Hacettepe University Graduate School Of Social Sciences

Department of Economics

THE JOBLESS GROWTH: THE SHAPLEY VALUE APPROACH TO THE TURKISH ECONOMY

Mehmet Ali TEKKANAT

Master's Thesis

Ankara, 2022

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ABSTRACT

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Although Turkey economy has been in a real growth pattern since the beginning of the 21. Century, unemployment rate keeps being high in a contradicting manner with the Okun's Law which states that there is an inverse relationship between growth rate of an economy and its unemployment rate over its natural level, which is known as the jobless growth in the literature. The aim of this thesis is testing whether Turkey economy experienced jobless growth throughout 2009-2019 period and its intensity by using a game theory based decomposition analysis approach- the Shapley value- with which was come up by Lloyd Shapley in 1953 to show how the output generated by a coalition should be distributed among its members so that it be fair, which is the main scientific contribution of this thesis as this is the first time the Shapley value decomposition method was used for testing the jobless growth performance of the Turkish economy. Moreover, intensity of the jobless growth could be computed accurately thanks to the Shapley value decomposition method since it is an axiomatic decomposition approach, which is the secondary scientific contribution of this thesis.

According to the results of the analysis, 41,3 % of growth of the Turkish economy over the time period from 2009 to 2019 was accounted for by the demographic changes while its rest accounted for by the economic activities. The share of the jobless part of the growth contributed by the economic activities is 58,665 % in the growth. Therefore, 99,665 % of the growth is jobless, which means that jobless growth is a major issue for the Turkish economy.

Keywords

Jobless Growth, The Shapley Value, Decomposition

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ABBREVIATIONS

ARCI: aegean region chamber of industry

ARDL: autoregressive distributed lag

ARFIMA: autoregressive fractionally integrating moving average

ARIMA: autoregressive integrated moving average

BCEA: box-cox extended autoregressive

BK: baxter king

BP: band pass

BRICS: brasilia, russia, india, china and south africa

BW: butterworth

CBTR: central bank of the republic of turkey

CF: christiano fitzgerald

CLRM: classical linear regression model

CUSUM: cumulative sum

CUSUMQ: cumulative sum square

DF-GLS: dickey fuller generalized least squares

DOLS: dynamic ordinary least squares

e.g. : exampli gratia (for example)

ECM: error correction model

EGLS: estimated generalized least squares

et al. : et alii (and others)

etc. : et cetera (and so forth)

