# CONTRIBUTION OF TOTAL FACTOR PRODUCTIVITY IN ECONOMIC GROWTH RATE

***Ahmet Emre Biber***
Assoc. Prof. Dr. Abant İzzet Baysal University, Turkey biber_a@ibu.edu.tr

## ABSTRACT

The main source of growth rates of countries is the increase in total factor productivity (TFP), which is the amount of physical-human capital used in production and how these two factors are used together in the most efficient way. One of the most important determinants of economic performance is productivity growth. New theoretical approaches, together with the increase in the amount of investment, show that productivity increases contribute positively to the growth processes of developing countries in particular.

**Keywords**: Growth, Total Factor Productivity, ICT, Labor Quality

## 1. INTRODUCTION

The main source of growth rates of countries is the increase in total factor productivity (TFP), which is the amount of physical-human capital used in production and how these two factors are used together in the most efficient way. Nevertheless, while it is possible to dividing GDP by the sources of growth, the contribution of human capital, the quantity of labor and the quality of labor, the contribution of capital to GDP growth is Information and Communication Technologies (ICT) capital (which includes hardware, communication and software) and non-ICT capital (transport equipment and non-residential construction; products of agriculture, metal products and machinery other than hardware and communication equipment; and other products of non-residential gross fixed capital formation) (OECD, 2011). The increase in the quality of labor capital and ICT capital, which includes technology, is the source of the increase in TFP.

With the globalization of the world economy, economic growth has become one of the main issues of all countries. In this process, the countries have been looking for different economic policies to determine what the engine of growth and what resources are and how these dynamics will take action so that faster economic growth can be achieved. However, in economics theory there are different approaches and debates about the basic sources of growth. For example, according to the Harrod-Domar model, while the increase in growth is due to a constant production technique, an increase in the savings rate or the efficiency of the capital, Solow (1956) bases the basic source of economic growth on the capital and labor factor, but the technology as an external and fixed variable. Solow also concludes that the assumption of diminishing returns and constant return on a scale, while the growth rates of the rich countries will enter a period of steady state, poor countries will catch up with the following path of developed countries. After the 1980s, such as Lucas, (1988), Romer, (1990), Grossman, Helpman, (1991) and Rivera-Batiz (1991) Other approaches, expressed as internal growth models of economists, contrary to Harrod-Domar and Solow models, they expressed that the basic dynamics of economic growth are technology-based, such as human capital investments, R & D activities and innovation, which are sources of total factor productivity (TFP).

Total Factor Productivity (TFP) increases are very significant on growth. This effect is realized by two ways. The first is the contribution of the ICT to capital accumulation and the other is the contribution to total TFP. ICT and increasing level of technological development contribute to the accumulation of capital and increasing the TFP by causing investment

increases in the sectors producing and using these technologies (Saygılı, 2003, Yapraklı ve Sağlam, 2010).

ICT is basically affecting economic growth by increasing the efficiency of the physical capital, increasing productivity, creating employment opportunities, technological development and spillover effects. for this reason physical capital increase contributes to growth as an increase in the amount of production factors, while more efficient use of physical capital requires increased knowledge accumulation. Because the reduction in the marginal return of the physical capital is postponed due to the increasing efficiency of the information, investments in information technology together with physical capital constitute the source of technological developments (Yapraklı ve Sağlam, 2010).

## 2. R&D AND INNOVATION FOR TFP

Increasing Total Factor Productivity (TFP), one of the sources of economic growth, is a key variable for sustainable growth. The debate about the relative importance of non-material factors such as physical, human capital, labor, and knowledge to growth is quite old. While the neo-classical model regards technology as an external process as the source of growth and instead focuses on capital accumulation, the theory of internal growth and its successors treats the effect of technological process as an internal variable. Innovation in these models has been considered as the driving force of productivity growth (Coe & Helpman, 1995). As a matter of fact, for sustainable economic growth, as well as increasing.the capital stock and labor their productivity must be increased. Increases in production and productivity levels are largely dependent on inputs used in the production process. For example, human capital contributes to the technological progress, process by facilitating the production and use of technological knowledge as well as facilitating the adaptation of the labor force to technological development. The realization of these contributions depends both on the high efficiency of the human capital and on the positive externalities that increase the productivity of other production factors. Because these externalities spread among the economic units and increase the productivity of the human capital in the production of information (new product or new production method), and thus the economy has a greater knowledge stock (Çakmak & Gümüş, 2005:62).

