

Revista de Investigación Científica y Tecnológica

Llamkasun

ISSN: 2709-2275

Trabajemos

Vol. 02 Num. 03 - Junio 2021



Estimation and its determinants of total productivity changes of Peru factors 1980 -2019



Estimación y sus determinantes de los cambios en la productividad total de los factores de Perú 1980-2019



Estimativa e seus determinantes das mudanças de produtividade total do Peru factores 1980 -2019

<https://doi.org/10.47797/llamkasun.v2i3.64>



Edición Especial

COVID - 19

UNIVERSIDAD NACIONAL AUTÓNOMA DE
TAYACAJA DANIEL HERNÁNDEZ MORILLO

VICEPRESIDENCIA DE INVESTIGACIÓN

Estimation and its determinants of total productivity changes of Peru factors 1980 -2019

Estimación y sus determinantes de los cambios de productividad total de los factores de Perú 1980 - 2019


Estimativa e seus determinantes das mudanças de produtividade total do Peru factores 1980 -2019

Marco Antonio Arroyo Yupanqui 

National University of the Center of Peru

Juan Carlos Pérez Ticse 

National University of the Center of Peru

Oscar Villaverde Montoya 

National University of the Center of Peru

Waldo Morales Paredes 

National Autonomous University of Tayacaja Daniel Hernández Morillo

Alberto Valenzuela Muñoz 

National Autonomous University of Tayacaja Daniel Hernández Morillo

Catherine Felicia Balvin De la Cruz 

National Autonomous University of Tayacaja Daniel Hernández Morillo

ABSTRACT

There are several ways to explain a country's economic growth in both the long and medium term. One of the best approaches to this is Total Factor Productivity (TFP). In Peru, it has been observed that productivity has seen a sharp drop in recent years, leading to a major slowdown in economic growth and bringing it well below its potential level. Therefore, the main objective of the research focuses on the need to determine peru's TFP within the analysis period of 1980-2019. With this, it will be possible to find the determinants of economic growth for both the medium and long term. To achieve the objective, various correlation analyses will be carried out between economic growth, explained with the country's Gross Domestic Product (GDP), and important macroeconomic variables such as investment and consumption. Investment will be found to be the variable that will be correlated with GDP. Therefore, it will be concluded that the private sector will stand out from the rest of the sectors. Then, the promotion of investment should influence the rest of the sectors of the country such as consumption and

RECIBIDO : 23-07-2021

ACEPTADO : 20-11-2021

DOI:

<https://doi.org/10.47797/llamkasun.v2i4.64>



52



external. On the other hand, it should be noted that public spending will not influence GDP. Finally, the TFP will demonstrate that the consumption of intermediate and final goods will be of great importance for the country's growth.

Keywords: total factor productivity, gross domestic product, investment and government spending.

RESUMEN

Existen diversas maneras de explicar el crecimiento económico de un país tanto en el largo como en el mediano plazo. Una de las mejores aproximaciones a esta es la Productividad Total de Factores (PTF). En el Perú, se ha observado que la productividad ha percibido una caída cuantiosa en los últimos años, lo cual propició a una desaceleración de gran magnitud del crecimiento económico y lo llevó por muy debajo de su nivel potencial. Por lo tanto, el objetivo principal de la investigación se centra en la necesidad de determinar la PTF del Perú dentro del periodo de análisis de 1980-2019. Con ello, se podrá hallar los determinantes del crecimiento económico tanto para el mediano como largo plazo. Para lograr el objetivo, se realizará diversos análisis de correlación entre el crecimiento económico, explicado con el Producto Bruto Interno (PBI) del país, e importantes variables macroeconómicas como la inversión y el consumo. Se encontrará que la inversión es la variable que estará correlacionada con el PBI. Por lo tanto, se concluirá que el sector privado destacará sobre el resto de sectores. Entonces, el fomento de la inversión deberá influir hacia el resto de los sectores del país como es el consumo y el externo. Por otro lado, se debe resaltar que el gasto público no influirá sobre el PBI. Para terminar, la PTF demostrará que el consumo de bienes intermedios como finales serán de gran importancia para el crecimiento del país.

Palabras clave: productividad total de factores, producto bruto interno, inversión y gasto del gobierno.

RESUMO

Há várias maneiras de explicar o crescimento económico de um país, tanto a longo como a médio prazo. Uma das melhores abordagens a esta questão é a Produtividade Total dos Factores (PFT). No Peru, tem-se observado que a produtividade tem registado uma queda acentuada nos últimos anos, levando a um grande abrandamento do crescimento económico e trazendo-o bem

abaixo do seu nível potencial. Portanto, o principal objectivo da investigação centra-se na necessidade de determinar a PFT do Peru no período de análise de 1980-2019. Com isto, será possível encontrar os determinantes do crescimento económico, tanto a médio como a longo prazo. Para alcançar o objectivo, serão realizadas várias análises de correlação entre o crescimento económico, explicado com o Produto Interno Bruto (PIB) do país, e variáveis macroeconómicas importantes como o investimento e o consumo. O investimento será encontrado como a variável que será correlacionada com o PIB. Por conseguinte, concluir-se-á que o sector privado se destacará do resto dos sectores. Depois, a promoção do investimento deverá influenciar o resto dos sectores do país, tais como o consumo e o externo. Por outro lado, é de notar que a despesa pública não influenciará o PIB. Finalmente, a PFT demonstrará que o consumo de bens intermédios e finais será de grande importância para o crescimento do país.

Palavras-chave: produtividade total dos factores, produto interno bruto, investimento e despesas governamentais.

INTRODUCTION

There is a large number of authors who conceptualize Total Factor Productivity (TFP), since according to (Gáfaró & Mantilla, 2019) indicates that TFP is an indicator that measures the ability of an economy to efficiently combine its available productive resources, which include skilled and unskilled labor, capital and other resources such as land or natural resources to determine the production of goods and services. For his part (Gutiérrez, 2019), indicates that TFP is related to various factors such as macroeconomic stability, efficient allocation of productive resources, institutional efficiency, investment in education and health (human

capital) and productive infrastructure. However, both authors agree that TFP is used to measure the level of productivity of an economy.