EU: european union

EU15: the first 15 members of european union

FDI: foreign direct investment

FED: federal reserve

FGLS: feasible generalized least squares

FMOLS: fully modified ordinary least squares

G-20: group of twenty

G-5: group of five

G-7: group of seven

GARCH: generalized autoregressive conditional heteroskedasticity

GDP: gross domestic product

GMM: generalized method of moments

GNP: gross national product

HP: hodrick-prescott

IMF: international monetary fund

LCS: local currency

MADF: multivariate augmented dickey fuller

MENA: middle east and north africa

ML: maximum likelihood

MRA: meta regression analysis

MTAR: momentum threshold autoregressive

NAIRU: non-accelerating inflation rate of unemployment

NARDL: non-linear autoregressive distributed lag

NECM: non-linear error correction model

OECD: organisation for economic co-operation and development

OLG: overlapping generations

OLS: ordinary least squares

p.c. : per capita

PARDL: panel autoregressive distributed lag

PECM: panel error correction model

POLS: pooled ordinary least squares

PPI: producer price index

QLRT: quant's likelihood ratio statistic

ROLS: rolling ordinary least squares

STVC: spatio-temporally varying coefficient

SUR: seemingly unrelated regression

SURE: steinback's unbiased risk estimate

TAR: threshold autoregressive

TARCH: threshold autoregressive conditional heteroskedasticity

TECM: threshold error correction model

TUCCE: turkish union of chambers and commodity exchanges

TOC: the okun's coefficient

TVP: time varying parameter

U.S.A: united states of america

UK: united kingdom

UN: united nations

US: united states

VAR: vector autoregressive

VECM: vector error correction model

WAP: working age population

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INTRODUCTION

The main indicator which is used in order to assess the economic performance of a country is generally real growth rate, which indicates the increase in the aggregate production. Therefore, a huge literature about the economic growth has been being developed and one of the most important theory about the economic growth is the Okun's Law which simply states that there exists an inverse relationship between growth rate of an economy and its unemployment rate over its natural level. Contribution of one percent change in unemployment rate over its natural level to growth rate is known as the Okun's coefficient due to the fact that this theory is referred to Arthur Melvin Okun owing to his 1962 dated study; *"Potential GNP: Its Measurement and Significance".* But recent studies have shown that this simple and important theory may not work. In other words, economic growth does not necessarily guarantee a decrease in the unemployment rate or vice versa. Moreover, an economy may grow while unemployment rate raises. Therefore, the literature is introduced with a new term, "jobless growth" or "jobless recovery", which defines the situation in which an economy grows despite the non-decreasing unemployment rate. This situation was accepted as one of the five unwanted types of growth by U.N Human Development Report in 1996.

The growth of the Turkish economy has been following a positive trend since the beginning of the 2000's and it was always positive except for the 2008 global crisis era. However, the unemployment rate was not able to decrease in line with high growth rate performance. Therefore, this might imply that the Turkish economy has been experiencing jobless growth problem for two decades.

The aim of this thesis is to investigate whether the Turkish economy experienced jobless growth over the 2009-2019 period. To this end, the Shapley value decomposition approach to the growth is used in this thesis.

The contribution of this thesis to the literature is twofold. Firstly, this thesis is the first to use the Shapley value approach for analyzing jobless growth performance of Turkey. Secondly, the results of the Shapley value decomposition method are accurate as it is an axiomatic decomposition approach. Accuracy of results means that model does not include any stochastic process or error term and overcomes the model specification bias. The methods that were employed in the literature in order to test the jobless growth performance of a country are generally different versions of causality tests such as Granger causality test, Toda-Yamamoto causality test, etc. or cointegration tests such as Engle-Granger and Johansen, or error correction models. However, there is a huge variation among the used methods before. Some of them could be listed as OLS, FMOLS, ARDL, POLS, SUR, Rolling Regression, Markov-Switching, TAR, MTAR, GMM, ARCH, GARCH.

This thesis is made up of three chapters. In the first chapter, after the different theoretical approaches which was developed in order to explain the jobless growth phenomena are explained, relevant literature review is given in order to be able to summarize the theoretical and empirical background. In the second chapter, origin of the Shapley value and theory of how the Shapley value decomposition could be applied to growth was described in detail. In the third chapter; data sets, descriptive statistics and application of the Shapley value decomposition for the Turkish economy were given.

CHAPTER 1

RELATIONSHIP BETWEEN UNEMPLOYMENT AND GROWTH

This chapter is composed of two main parts. In the first part, theories explaining the relation between unemployment and growth are given while empirical studies about it are listed in the second part.

1.1. EARLY THEORETICAL EXPLANATIONS ABOUT THE RELATION BETWEEN UNEMPLOYMENT AND GROWTH

When history of the modern economics is examined, it could be seen that direct investigation of the relationship between unemployment and growth dates back to 1962 dated study of Arthur Okun Melvin, *"Potential GNP: Its Measurement and Significance"* (Mankiw, 2009). But, it is possible to find theories explaining the relation indirectly before 1962 (Yılmaz, 2005).

According to the old classical doctrine, wages are perfectly flexible, which ensures that market-clearing wage is established and labor market operates at the full employment level all the times though deviation from market-clearing level is possible. Thus, permanent involuntary unemployment is not a possibility in the old classical model (Snowdon and Vane, 2005). Any government intervention is neither necessary nor desirable to achieve the full employment (Ackley, 1966). Therefore, any relation between unemployment and growth could not be established in the long-run.

However, classical economics does not provide a framework to explain the Great Depression era during which industrial production decreased drastically in the whole world (Snowdon and Vane, 2005). The decrease was 46,8% in the U.S.A.,

41,8% in Germany, 31,3% in France, and 33% in Italy during the Great Depression period (Romer, 2004). These high decline rates came along with rising unemployment rate (Aldcroft, 1993). For example, unemployment rate of the U.S.A was 3,2% in 1929, while it was 25,2% in 1933. Moreover, the price level declined by 24% in these years (Gordon, 2000; Snowdon and Vane, 2005). In such a period, Keynes put forward a new doctrine by his famous book "*General Theory of Employment, Interest and Money"* in 1936 as a remedy to the Great Depression. Although Skidelsky (1996) states that Keynes did not write his *"General Theory"* to develop a cure method for the Great Depression, it is not likely to deny that *"General Theory"* was written as a response to the disastrous events among capitalist economies after the Great Depression.