Technology also affects economic growth in terms of total productivity. In order to achieve sustainable economic growth, it is necessary to increase the level of factor equipment or productivity. Increases in production and productivity levels are largely dependent on inputs used in the production process (Özgüler, 2003: 117). An increase in the productivity of the technological knowledge factor which is one of these inputs, plays an important role. Increased possibilities of acquiring knowledge in the information economy, the elimination of restrictions to market entry, the reduction of costs, the possibility of providing uninterrupted services, and etc. contribute to increasing productivity and increasing productivity (Yapraklı ve Sağlam, 2010).

In theory, innovation is an important variable that increases productivity in the production process and is the result of R & D investments. Increasing and activating R & D investments will allow for a high growth trend by increasing both physical investments and factor productivity (Taban & Kar, 2006). On the other hand, R&D activities are an indication of an country's ability to create technology. Because R&D investments are great importance in the development of new products and production systems, at every stage of technological activities such as the efficient use, adaptation or replacement of existing technologies or imported technology. It is therefore not only an important determinant of growth performance but also of international competition (Parlakyıldız & Güvel, 2015:34). In addition, R&D investments have an increasing effect on total factor productivity. This effect is not only

dependent on local R&D investments but also on foreign R&D capital investments. Because R&D activities are input of technological innovation. Technological innovation is the engine of increased productivity both in human and physical capital. Therefore, while R&D investments are a source of growth by affecting the total factor productivity on the one hand providing a cumulative increase in information stock (Coe & Helpman, 1995).

## 3. EFFECT OF TECHNOLOGY TRANSFER

Globalization is a process in which national and regional markets are tightly integrated with each other and the effect of governments and the national barriers in transferring technology and trade with each other (Maskus, 2000).

Technology transfer between countries, foreign direct investment, and its total factor productivity and its impact on growth are often discussed in the literature. There is a significant relationship between foreign direct investment, trade flows and technology transfer. This relation arises from technology transfer, learning new technologies and R & D activities. The degree of protection of intellectual property rights in this process is also very important. Analyzing the development disparities between countries, it is seen that developed countries have the ability to create higher technology and therefore have more stable and high growth rates. However, the emerging economies of the developing world can only benefit from this transfer of technology. The first way of transferring technology is the import of technology products in the form of raw materials and the second is direct foreign capital investments.

The impact of foreign direct investment depends on the content of investments. If the investments are concentrated in the areas of low technological goods and services such as distribution, textile, assembly and hotel management, the impact of investments will be low. Because what is important for developing countries is transfer to new technologies and production techniques. It is necessary for the developing countries to carry out structural and institutional changes in order to attract such investments to their own countries. As a result, technology transfer, which will be provided by foreign direct investment, will positively affect growth by increasing high-tech investments, increasing efficiency in recreation and international trade.

It is widely acknowledged by economists that the trade of goods and services can lead to the transfer and diffusion of technology, reduce the costs of importing capital goods and technical inputs, and increase factor productivity. However, this benefit varies depending on the technology content of the import. For example, Mayer (2001) has found that the import of technological goods in the study of 51 developing countries has reached the conclusion that the interaction between human capital and machinery equipment in these countries has increased total productivity. Coe, Helpman (1995) examining 22 OECD countries, foreign R & D activities have resulted in direct effects of new technology and materials such as production processes and establishment methods, while indirect benefits are derived from imports of goods and services developed by trading partners. Coe, Helpman, and Hoffmaister (1997) in their study of 77 countries, including OECD and developing countries found that high technology imports of technology imports tend to increase total factor productivity by 1% in OECD countries and by 0.3% in developing countries.

## 4. STATUS IN ADVANCED ECONOMIES

As seen in the table, developed countries are seen to be positive in terms of average growth rates of 20 years between 1994 and 2014. However, the main source of this long-term growth rate of these countries comes from the amount of labor quantity and contribution of ICT

capital. This is more pronounced in countries like Norway, South Korea, Taiwan, Turkey Australia, China and Brazil.