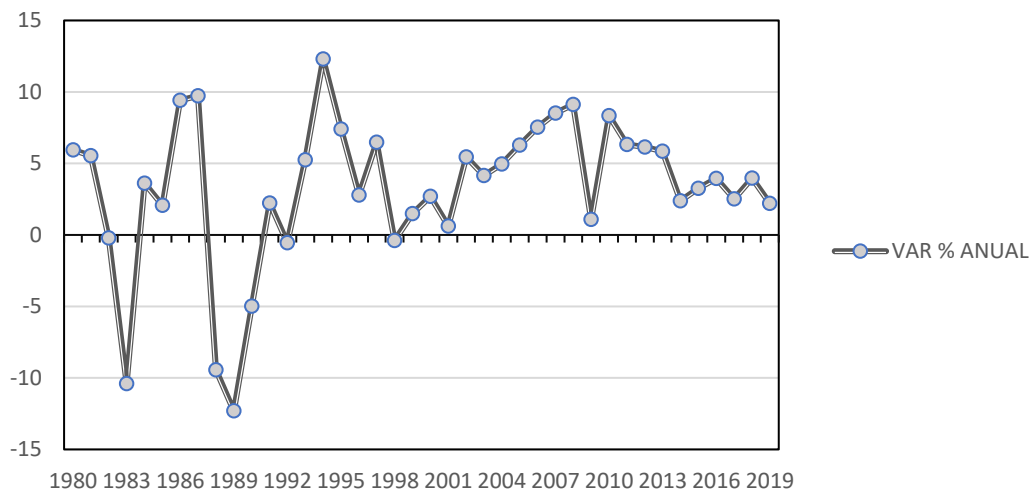
Figure 1 shows us that the behavior of TFP in Peru had abrupt fluctuations in the economy, as can be seen, in 1980 the percentage change in factor productivity was 5.94% and in 1983 had a negative variation of -10.4%. But the steepest fall occurred in 1989 during the first government of then President Alan García. Hyperinflation caused productivity to drop by -12.3%; With the entry of former President Alberto Fujimori and the reforms applied, the productivity of the Peruvian economy reached a positive variation of 12.3%, reaching the highest point in history

in the last 40 years. In 2008 the financial crisis broke out, which had an impact on the productivity level of the Peruvian economy from 9.1% to 1.09% for 2009, Although this crisis had a generalized effect, in our economy there were still positive figures in

relation to the other countries in the region, which reached negative figures during that period. In 2010 there was an increase in the percentage variation reaching 8.33% and later in 2019 the percentage variation stood at 2.2%.

Figure 1

Evolution of Total Factor Productivity (%)



Note. Own elaboration using World Bank data

To begin with, the authors (Céspedes, Lavado, & Ramírez, 2016) estimate TFP for the period from 2003 to 2012 by two methods: primal and dual. The first refers to the procedure to find the Solow residual, which is based on the fact that economic growth is determined by the level of capital and labor, the residual being the TFP. With this method, the author finds that TFP grew on average 1.6% in his study period. It should be noted that this result already considers the adjustment for variations in

the use and quality of the factors. On the other hand, the second considers only marginal levels; in the same way, it is found that with this method TFP grew 1.7% on average. As can be seen, TFP can be considered part of the production factors. Therefore, it will also contribute as the factors within economic growth. Nevertheless, The main problem with this indicator is that it cannot be observed directly like the others. This is estimated using an approach proposed by(Solow, 1957). In this case, the residual found when

estimating the contribution of total capital and labor to the economy with respect to the country's growth will be TFP. However, since the total and the quality of the factors within production are not exactly known, usually the residual can also be defined as the “size of ignorance” (Abramovitz, 1956). This method is called the primal method, since a neoclassical production function composed of capital and total labor of a respective economy is being used. Therefore, it is required to have a correct and exact measurement of these two production factors. This is characterized by having an extensive empirical literature, since it has been studied in several countries with different findings. It should be noted that in each case studied the indicator that approximated the labor factor was the number of workers in an economy and the stock of physical capital is approximated with the perpetual inventory method.

The purpose of this research is to estimate the TFP of Peru for the study period 1980-2019. This with the reason that a much broader vision will be had to know the variables that can explain the long-term economic growth of the country, because as indicated (Atayde, 2016), growth may be higher in one period and lower in the next. In addition, it will be possible to detect the macroeconomic variables GDP,

Employment, Investment, TFP public expenditure and Consumption with high correlation with economic growth.

Theoretical framework

Background

First, (Fuentes & Morales, 2011) They highlight that TFP can be modeled as an autoregressive process (AR) and take as inspiration the theory of real business cycles. In addition, they consider it important to separate the TFP from the sampling error, since the error will provide an additional factor in measuring growth, since this is the part that cannot explain the use of the other factors.

Second, the authors (Azariadis & Kaas, 2014) propose the development of a new theory of productivity based on sectors for the aggregate factors directed towards a multisectoral economy considering an economy modeled on the basis of a production function AK. In this case, both the growth rate and TFP interact with endogenous variations within the distribution of the sectors of the physical capital factor. This, in turn, will respond to exogenous changes that can be reversed by improving the productivity of the sectors as a function of the factor.

In third place, (Moro, 2011) shows that the intensity of use of some intermediate goods can effectively affect TFP in several ways. The author in his research builds a model based on an economy that has free entry and exit of companies, which will have a production process explained by a production function that, in addition to the two traditional production goods, uses a variable that will capture the effect of intermediate goods. Therefore, the author will highlight that the characteristics of the inputs that are used in the production of goods will also have an effect that can be positive or negative on the growth of a country. Then, the use of the goods that is used in production must be important to study them.

In fourth place, (Dávila, 2016) focuses on studying the impact of present production on future productivity. As can be highlighted in their research, they show that variations in TFP from previous periods have a great weight as a determining factor in the variation in production. For this reason, considering the history of a country and its production processes is important to know how it will fare in the near future.

In fifth place, (Castiglionesi & Carmine, 2013) tries to investigate various determinants of productivity and their impact on the economic growth of

respective countries. Its main conclusions focus on the fact that TFP can almost perfectly explain the technological change that occurs in countries over time. They even find that there is a high and positive correlation between the productivity growth rate and the respective growth rates of both human capital and innovation of all the companies that are within the study country. Sixth, (Maryam & Jehan, 2018) They tried to investigate whether the determinants of production may have a tendency to make countries converge through the diffusion of technological processes for the productive improvement of the countries. This is measured by the commercial opening of the country and considers direct foreign investment. In addition, they analyze the terms of trade and their role in the diffusion of technology between countries. Therefore, they focus on showing the effect of technological diffusion and the possible existence of convergence in the growth rates of all countries in the long term.

In seventh place, (Solow, 1957) they try to develop the neoclassical production function much more precisely on the basis of modern macroeconomic models that take into account both the long term and the short term. Therefore, making this distinction and trying to show the short-term effect is a consideration that has not

been seen in much research. The authors emphasize that the empirical application of macroeconomic theory requires the correct specification of the relationships of the variables that are being considered in the model together with the technological progress that causes them to change their direction. Furthermore, it must be known whether the model is speaking in aggregate or per capita terms.

Eighth, the authors (Caliendo, Parro, Rossi-Hansberg, & Sarte, 2018) They have been able to calculate the effect of the commercial interconnection between internal sectors also considering regional and industrial sectors using data from the United States. The authors find both sectoral and aggregate elasticities. These elasticities are used to determine TFP, the country's GDP growth rate, and the employment growth rate. With all this, they find that variations in the sectors affect the country's economic growth more strongly and also which region is being discussed.

Ninth, the author (Van Beveren, 2012) presents the purpose of his research based on giving future researchers of empirical regularities an overview of various questions that have to do with the methodology used to approximate the TFP. In addition, it shows criticism of the existing techniques and tries to correct them

and incorporate them into the methodology that the author proposes. On the other hand, it explains the problems that can arise in estimating TFP, such as selection bias and simultaneity bias. Therefore, it is going to emphasize that some modern techniques are correcting these two problems that affect both the input values of the model and the output values.

