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## Technological Change and Economic Growth

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### Abstract

In a globalizing world economy, the reason for differences in economic growth and inter-country income inequality is explained on the grounds of technological differences. The goal of science and technology is to enable enterprises and individuals to use technologies more efficiently, as this results in reduced costs and enhanced productivity gains. The use of new technologies paves the way for production of new cheaper goods and for capital accumulation and, for that matter, for an enhanced international competitiveness of individual countries, as well as to an enhanced quality for scientific research institutions, while, on the other hand, contributing to cultural and political development of societies. The quality of growth rates is as much important as their size. One may ask the following questions in order to get a better understanding of whether growth has its reflections on people's life or not: Are people involved and included in growth process? Does everybody enjoy the opportunities driven by growth? Do new technologies or trade volumes increase the choices facing people? Is welfare level of the future generations planned? Or, else, who is cared about is today's generations only? Are markets accessible and open to everybody?

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### 1. Introduction

Technology developed and unceasingly continued to evolve since the start of history of mankind. In the 2000s, technology has transformed into a structure containing large amounts of information. In the past 100 years, technological advances increased with incredible speed as compared to the previous times.

Technology involves application of science especially for industrial or commercial purposes and use of

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scientific methods and materials in order to achieve a commercial or industrial purpose and making “innovations” to the production machines, production methods and products in order to increase the production volume or efficiency all resulting in competition advantages and profit increases. Therefore technological transformation plays a key role in the economic growth because accurate or wrongful use technological advances may make considerable positive or negative impacts to a specific firm, sector or nation. For that reason, it has been assumed that technological development and technological information is an external factor which has a public character. Technology realizes the production of specific goods with less input. And technology is not complex and it could be understood, sold and purchased easily. So its transfer from one firm to the other does not require too much effort and cost and similarly no problems arise in its transfer from one nation to the other (Elster, 1983).

Technological development is an important factor increasing the growth rate of economy at macro level and profits and market shares of the firms at micro level. The social development occurs if a society can make technological advances and reflect them to their social and cultural lives. It seems that economy has been guiding the technology as the innovations introduced to the world by technological advances are closely correlated with economy and follow the economic relationships. The nations that could efficiently disseminate technology and information to all areas of the society can create new areas of employment in their countries. However these new areas require qualified work force. Thus necessary revisions should be made to the education policies to ensure the development of human sources with such qualifications supporting the economic growth.

## **2. Literature Review**

### *2.1. Economic growth and definition*

Economic growth is defined as an increase to the tools and products that will be used to meet the human needs in any country or region. A method to measure economic growth rate involves inquiring whether there has been a real increase (excluding price increases) in GDP (Gross Domestic Product) from one year to the other as GDP represents the market equivalent of all measurable values produced by one economy.

The main three indicators of economic growth are capital accumulation, technological advances and increase in the population and work force. Capital accumulation is considered as the basic dynamic of economic growth. The most important condition to be met for guaranteeing development is the existence of sufficient investments. And realization of an investment depends on the increase in savings to be earned from the revenues. As the second indicator of economic growth, technological advances can be defined as the whole system of information, organization and techniques required in the production processes. With the help of technology, it is possible to obtain more outputs with the use of same quantity of inputs in any production process. This surely will bring savings in the work force and capital. The final indicator is an increase in the population and work force. With the increase in population resulting in a similar increase in the work force, an important motivator of economic growth will be created.

## **3. Economic Growth Theories**

### *3.1. In theory*

However source of economic growth has changed throughout the history. The increase in and strengthening of the state’s treasury was taken as a basis in mercantilism and the condition that export volume being more than the import value was accepted as a general rule for growth. Physiocracy adopted

the idea of continuing the natural order. As the basic sector of economy, agriculture is the only way for growth. This thought partially accepts the importance of industry and did not give any importance to commerce.