Table-1: Developed Economies Average Growth Rate and Resources (Approx.%)

| | 1994-2014 Avarge Growth Rate | Contribution of Labor Quality | Contribution of Labor Quantity | Contribution of ICT Capital | Contribution of Non-ICT Capital | Contribution of Total Factor Productivity |
|---|---|---|---|---|---|---|
| France | 1,6 | 0,2 | 0,1 | 0,3 | 0,8 | 0,1 |
| Germany | 1,3 | 0 | 0 | 0,4 | 0,3 | 0,6 |
| Finland | 2,3 | 0,1 | 0,4 | 0,9 | 0,3 | 0,6 |
| Italy | 0,6 | 0,1 | 0 | 0,2 | 0,5 | -0,2 |
| Sweden | 2,5 | 0,1 | 0,3 | 0,7 | 0,9 | 0,5 |
| United Kingdom | 2,2 | 0,3 | 0,5 | 0,7 | 0,8 | 0 |
| Canada | 2,6 | 0,2 | 0,8 | 0,7 | 1 | -0,1 |
| Japan | 0,8 | 0,2 | -0,4 | 0,3 | 0,4 | 0,3 |
| United States | 2,5 | 0,2 | 0,5 | 0,6 | 0,6 | 0,6 |
| Norway | 2,3 | 0,1 | 0,5 | 0,4 | 1,6 | -0,4 |
| South Korea | 4,6 | 0,4 | 0,2 | 0,6 | 1,6 | 1,9 |
| Taiwan | 4,4 | 0,3 | 0,4 | 0,5 | 1,7 | 1,5 |
| Turkey | 3,7 | 0,1 | 0,6 | 0,4 | 4,0 | -1,4 |
| Australia | 3,3 | 0,2 | 0,9 | 0,8 | 1,6 | -0,3 |
| China | 7,0 | 0,1 | 0,6 | 1,2 | 5,0 | 0,1 |
| Brazil | 2,9 | 0,1 | 0,6 | 0,9 | 2,5 | -0,2 |

Kaynak: The Conference Board. 2015. The Conference Board Total Economy Database™

In addition, it is seen that the amount of labor force is the other important factor that is the source of growth in the countries. Together these two variables determine the growth rates of these developed countries at a significant level. However, it is also seen that the contribution of technology-based capital is also significant to the growth rates of developed countries in the table.

For all developed countries, on the other hand, the impact on the growth rate of TFP, which is influenced by the quality of the labor force and the technology-based capital, is negatively or very low, except for Taiwan, South Korea, United States, Sweden, Germany and Finland. The most important factor here is the impression that the quality of the labor force is closely related to the low contribution of all countries.

Another noteworthy situation in the table is the countries such as Turkey, Australia, China and Brazil where the growth rate of the last two decades is high but the effect of TFP is negative. In other words, the weighting of the TFPs in the countries will be a significant increase their growth rates.

## 5. STATUS IN DEVELOPING COUNTRIES

From the perspective of the developing countries, it is seen that the distribution of the resources of the economic growth rate is more different. The contribution of the workforce to the growth rate is generally low, but the contribution of information technology is seen to be the same as the developed countries, except for the major natural gas exporter countries such as Russia, Qatar, and Azerbaijan. However, it is seen that the contribution of Non-ICT Capital investments which are the main factors for the economic growth rate of the developing countries.

Although the growth rates of developing countries are high, the impact of TFP is either very low or negative in countries where the main source of growth is from Non-ICT Capital and

labor quantity. The main reason of case that technological investments are less or not at all in these countries.

Table-2: Emerging Economies Average Growth Rate and Resources (Approx.%)

| | 1994-2014 Avarge Growth Rate | Contribution of Labor Quality | Contribution of Labor Quantity | **Contribution of ICT Capital** | Contribution of Non-ICT Capital | **Contribution of Total Factor Productivity** |
|---|---|---|---|---|---|---|
| India | 6,7 | 0,1 | 0,7 | **0,8** | 3,5 | **1,5** |
| Romania | 2,8 | 0,2 | -1,1 | **0,6** | 0,1 | **3,0** |
| Russia | 2,2 | 0,4 | 0,2 | **0,9** | -1,1 | **1,7** |
| Malaysia | 5,1 | 0,2 | 1,2 | **1,2** | 2,3 | **0,2** |
| Thailand | 3,6 | 0,3 | 0,5 | **0,5** | 2,1 | **0,2** |
| Argentina | 2,4 | 0,1 | 0,6 | **0,3** | 1,8 | **-0,4** |
| Bulgaria | 2,0 | 0,3 | -0,1 | **1,4** | 2,7 | **-2,3** |
| Azerbaijan | 10,2 | - | 0,3 | - | 6,2 | **3,7** |
| Colombia | 3,5 | 0,2 | 1,0 | **0,7** | 2,3 | **-0,7** |
| Philippines | 4,6 | 0,2 | 0,9 | **0,7** | 1,8 | **1,0** |
| Qatar | 9,9 | - | 4,1 | - | 4,1 | **1,7** |
| Belarus | 5,8 | - | -0,1 | - | 2,7 | **2,9** |
| Croatia | 2,4 | 0,2 | 0,1 | | 2,1 | **0** |
| Mexico | 2,6 | 0,1 | 0,7 | **0,5** | 2,1 | **-0,8** |
| Indonesia | 4,4 | 0,2 | 0,9 | **0,6** | 2,7 | **0** |