In tenth place, (Grafton, Knowles, & Owen, 2004) they highlight a new concept that may affect the calculation of the determinants of growth: social divergence. The authors define this concept as the possible existence of the so-called social barriers based both on the communication of individuals within a society as well as the exchange of goods that is generated within them. Therefore, to analyze this variable, it is done on per capita income and TFP. The authors use a selection of 27 countries to investigate the effect of this problem in each of them. Therefore, they emphasize that effectively per capita income is considerably reduced and TFP also does so. This stands out much more in countries that are characterized by the diversity of languages, religions and also a low Gini coefficient in education. Therefore, they conclude that these gaps must be reduced in some countries if the countries' economic growth is to improve. In addition, they

emphasize that a main concern that the States must solve must be based on the territorial and social union of the people of a country.

In eleventh place (Miller & Upadhyay, 2002) study the convergence of total factor productivity and real gross domestic product per worker for a combined sample of developed and developing countries. Their findings support the absolute and conditional β convergence of total factor productivity, but only the conditional convergence of real GDP per worker.

In twelfth place, (Gonzales & Delbianco, 2011) study the existence of structural breaks in TFP in various openness indicators for a sample of 20 Latin American and Caribbean economies. The results indicate that opening shocks operate on TFP growth rates.

In thirteenth place (Aquino, 2015) estimates the Total Factor Productivity of Paraguay following alternative methodologies to the classic Solow Residue. Alternative calculations of Total Factor Productivity revealed that the capital factor was the main determinant of Paraguayan economic growth in the period 1991-2014 and that the performance of Total Factor Productivity in the same period was adverse.

As also (Beugelsdik, Klasing, & Milions, 2015) documenting the fact that large and

persistent differences in economic development between sub-national regions of European Union countries can be largely attributed to differences in total factor productivity (TFP). As their analysis revealed, TFP differences are large even within countries and are closely related to economic geography and historical development trajectories.

In fourteenth place (Campano, González, Fariás, & Gonzales, 2016) analyze the change in total factor productivity of the Chilean manufacturing sector estimating the Malmquist index for the period 1998-2010. They found that in this period TFP decreased mainly due to technological change, while technical efficiency remained constant.

In fifteenth place, (Lin & Chen, 2018) They measure the total productivity of ecological factors, to analyze whether factor market distortions inhibit the ecological development of the Chinese economy. Their results show that the factor market distortion has negative influences on the growth of GTFP, exports and the spillover effect of China's FDI significantly.

Finally, the authors (Chumacero & Fuentes, 2006) develop and propose a theoretical framework to be able to effectively analyze the growth dynamics for a country like Chile. The authors use econometric models

based on univariate time series to find that Chile's growth method can be better explained using traditional growth models than endogenous ones. They emphasize that the terms of trade, the improvement in the quality of the physical capital that is imported and the possible existence of distortions are elements that must be taken into consideration to achieve an efficient dynamic demonstration of both the country's TFP and the growth rate of the country. PBI. When analyzing the results of the impulse-response that the authors find, they highlight the existence of a positive transitory process. The authors highlight that a variation in physical capital on the country's aggregate investment has a negative effect. However, this effect will only be temporary, since when it affects the GDP growth rate the effect is much smaller and occurs after 3 years. In addition, they find that the same thing happens when there is a positive variation. However, it should be considered that the variation must be of greater magnitude compared to the negative variation. Therefore, they find that also if a change is generated in the expenses that the government makes on the country's GDP, the effects can be seen after 3 years of the change. since when it affects the GDP growth rate, the effect is much smaller and occurs after 3 years. In addition, they find

that the same thing happens when there is a positive variation. However, it should be considered that the variation must be of greater magnitude compared to the negative variation. Therefore, they find that also if a change is generated in the expenses that the government makes on the country's GDP, the effects can be seen after 3 years of the change. since when it affects the GDP growth rate, the effect is much smaller and occurs after 3 years. In addition, they find that the same thing happens when there is a positive variation. However, it should be considered that the variation must be of greater magnitude compared to the negative variation. Therefore, they find that also if a change is generated in the expenses that the government makes on the country's GDP, the effects can be seen after 3 years of the change.

Theory

The Solow model based on the research of (Solow, 1957). uses a well-behaved neoclassical production function composed of both capital (K), the level of employment (L), and a variable that captures the level of technology (A). Furthermore, the authors are equating the production function with the country's GDP (Y) over time (t). In addition, it can be linearized and is

homogeneous. It is the so-called Cobb-Douglas function:

$$Y_t = A_t K_t^\alpha L_t^{1-\alpha}$$

Then, by clearing A within this function, the remainder will be found, which is also the so-called PTF:

$$A_t = \frac{Y_t}{K_t^\alpha L_t^{1-\alpha}}$$

One has to consider the existence of the neoclassical production function assumption that focuses on explaining the existence of constant returns to scale in the two main variables: capital (K) and labor (L). On the other hand, this explains the reason that it is homogeneous in degree one. Another assumption focuses on explaining the existence of diminishing marginal returns, which explains that the marginal productivity of each factor will have a positive slope, but this will decrease over time.

It should be remembered that the authors (Fuentes & Morales, 2011) They highlighted that from this function the countries' economic growth began to be counted. Therefore, with the aforementioned assumptions and Inada conditions; the function could be written as follows:

$$Y_t = F(K_t, h_t L_t, Z_t)$$

Where Y represents total production, K physical capital, L crude labor, h human capital, and Z a TFP index. In this case, human capital is also being considered within the production function, since it is important to consider the years of study of the people and the various training that all the inhabitants of a country take over time. All of this also has a positive effect on production; therefore, it is important to consider this variable within the analysis method. On the other hand, the variable Z can be considered as another factor that is used in the production process that is not being captured within the other possible variables. Therefore, the production function can be linearized to arrive at the following form. What's more,

$$\Delta \ln Y_t = \alpha_t \Delta \ln K_t + (1 - \alpha_t) \Delta \ln h_t L_t + \Delta \ln Z_t$$

Where and will be the per capita production and per capita capital; this means that they are the levels of production and capital per worker. On the other hand, the variable will be considered as a trend with stationarity characteristics that will capture the technological changes that occur in the economy and may affect the other variables within the production function. This variable can be econometrically modeled as an AR (q) process, since we still do not know how many periods this process will

have. It should also be considered that this variable can capture changes in technology that may not involve changes in capital or labor. It can capture technological changes that have affected the improvement of the productivity of both capital or labor both at the level and marginal. Therefore, ykZ

METHODOLOGY

The method to be used in this research will be the deductive one, which from empirical observations will be able to form a theory that can be applied in various contexts in order to validate its level of theory. Therefore, it can be considered that this method is based on reality and then comes up with new ideas that can be used to be defined as a theory. Then, the investigation will be endowed with empirical antecedents to later be able to define the causal relationship of the variables and also the possible hypotheses that are also derived from them.

Finally, the research design to be used in this article will be the causal correlational. This is because we are going to try to perform correlational analysis between the variables that we are going to consider in the research. The data that we are going to use comes from the Central Reserve Bank of Peru (BCRP), data from the World Bank

and the National Institute of Statistics and Informatics (INEI) will also be used. Finally, the programs to process the data obtained from the respective entities will be Excel for the compilation; then, for the estimation and forecasting, the statistical program EVIEWS 10 will be used.

