research and development R&D technical faults. There are at least five interrelated questions in the economics of science and technology policy. These generate difficulties for researchers and for the technological policy.

  - What is the research problem of the agenda?
  - How many projects and what kind of the research projects are they?
  - How are resources to be allocated to the research project?
  - Who is conducting the research?
  - Who ought to have the final owner of the research outcome?
  - research personnel?

This condition makes insignificant outcomes in the R&D sector.

- Technological gap of the countries caused the increasing income inequality of the developing world. (OECD Empirical Analyze)

- Technological development in the long run *the Solow model to include human capital or skilled labor is relatively straightforward as we will show in the following economic growth.*

$$Y = K^{\alpha}(AH)^{1-\alpha},$$

- *Human capital of the economy is assumed to affect the technological progress by having an influence on the domestic innovation, and on the collaboration of foreign technology,*

- *Technological changes have contributed to new economic trends for the ordinately. We called this "Positive economics".*

- *R&D, with the technological policy contributes to the knowledge of the world .*

- *Public policy is much complicated in the information field because R&D benefits depended on the technological opportunities.*

- *Technological policy improves the opportunities of the government: governments have access to appropriate and new technology at the lowest possible cost, with forecasting invention and innovations. It also encourages the innovations, new technologies, and governments get adapted to technology related advance economics advantages in to economy.*

- *Technological policy should be concerned with the use and exploitation of technology as well as with its sources. Keith Pavitt (1989) introduced the principles sources of the technology.*

- *Technology works in the technological policy. For example, innovation field, production field, wealth creation field, inputs or capital industry etc. Therefore, technological policy is a much-advanced policy in the economy.*

- *Technological policy improves the condition of science policy and vice versa. This science policy is closely integrated with the health policy, environment protection policy, and again technological policy .*

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- *Patent policy of the technology secures the ownership of the innovation and also, patent system* results in capital deepening and this may generate growing unemployment rate in developing countries

▪ There is a negative relationship between industrial technology development rate and Environment protection (Eric Maskin,1989)

▪ Technological resources are not common in every country in the world. Therefore, technological policy implementation gives deferent outcomes according to the deference in the economics and scientific conditions in different countries. As a result, some of the outcomes may not illustrate the real outcome expected by the world.

undertakes to solve the problem of financing the pursuit of the scientists.

- *The globalization of R&D and the increasing spatial division of R&D: the geographical widening and deepening of R&D .*

V. Conclusion

In conclusion of this paper tried to summaries what appears to be the basic issues in the economics and technological policy. Beginning of this chapter, it stated the informational role of the R&D policy and significant benefits and costs of this role. also explained the value of public policy and SO in the society. Then, this paper explained the role of technological and science policy along with implementations, policy instruments, and final cost-benefit analysis of these policies. However, the academic history proves the significance of the technology for the economic growth and development. This descriptive research also proves this significant relationship again. Also, this work provides knowledge to policymakers to identify the important areas in the technological policy. Finally, this work theoretically and empirically proves the importance of the Solow growth with technology in the economic growth theory.

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