From the Keynesian perspective, full employment is an exception, not the general situation and economy works at underemployment level (Keynes, 1936, pp.3). This is because Keynes rejects perfectly flexible prices assumption of the old classical doctrine and asserts that prices are downward rigid. The rigidity assumption of Keynes is the core of his explanation for involuntary unemployment (Modigliani, 1944). Since nominal wage may not be reduced until the necessary level for full equilibrium due to the rigidity assumption when real wage is above the full employment level, labor market is likely to work at underemployment level and involuntary unemployment could exist. It is coherently seen that the cure for the problem is decreasing real wage either by decreasing the nominal wage or increasing the price. Moreover, he thought that monetary policy has limitations (Keynes, 1936, pp.173) especially in the contracting periods. Therefore, he recommended that governments should interfere the economies through fiscal policies such as government expenditures, tax cuts in order to push aggregate demand up to carry the economy to the full employment equilibrium level (Snowdon and Vane, 2005). In other words, underemployment equilibrium is caused by aggregate demand deficit. Then, it can be concluded that as demand deficit is declined by expansionary fiscal policies, voluntary unemployment lessens since rising prices brings about a decrease in real wages and thus,

aggregate output goes up, which is growth. Lastly, growth and unemployment are inversely related since it is possible to rise aggregate output by increasing employment since economy operates at underemployment level.

In this manner, Stewart (1986) states that “the common sense conclusion is that Britain and other Western countries had full employment for a quarter of a century after the war because their governments were committed to full employment and knew how to secure it; and they knew how to secure it because Keynes had told them how.” Keynesian doctrine based policies got popularity in the post-depression period after it got successful at eliminating the high unemployment rate caused by the Great Depression.

This approach led to the foundation of welfare state approach which means that government must take actions in order to raise well-being of the citizens. These demand management oriented policies became successful and gave strong performance by contributing to high growth rate, low unemployment rate, wage improvement and social development during the golden age (1950-1973) until the beginning of the 1973 oil crisis in exchange for rising inflation (Tobin, 1987).

In the beginning of 1970’s, unemployment could not be sustained at a low level despite the high inflation levels in the industrial countries. To give some examples, the unemployment rate increased from 4,4% to 5,5% and the inflation rate increased from 5,9% to 11,0% in the US economy between 1970-1974 whereas the unemployment rate increased from 3,0% to 3,6% and inflation rate increased from 6,4 % to 9,4 % in the UK economy between 1970-1971 (IMF and OECD data). Therefore, coexistence of the inflation and recession which is called stagflation with 1973-74 OPEC oil crisis disproved the theory of trade-off between unemployment and inflation, which was assumed implicitly by Keynes (Snowdon and Vane, 2005) since the oil crisis dramatically increased the cost to bear in

order to push aggregate demand up and lower the unemployment rate. Then, Keynesian expansionary fiscal policy prescriptions for high employment and growth rates were abandoned, and the Monetarist (Chicago) School began to dominate the economic doctrine.

Monetarist school states that the reverse relation between unemployment and inflation is temporary. Unemployment could be lowered below its natural level only in the short-run and unemployment goes back to its natural level in the long run (Friedman, 1968) since the economic agents are assumed to have adaptive expectations. Therefore, monetarist view postulates that unemployment and growth are not related in the long-run.

The long run relationship between unemployment and growth is analysed by taking into account economic growth. The neo-classical growth theory asserts that economy reaches a steady state, where intensive growth, which could be defined as growth gained thanks to productivity increase, rate is zero regardless of starting point (Solow, 1956). However, extensive growth, which refers the growth through input increase, depends on the rate of technological progression and population growth which are determined exogenously in the model. Moreover, growth does not sustain in the long-run without technological progression and saving rate does not affect the long-run growth rate. The determinants of the growth are external shocks (technology and population) in the Solow growth model and unemployment does not play any role in the determination of growth rate in the long-run (Solow, 2002; Mankiw, 2003).