RESULTS

Variables Analysis

Real gross domestic product

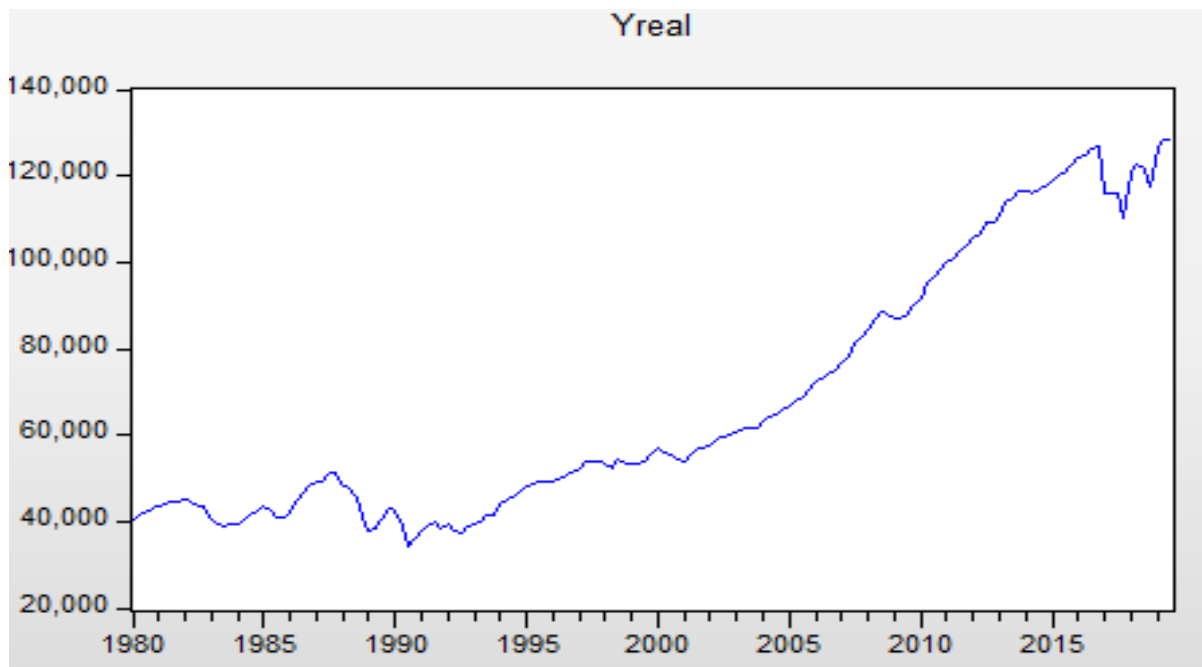
When observing the dynamics of the economic cycle of Peru, it can be observed that the growth rate of the Gross Domestic Product is very volatile between 1980 and 2019. Even when analyzing the behavior of this variable during the 80's, it can be noted that there was a great reduction of approximately 10% of its total value in 1983. Then, during 1988 and 1989 it continued to fall. However, based on the reforms carried out during the 1990s, it can be observed that the GDP situation changed and achieved high growth for the year 1994. Later, in the first decade of the new millennium, it can be noted that the GDP growth was much more stable than previous years (approximately 5% per year) until the arrival of the 2009 financial crisis, in which a slowdown began to occur. After the crisis,

the growth of the variable began to be sustained again. However, when observing possible projections of the variable, it is expected that it will decrease again as it has been showing the patterns of the behavior of the variable. Even in 2016 there was a

problem of capital flight that delayed the economic growth of the country, however, for the years 2017 to 2019 there was a fall in the gross domestic product and it recovered for 2018 and 2019.

Figure 2

Gross Domestic Product Series (GDP).



Note. Own elaboration using BCRP data.

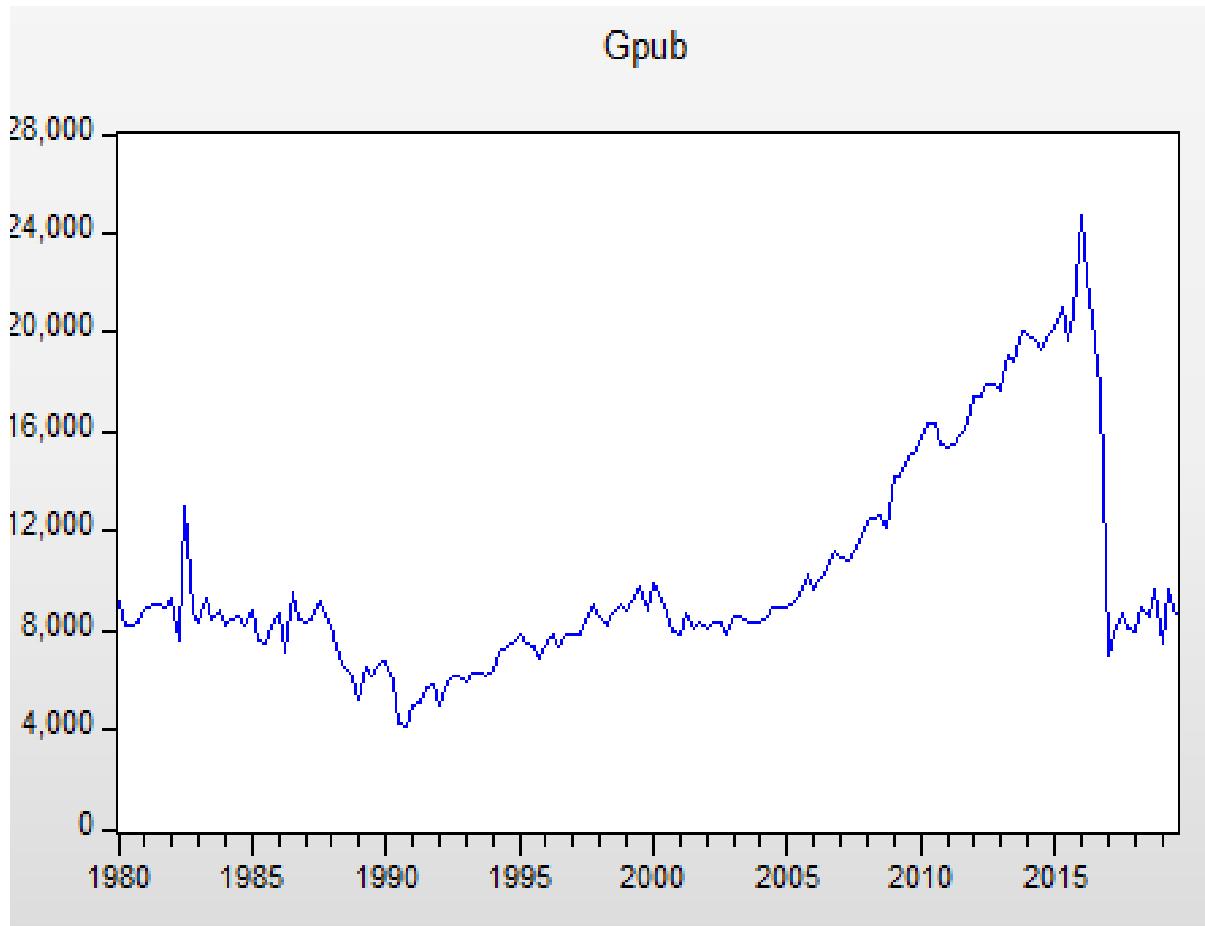
Public spending

Through fiscal policies, the state can alter the distribution of income in the economy, revenues are collected through taxation instruments. For its part, public spending influences income distribution by transferring part of these funds to families, either in the form of infrastructure, services

or liquid transfers. Public spending in the Peruvian economy has maintained an upward trend on average, this evolution is partly explained by the effect of the privatization program at the beginning of the 90s that allowed a progressive reduction of the state's participation in productive activity. (Castillo & Tuesta, 2006)