The classical growth theory was developed at the end of the 18<sup>th</sup> century and beginning of the 19<sup>th</sup> century by A. Smith, R. Malthus and D. Ricardo. This theory uses the concept that population increase is determined by the level of income per person. Classical growth theory was dominant when most of the population worked in animal breeding and agriculture in 1770s. Working conditions of the people employed in animal breeding and agriculture were harsh and income levels were low. In time, productivity in agriculture increased with the technological advances. With the increase in productivity, production also increased and agricultural workers started to migrate to the cities. Revenues increased for the people migrating to cities and it seemed that wealth was enhanced. However classical economists believe that increasing wealth levels will not be permanent for the people. In the later years, birth rates reduced in the Western countries and population increased slower. Reasons like increase in the employment chances and salary levels for women resulting from reduction in population increase rates and higher costs required to raise a child caused the families to have less children. This caused a reduction in the birth rates. The inverse relation between the growth rate of real income and growth rate of the population gave a consequence not conforming to the expectations of the classical economists.

According to the growth principle in neo-classical theory, technological transformation causes an increase in the capita per person and motivates savings and investments and as a result, causes an increase to real GDP. If technological transformation ceases, the growth will also stop. Schumpeter is known as the first economist to defend that technological development will make positive impacts to the economic growth. The conceptual framework of Schumpeter brings forth “an evolutionary process developing with the creative destruction of the weakening sectors and involving the development of new technologies and new industries in economy”. This process is correlated with the technological advances defined as economic growth and structural changes. (Justman & Teubal, 1991) In Schumpeter’s approach, technology is an external concept very much like in neo-classical approach and the firms buy proper technologies for them by monitoring the technological advances. Thus Schumpeter expanded the area of the technological novelty concept and defined it not only as the use of a new technology in a production process but also as to include other processes such as production of a new goods, opening of new markets, making new market organizations and finding new sources for the raw materials.

All factors affecting technology such as characteristics of the product produced, organization of the production process, capacity of the production unit, size of the targeted market, type and quantity of the energy used, size and nature of the business volume generated, supplementary inputs, requirements for the semi-finished goods and development level of the infrastructure facilities leave their mark to the country in which the technology is developed. Thus it is not possible for technology to be impartial or neutral to the social and economic conditions.(Stewart, 1978). Technology transfer is made from developed countries to the developing countries and causes inefficient production and imbalance in distribution of revenues in these countries. Capital-intense techniques bought against very high costs from the developed countries create unemployment on the one hand and require expertise that is normally not provided by the technical capacity of that country on the other hand. For that reason, transfer of capital-intense technologies based on the consumption habits of the Western countries creates problems (Schumacher, 1975).

The aim of modern societies is to guarantee economic and social development in order to enhance wealth levels. This aim requires increasing the volume of goods and services produced in the society. However quantity of the production factors and increase in efficiency depends on the technological developments.

For that reason, the production increase occurring in a specific time period represents the growth in that economy (Bocutoğlu, *at all*, 2000). Growth takes into account the numerical variations in a country's economy but it does not take into consideration those variations that could not be defined in numbers in the economic, social, corporate structures and other structures. At this point, the source of increase in the production of goods and services can be said to be the increase in the production capacity (Bocutoğlu, *at all*, 2003). Under-developed or developing countries must attempt to develop their scientific and technical capabilities to create their own technologies according to the social and economic conditions of their countries. In line with this aim, these countries must adopt an efficient scientific and technological policy and must make social, economic and cultural independency and self-sufficiency their priority under that policy (Herrara, 1977). It is generally accepted that technological transformation is one of the most basic determinants for a rapid increase in the production volume and income and is a must for achieving international competitive power. In its book named "Competitive Superiority of the Nations". M. Porter addressed "competitive capacity" from the aspect of "enhancing life standard/wealth of society" and defined it as the ability to increase productivity. In that regard, Porter points out to the fact that competition race is made totally among innovative firms and gaining the ability to create technological novelties in these firms results in both an increase in the productivity and also guarantees competitive advantages in the international markets (Porter, 1991)

Technological transformation does not only mean a way to increase the richness and wealth of the nations but it also gives the people the ability to do things that they have not done so far. Therefore the novelty determines whether a whole life quality will develop positively or negatively (Freeman and Soete, 2003). As a matter of fact, negative consequences of technological transformation and industrialization – for example rapid consumption of natural resources, pollution of natural environment, disruption of the ecological balances- are greatly restricting the chances and sources for the future generations. Rapid consumption of the resources poses the threat for big hostilities and conflicts among the nations in the future. Even at this point, it is obvious that the cost to replace the rapidly consumed resources will be very high and economic problems will be inherited to the future generations. In the report named *The Limits of Growth* that was published in 1972 by a group of researchers known as Roman Club and made tremendous impression in the world, five global trends that are of great concern have been determined. These are: increasingly fastening industrialization, rapid increase in population, widespread insufficient nutrition/famine, fast consumption of non-renewed resources and environmental pollution. This study aims to unfold the potential consequences of these five trends affected from each other in the next century (Meadows *at all*, 1972).