Kaynak: The Conference Board. 2015. The Conference Board Total Economy Database™

Another remarkable situation in Table-2 is that the growth rates of developing countries are quite high for the last two decades. In this increase, the effect of Contribution of Non-ICT Capital investments is high. However, it is expected that the growth rates will also slow down when the countries complete their development stages. In order for the economic growth to continue, human capital investments and technological capital investments and the TFP directly affected by these two variable to be increased.

## 6. CONCLUSION

With the globalization of the world economy, economic growth has become one of the main issues of all countries. It is clear that the main determinants of growth, both in terms of developed and developing countries are labor and capital. However, it is seen that ICT Capital and Labor Quality are the factors that lead to the economic growth of the most developed countries. In this respect, contribution of total factor productivity to economic growth gains importance. Developed countries are in an important position in the global race due to produce high technology and export of high added value products. At this point, the impact of TFP plays a decisive role in the economic performance of the countries in the long run, and it opens up the long-term sustainability of growth.

## REFRENCES

Coe, D. T. & Helpman, E. (1995). International R&D Spillovers. *European Economic Review*. 39, 859-887.

Coe, D.T., Helpman, E. & Hoffmaister, A.W. (1997). "North-South R&D Spillovers", *Economic Journal*. Vol:107, 134-49.

Çakmak, E. & Gümüş, S. (2005). Türkiye'de Beşeri Sermaye ve Ekonomik Büyüme: Ekonometrik Bir Analiz (1960 - 2002). *Ankara Üniversitesi Siyasal Bilgiler Fakültesi Dergisi*. 60(1), 59-72.

Grossman, G., ve Helpman, E. (1991), *Innovation and Growth in the Global Economy*, Cambridge: MIT Press.

Lucas, R.E. (1988), "On the mechanics of economic development", *Journal of Monetary Economics*, 22(1), 3-42

Maskus, K. E. (2000). *Intellectual Property Rights in The Global Economy*. Institute for International Economics, Washington D.C.

Mayer, J. (2001). *Technology Diffusion, Human Capital and Economic Growth in Developing Countries.* Discussion Papers, No.154, Geneva: United Nations Conference on Trade and Development.

OECD (2011). OECD Factbook 2011-2012, Economic, Environmental and Social Statistics, Paris: OECD Publishing.

Özgüler, V.C. (2003): Yeni Ekonomi Anlayışı Kapsamında Gelişmiş ve Gelişmekte Olan Ülkeler: Türkiye Örneği, Anadolu Üniversitesi İİBF Yayınları No: 179, Eskişehir.

Parlakyıldız, F. M. & Güven E. A. (2015). Fikri Mülkiyet Hakları ve Bu Hakları Korumanın Ekonomik Önemi. *Niğde Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*. Cilt-Sayı: 8 (4), 29-39.

Rivera-Batiz, A. Luis ve Romer, M. Paul (1991), "International Trade with Endogenous Technological Change". *European Economic Review*, 35: 971–1004.

Romer, M. Paul (1990), "Endogenous Growth and Technical Change", *Journal of Political Economy*, 99: 807–27.

Solow, R. (1956), "A contribution to the theory of economic growth", *Quarterly Journal of Economics*, Vol. 70 No. 1, 65-94.

Saygılı, Ş. & Cihan C. (2008). *Türkiye Ekonomisinin Büyüme Dinamikleri: 1987 - 2007 Döneminde Büyümenin Kaynakları, Temel Sorunlar ve Potansiyel Büyüme Oranı*. İstanbul: TÜSİAD.

Taban, S. & Kar, M. (2006). Beşeri Sermaye ve Ekonomik Büyüme: Nedensellik Analizi, 1969-2001. *Anadolu Üniversitesi, Sosyal Bilimler Dergisi*. Yıl: 6, Sayı:1, 159-181.

The Conference Board (2015). The Conference Board Total Economy Database, September 2015, http://www.conference-board.org/data/economydatabase/

Yapraklı, S. & Sağlam, T. (2010). Türkiye'de Bilgi İletişim Teknolojileri ve Ekonomik Büyüme: Ekonometrik Bir Analiz (1980-2008) *Ege Akademik Bakış / Ege Academic Review*. 10 (2), 575-596