Figure 3

Variation in public spending



Note. Own elaboration carried out with the data obtained from the BCRP

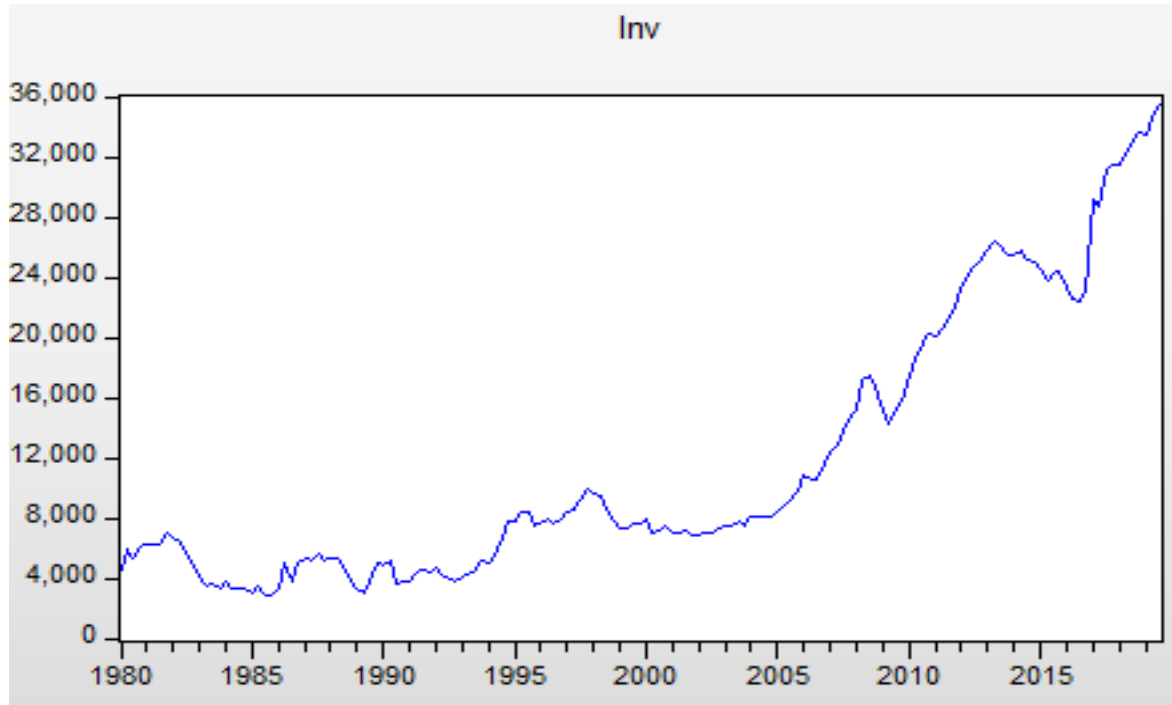
Variable private consumption

Private consumption is considered in the economic literature as the main component of GDP, therefore, it has been the main source of product growth. Empirically, private consumption represents the largest proportion among the components of the product (between 50% and 70% of the total product. The share of consumption in the gross domestic product GDP has followed a

significant increasing trend in the last 39 years; the amplitude of the volatility of the consumption cycle (measured as the standard deviation of the series) in the study period has been rising to a certain point, thus in the last decade consumption had the most volatile behavior, in macroeconomic terms this relationship shows high integration between consumption and gross domestic product (GDP).

Figure 4

Private consumption.



Note. Own elaboration using BCRP data.

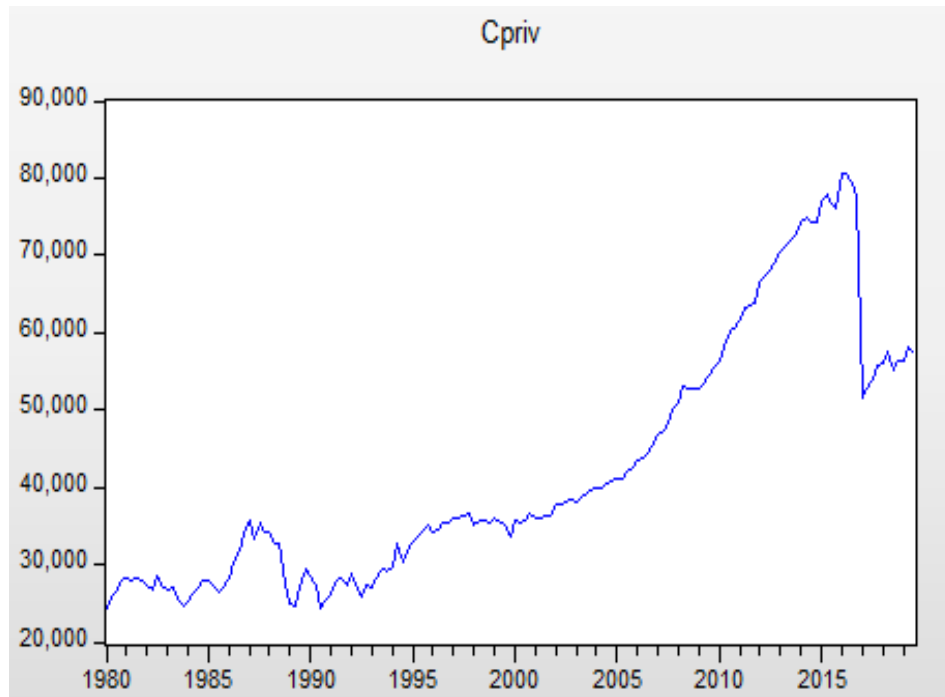
Investment

In the long term, gross domestic investment constitutes one of the main determinants of economic growth due to its contribution to the formation of the capital stock. In the short term, fluctuations in investment explain a significant proportion of the changes in output and in aggregate demand. Gross domestic investment has maintained an upward behavior on average in the period 1980-2019, in the eighties Peru registered an outflow of private capital, according to data from the Central Bank between 1980-

1990 an outflow of private capital of \$ 4.38 million, the reasons for this capital flight, which were the high international interest rates, the financial crisis in Latin America and the Peruvian scene of violent irruption of terrorist groups that persisted until 1992. In the nineties, Peru became an important recipient of private capital from the rest of the world. Between 1991 and 1997, more than \$ 15644 million entered Peru, these results are strongly influenced by the dynamic process of privatizations. In 1998.