In the second report of the Roman Club named *Mankind at the Turning Point*, the researchers say that technological optimism is the most widespread and dangerous reaction since technology can only alleviate the symptoms of a problem and cannot eliminate the reasons laying under the problem. Roman Club believes that finding shelter in technology causes us to ignore "the problem of growth in a limited system" which the most important problem and prevents us from taking the necessary measures to find a solution and then summaries its attitude as "opposition against ignorant development rather than an ignorant opposition to the development (Mesarovic & Pastel, 1975).

And in the final report of the Roman Club named *The First Global Revolution*, the researchers point out to the fact that technological novelties may bring us the ability to solve our problems to the extent we can use our political will. They also warn us about the global warming threat, "hazardous nature of global food safety issue" and new problems increasingly arising between the rich countries and poorer countries (King & Schneider, 1991).

If we try to find an answer to the question of how to create political will, we must first remember that a certain problem will mostly have various technological solutions rather than a single solution and this solution may have certain weak and strong aspects. Although the people residing in developed countries comprise 20% of the world population, they consume 80% of the natural resources used in the world (Brown and others, 1989:174-94, retold by Lowe, 1998).

If we examine the countries of the world, we can see that economic differences among the countries cause important differences in life quality. While certain countries regularly improve the life quality of individuals with the support of advanced technologies, other countries is way behind them in this improvement.

#### **4. Conclusion**

Nowadays scientific and technological changes form the motivating power of scientific and economic policies adopted to ensure economic growth and development. Technological development brings economic growth. However it also enhances social wealth on the one hand by increasing the income levels and wealth and causes certain social problems on the other hand.

Technological development makes very important contributions to the economic and social-cultural life. A study conducted in America reveals that people work more than the past; virtues like industriousness and self-discipline are more valued; entrepreneurship increased and people increased their technological capabilities for their new careers (Eraydin, 2001). However in spite of these positive developments, the fluctuations and uncertainties created in the commercial life by the technological development caused uncertainties in the job positions of the employees. While technological development eliminated certain jobs and work areas and made a negative impact to employment on the one hand, it created new job opportunities and taught other methods to perform the jobs on the other hand.

This condition brought negative consequences for the developing countries that have great difficulties in producing technology. The traditional industrial centers of the past find hard to preserve their competitive power and at the same time, global cities started to become dominant as new supervisory centers. Causing increased communication, easy and fast access to the new markets, increase in the marketing channels and company mergers, technological development made a positive impact to the economy. As a result of e-commerce made on Internet, the dimensions of commerce have changed. The producers and consumers could meet with each other in international markets through e-commerce and make commerce. Technological advances develop competition among nations.

For the technology producing countries, technology brings economic and military superiority to other countries. Thus countries with superior technology may exert pressure to the other countries. The speed of the technological development causes economic uncertainty and difficulties in forecasting the future. Increasing exposition of the economies to global fluctuations, fierce competition environment and insufficient security cause economic negativities. Increasing mutual dependency between the global countries make economies exposed to the financial crises (Mandel, 1998). One of the areas in which we can observe the effects of technological development is the financial markets. Many banks and intermediary institutions adapt their systems to the technological developments and start to provide on-line banking services. Branch-free banking activities are able to provide banking services on 7-24 basis throughout the world because information could be transferred and shared.

At this point, we must emphasize the importance of education. Education may make a great contribution

to this ongoing process by re-training the people and helping the individuals and to societies adapt to the new conditions. Therefore the nations should to derive the maximum benefits (growth) from technological advances by supporting and disseminating the positive aspects of this process and minimizing its negative impacts.

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