Figure 5

Private consumption



Note. Own elaboration using BCRP data.

Results Hodrick-Prescott (HP) filter

The filter was raised by two economists (Hodrick & Prescott, 1980), is one of the most important and popular filters in the statistical literature oriented to find both the trend and cycle of a variable. This is because the filter is easy to use and allows the researcher to obtain what is necessary to have the trend of the variable in question. Continuing, to get what you want with the filter you have to satisfy two important restrictions. First, the distance between the effective values of the series and the trend must be minimized. Then, the variation of the trend must be minimized. While these restrictions may seem contradictory, it is necessary to balance these with different weights. These weights are calculated from the decision of the researcher. This smooths the variation of the variances with respect to the cycle level. Although this method has received several criticisms by several recognized economists because there is no theoretical explanation to decide the smoothing, since everything depends on the researcher. Usually, the value of the smoothing is between 100, 1600 and 14400 this taking into account the data that are annual, quarterly or monthly. The results of the Hodrick-Prescott (HP) filter applied to the variables are presented below:

Table 1

Results Hodrick-Prescott (HP)

	From	Of relative	Corr. Gdp	Autocorr.
GDP	0.014473	1	1	0.896176
job	0.016412	1,133985	0.791821	0.961585
Investment	0.061532	4.251487	0.862997	0.909134
Public spending	0.050059	3.458822	0.193039	0.925652
PTF	0.010052	0.694514	0.408052	0.861153
Consumption	0.017914	1.237728	0.797317	0.947827

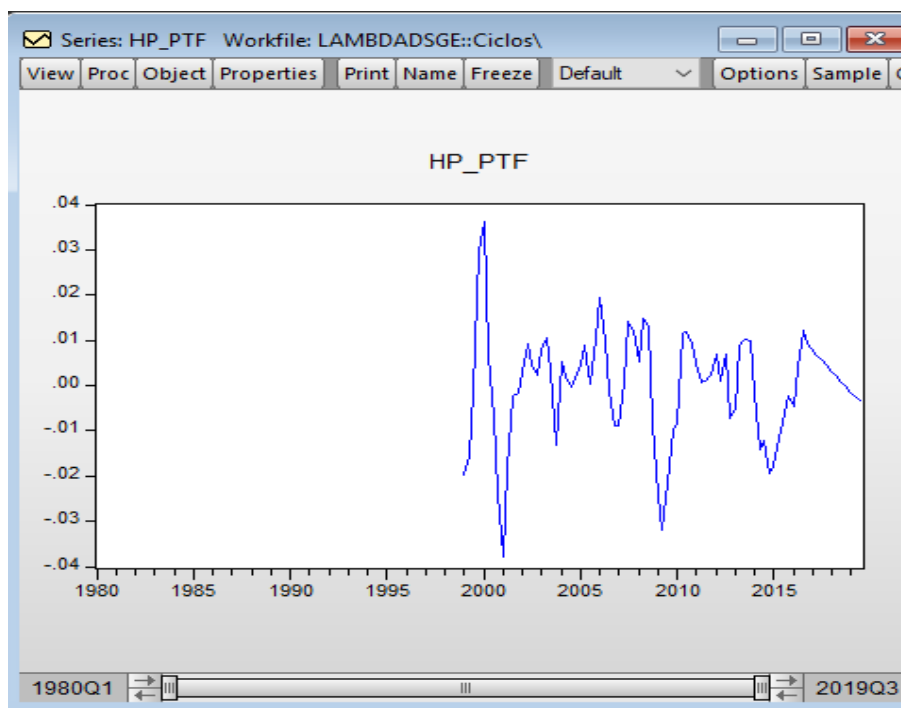
Note. Own elaboration using BCRP data.

As can be seen, it can be noted that the variables have a high correlation with GDP. It should be noted that investment is the one with much higher correlation, since it is the main variable to be able to increase GDP growth. Second, employment can also be seen to have a high correlation with GDP.

Third, consumption and TFP also have a significant influence on GDP. However, public spending has a very low correlation; therefore, this shows that increased public spending will not affect GDP growth significantly.

Figure 6

Total factor productivity using the Hodrick-Prescott filter.



Note. Own elaboration using BCRP data

Baxter and King (BK) filter

On the other hand, the authors (Baxter & King, 1995) They develop a much more advanced filter than the HP using a moving average and it will aim to eliminate the cyclical components of any series, but it must have at least 8 data points. To begin with, first the filter excludes some variables in order to extract some stationary and even random components of a variable, which is

called short-term white noise. Therefore, by excluding these effects, the trend component (long-term) can be obtained. Then, a series will be obtained that will filter components of the economic cycles. In the same way, the filter will ignore information from the start in order to extract data in the future. The results obtained by the filter are presented:

Table 2

Baxter and King (BK) filter results

	FROM	OF RELATIVE	CORR. GDP	AUTOCORR.
GDP	0.014568	1	1	0.899226
job	0.016269	1.116727	0.781348	0.961534
Investment	0.061122	4.195516	0.837594	0.909681
Public spending	0.045792	3.143206	0.164154	0.891137
PTF	0.010009	0.687011	0.417523	0.861636
Consumption	0.015749	1.081033	0.847213	0.932696

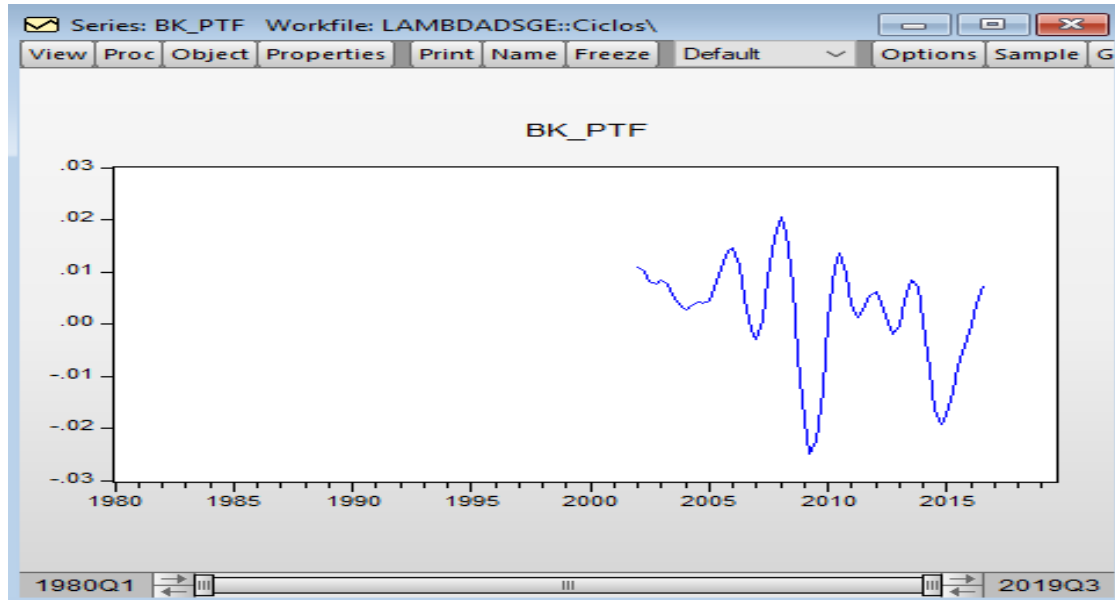
Note. Own elaboration using BCRP data

It can be highlighted in the table that the correlation of the series with the GDP series will have a high degree of influence on the model. In the same way, investment is the one that has the greatest influence on the GDP growth rate; then employment follows. Furthermore, consumption has a high influence as well and, unlike the other filter, it is found that TFP also has a very high correlation. However, public spending

continues to have a very low influence. So, we can mention much more precisely that the growth of the Peruvian economy will not be possible due to an increase in public spending.

Figure 7

Total factor productivity using the Baxter-King filter.



Note. Own elaboration using BCRP data.

DISCUSSION

This research has been based on (Fuentes & Morales, 2011) As you can see, TFP has been modeled through an autoregressive process (AR) based on real business cycle models. This with the objective of separating the residual term from the production function to obtain this respective residual term. On the other hand, according to the authors(Chumacero & Fuentes, 2006)When applying their methodologies to Chile, they find results that can be consistent with the research that has been carried out for the Peruvian case, which gives much more credibility to our findings. When analyzing the results of the Chilean

economy through the impulse-response functions, the authors will highlight that there is a positive variation in the relative prices of capital, investment will have a negative but transitory effect on GDP. However, a positive effect on the terms of trade will also have a positive effect on GDP. All this occurs in a period of 3 years lagged. Finally, if a temporary increase in government spending is generated on GDP, it will have an almost direct effect, but lagged for 3 years. In contrast to the Peruvian case, economic growth is fully explained by investment within the country. This is the main growth factor, then there is employment. However, we must also highlight the role of consumption within

this, since it also has a considerable percentage of correlation. TFP and public spending do not exactly represent the growth of the Peruvian economy. Which suggests that the country's economic growth has not been influenced by the various state policies that current governments have carried out. This shows that Peru has led growth by factors that the inhabitants themselves have been carrying out and not by the various policies and transfers that both regional and central governments have been carrying out. This is the main growth factor, then there is employment. However, we must also highlight the role of consumption within this, since it also has a considerable percentage of correlation. TFP and public spending do not exactly represent the growth of the Peruvian economy. Which suggests that the country's economic growth has not been influenced by the various state policies that current governments have carried out. This shows that Peru has led growth by factors that the inhabitants themselves have been carrying out and not by the various policies and transfers that both regional and central governments have been carrying out. This is the main growth factor, then there is employment. However, we must also highlight the role of consumption within this, since it also has a considerable

percentage of correlation. TFP and public spending do not exactly represent the growth of the Peruvian economy. Which suggests that the country's economic growth has not been influenced by the various state policies that current governments have carried out. This shows that Peru has led growth by factors that the inhabitants themselves have been carrying out and not by the various policies and transfers that both regional and central governments have been carrying out. since it also has a considerable percentage of correlation. TFP and public spending do not exactly represent the growth of the Peruvian economy. Which suggests that the country's economic growth has not been influenced by the various state policies that current governments have carried out. This shows that Peru has led growth by factors that the inhabitants themselves have been carrying out and not by the various policies and transfers that both regional and central governments have been carrying out. since it also has a considerable percentage of correlation. TFP and public spending do not exactly represent the growth of the Peruvian economy. Which suggests that the country's economic growth has not been influenced by the various state policies that current governments have carried out. This shows that Peru has led growth by factors that the

inhabitants themselves have been carrying out and not by the various policies and transfers that both regional and central governments have been carrying out.

CONCLUSIONS

This study has focused on trying to obtain correlations of the most important variables of Peru with its Gross Domestic Product in order to show what determines the economic growth of the country. Investment has been found to be the variable most correlated with GDP, which suggests that the private sector is much more important than the other sectors. This suggests that the policy direction should focus on promoting investment in order to generate an increase in productivity within the country. In addition, with the promotion of investment it will be possible to distribute the positive effects on other sectors of the country such as consumption and also the external sector. However, it should be noted that public spending does not have a significant influence on GDP, which suggests that there are problems within the structure of the country's institutions. This should be a reason to draw attention to the change in structure, since in the majority of research carried out in other countries it has been found that public

spending is one of the most important variables within these in order to increase economic growth. Therefore, in Peru a redirection of public policies is required in order to change this situation. In this way, the productivity of companies can be increased much more directly with public spending. since in the majority of investigations carried out in other countries, it has been found that public spending is one of the most important variables within these in order to increase economic growth. Therefore, in Peru a redirection of public policies is required in order to change this situation. In this way, the productivity of companies can be increased much more directly with public spending. since in the majority of investigations carried out in other countries it has been found that public spending is one of the most important variables within these in order to increase economic growth. Therefore, in Peru a redirection of public policies is required in order to change this situation. In this way, the productivity of companies can be increased much more directly with public spending.

On the other hand, TFP shows that the consumption of both final and intermediate goods will be important for the country's economic growth. This may be because consumption encourages increased

investment in the country and they go hand in hand with each other. For this reason, employment plays an important role in growth, since by increasing employment there will be a large increase in consumption, which will lead to a large increase in investment. The role of the manufacturing industry should also be highlighted, since it generates higher royalties within the country for producing goods with high income elasticities and a high productive level. This industry also encourages intermediate sectors such as capital and labor. Then, the role of this sector on the economic growth of the country should also be analyzed. However, within Peru there is no significant representation of the manufacturing sector, since it has lagged for 30 years. Most of the manufactured products are obtained from China and Peru only dedicates the production to raw materials that are used by other countries in their production process of high productivity goods. This prompts the need to change certain production patterns within the country.

Finally, the TFP indices for this period of analysis highlight that they are very low compared to the aggregate economy. This can be explained because intermediate consumption is not like a factor of production. This suggests that

manufacturing companies should have more influence than they do now over the production of goods and services for local industry. In addition, a greater participation of the State on the economy.

Within the total factor productivity, the participation of some sectors is key within the growth of the economy, such is the case of the agricultural sector that during 2019 represented 5.4% of GDP, since it is intensive in the hands of Work is one of the sectors that generates a large percentage of labor as indicated by (COMEX PERU, 2020); on the other hand the (National Institute of Statistics and Informatics, 2019) indicates that during 2019 the productive activity of the country increased by 2.16%, within which three productive sectors (commerce, agriculture and services provided to companies) contributed 88% of the global result. During the period January - December 2019, the primary sector and the services sector had a positive behavior of 0.18% and 3.83% respectively, while the secondary sector decreased by 0.64%.

The main recommendation that can be given after observing the results of the research focuses on developing an intra-industrial development plan with the main focus on manufacturing. This may improve the internal linkages and the internal productive mechanism of the Peruvian

industry, which will generate that there is no capital flight or that the foreign investment made within the country releases the benefits obtained by the extraction of raw materials outside of Peru. With this, it will be possible to achieve a better connection between internal sectors, greater employment and benefits that will remain within Peru. In addition, consumption will play a much more important role, since only national products whose production is clearly within the Peruvian territory will be consumed.

BIBLIOGRAPHIC REFERENCES

Aquino, J. (September 2015). Ministry of Finance Directorate of Economic Studies. Obtained from GOV Economy:
https://www.economia.gov.py/application/files/6314/6591/0634/Documento_PTF_Final_092015.pdf

Atayde, A. (2016). Analysis of the growth of total factor productivity in the states of Mexico 1998 - 2013. 1–22.

Azariadis, C., & Kaas, L. (May 19, 2014). CAPITAL MISALLOCATION AND AGGREGATE FACTOR PRODUCTIVITY. (W. Barnett, Ed.) *Macroeconomic Dynamics*, 25 (5), 525 - 543. Retrieved August 03, 2021,

from

<https://doi.org/10.1017/S1365100514000236>

Baxter, M., & King, R. (1995). *Measuring Business Cycles Approximate Band-Pass Filters for Economic Time Series*. NBER Working Paper Series. WP No. 5022. Cambridge, Massachusetts.

Beugelsdik, S., Klasing, MJ, & Milions, P. (September 22, 2015). Taylor Francis. Obtained from *Regional Studies*:
<https://www.tandfonline.com/doi/full/10.1080/00343404.2017.1334118>

Caliendo, L., Parro, F., Rossi-Hansberg, E., & Sarte, D. (October 04, 2018). *The Impact of Regional and Sectoral Productivity Changes on the US Economy*. *The Review of Economic Studies*, 2042 - 2096. doi: 10.1093 / restud / rdx082

Campano, CC, González, MA, Farías, NC, & Gonzales, MJ (December 2016). *SciELO*. Obtained from *Revista de Economía Institucional*:
http://www.scielo.org.co/scielo.php?script=sci_arttext&pid=S0124-59962016000200012

Castiglionesi, F., & Carmine, O. (November 24, 2013). *ON THE DETERMINANTS OF TOTAL FACTOR PRODUCTIVITY*

- GROWTH: EVIDENCE FROM SPANISH MANUFACTURING FIRMS. (W. Barnett, Ed.) *Macroeconomic Dynamics*, 17 (3), 501-530. Doi: 10.1017 / S1365100511000332
- Castillo, P., & Tuesta, CM (2006). Stylized Facts of the Peruvian Economy. Work document. Central Reserve Bank of Peru (BCRP).
- Céspedes, N., Lavado, P., & Ramírez, N. (2016). PRODUCTIVITY IN PERU: measurement, determinants and implications (Vol. 1). Lima, Lima, Peru: University of the Pacific. Retrieved August 03, 2021, from <https://repositorio.up.edu.pe/bitstream/handle/11354/1083/C%C3%A9spedesNikita2016.pdf>
- Chumacero, R., & Fuentes, J. (2006). Chilean growth dynamics. *Economic Modeling*, 23 (2), 197-214.
- Chumacero, R., & Fuentes, R. (2006). Chilean growth dynamics. Department of Economics of the University of Chile. doi: 10.1016 / J.ECONMOD.2005.08.003
- COMEX PERU. (2020). Agro Sector Generated 4.8% Additional Tax Income in the January-September 2020 Period vs. the Same Period in 2019. Lima, 1053,
- Dávila, J. (August 1, 2016). OUTPUT EXTERNALITIES ON TOTAL FACTOR PRODUCTIVITY. (W. Barnett, Ed.) *Macroeconomic Dynamics*, 21 (6), 1389-1425. Doi: 10.1017 / S1365100515000905
- Felipe, BB (May 2017). Academic Repository of the University of Chile. Obtained from Total factor productivity: a structural estimate and its determinants in Chile during the period 1960-2015: <http://repositorio.uchile.cl/handle/2250/144305>
- Fuentes, R., & Morales, M. (April 2011). *Macroeconomic Dynamics*, 145 - 159. doi: 10.1017 / S1365100509991040
- Fuentes, R., & Morales, M. (2011). On the Measurement of Total Factor Productivity: A Latent Variable Approach. *Macroeconomic Dynamics* 15, 145-159.
- Gáfaró, M., & Mantilla, C. (February 2019). Total factor productivity and efficiency in the use of productive resources in Colombia. (A. Clavijo, Ed.) *Essays on economic policy* (89), 55. doi: 10.32468
- Gonzales, GH, & Delbianco, FA (June 2011). *Journal of Economic Analysis*. Obtained from SciELO:

- https://scielo.conicyt.cl/scielo.php?pid=S0718-88702011000100003&script=sci_artext&tlng=n
- Grafton, Q., Knowles, S., & Owen, D. (September 2004). Total Factor Productivity, Per Capita Income and Social Divergence. *Economic Record*, 80 (250), 302 - 313. doi: 10.1111 / j.1475-4932.2004.00190.x
- Gutiérrez, A. (November 06, 2019). DETERMINANTS OF THE TOTAL PRODUCTIVITY OF FACTORS IN SOUTH AMERICA. *RESEARCH AND DEVELOPMENT*, 19 (2), 5 - 26. doi: 10.23881
- Hodrick, R., & Prescott, E. (1980). Postwar US Business Cycles: An Empirical Investigation. Carnegie Mellon University discussion paper No. 451.
- Hofman, A., Mas, M., Aravena, C., & Fernández, J. (June 2017). The Economic Quarter. Obtained from SciELO: http://www.scielo.org.mx/scielo.php?pid=S2448-718X2017000200259&script=sci_artext
- National Institute of Statistics and Informatics. (2019). In 2019, national production grew 2.16% and accumulated more than two decades of positive annual results. 2018–2020
- INEI (2020) URL: <https://www.inei.gob.pe/bases-de-datos/#url>
- Lin, B., & Chen, Z. (October 2018). ScienceDirect. Retrieved from *Journal of cleaner production*: <https://www.sciencedirect.com/science/article/abs/pii/S095965261831744X>
- Maryam, K., & Jehan, Z. (June 2018). TOTAL FACTOR PRODUCTIVITY CONVERGENCE IN DEVELOPING COUNTRIES: ROLE OF TECHNOLOGY DIFFUSION. *South African Journal of Economics*, 86 (2), 16. doi: 10.1111 / saje.12189
- Miller, SM, & Upadhyay, MP (June 2002). *Journal of Macroeconomics*. Retrieved from Science Direct: <https://www.sciencedirect.com/science/article/abs/pii/S0164070402000228>
- Moro, A. (February 04, 2011). BIASED TECHNICAL CHANGE, INTERMEDIATE GOODS, AND TOTAL FACTOR PRODUCTIVITY. (W. Barnett, Ed.) *Macroeconomic Dynamics*, 25 (5), 184-203. Doi: 10.1017 / S1365100510000532

Solow, R. (August 1957). Technical Change and the Aggregate Production Function. *The Review of Economics and Statistics*, 39 (3), 312 - 320. doi: 10.2307 / 1926047

Van Beveren, I. (February 2012). TOTAL FACTOR PRODUCTIVITY ESTIMATION: A PRACTICAL REVIEW. *Journal of Economic Surveys*, 26 (1), 98 - 128. doi: 10.1111 / j.1467-6419.2010.00631.x

Contacto

Marco Antonio Arroyo Yupanqui

marroyo@uncp.edu.pe