The neo-classical growth theory was criticized for failing to explain the reasons for the technological progression which is main driving force of the economic growth since technology is presumptively exogenous in the model. Thus, endogenous growth models were developed in order to explain the reasons for

technological progression (Blaug, 2002; Romer, 1994; Crafts, 1996). As a result, some endogenous growth models provide explanation about the relationship between unemployment and growth.

For instance, Aghion and Howitt (1994) investigated the implications of the long-run unemployment rate by an endogenous growth approach. In their model, the relation between unemployment and growth is determined by two opposite effects *"capitilization effect"* and *"creative destruction effect".* Capitilization effect means that rising growth causes increase in capitalized returns of employment, therefore, a decrease in unemployment equilibrium level. Creative destruction effect indicates that rising growth causes a decrease in job-match time, which increases unemployment equilibrium level by increasing job leaving rate and by discouraging vacant occupation alternatives. Consequently, dominating of these competing effects determines the shape of the relation. If capitilization effect dominates, an inverse relation exists between unemployment and growth but positive relation exists between unemployment and growth if creative destruction effect dominates.

Another example for an endogenous growth model investigating the relation between unemployment and long-run growth rate is Zagler (1999). In this model, economy is composed of three components; households, manufacturing and innovation sectors. Labor force can work either for innovation sector or manufacturing sector and two sectors pay to labor force efficient wage. By using this model, he concluded that unemployment rate has negative effects on the long-run growth rate, since it decreases the capacity of innovation in the economy.

Cahuc and Michel (1996) investigated the effects of minimum wage legislation on the growth rate by using an endogenous growth model, where labor force is made

up of unskilled and skilled parts. Due to the existence of minimum wage legislation, demand for skilled labor force is higher than demand for unskilled labor force since unskilled labor has relatively higher wage. The difference between the demand for skilled and unskilled labor encourages the unskilled labor force to accumulate human capital in order to get a job. Increasing human capital stock triggers off higher growth rates. Therefore, unemployment and growth is inversely related.

Daveri and Tabellini (2000) also introduced an endogenous growth model in order to examine the relationship between unemployment and growth, along with tax in the industrialized economies. According to this model, if a rigidity in wage occurs due to any reason like unions, fiscal policies determine the relationship between unemployment and growth rate. When wage is rigid, taxes levied on the nominal wage raises the real wages. Therefore, cost of the labor force increases, which stimulates the substitution of capital for labor. As a result, productivity of capital decreases, which causes the displacement of investment. Then, economic growth performance deteriorates due to the increase in unemployment rate. Thus, it is possible to say that unemployment and growth relation is inverse (Arico, 2003).

Toche and Lyon (2001) studied whether there exists a trade-off between unemployment and growth rates. They concluded that there is a positive relation between unemployment and growth in the long-run as long as wages and productivity of labor co-increases. When wage increases while labor market shrank, stimulant to capital investment increases rather than hiring. Thus, a trade-off relation is established.

1.2. THE OKUN'S LAW

The association between employment and growth engaged interest of the economists because of the need for stabilization policy. When an economy operates at its long-run production level, unemployment rate is at its natural level, which refers to natural unemployment rate. Then, the question about the employment and growth relation becomes how unemployment behaves when output level of an economy deviates from its long-run level. Actually, economists were aware of the negative association between unemployment and growth (Umut, 2013) but Okun modelled that relation statistically the first time (Javeid, 2010; Mankiw, 2009) and showed empirically the linkage between unemployment and potential output (Holmes and Silverstone, 2006).

Okun concluded that there exists a linear inverse relation between the aggregate production and unemployment in his article *"Potential GNP and Its Measurement",* which examines the relevant relation for the time period from 1947 to 1960 by using quarterly data sets of the U.S.A. This negative association has been named as the Okun's Law since then. He also found that the relation is stable, which implies that it does not exhibit unpredictable patterns (Snowdon and Vane, 2005). The Okun's Law, which is that there exists a negative association between unemployment and real output, is based on the idea that producing more goods or services requires to employ more labor force.

The standard form of the Okun's Law could be written as following.

$(Y_t - Y_t^*) = \alpha + \beta(U_t - U_t^*) + \varepsilon_t$, where $\beta < 0$ [Equation-1]

Y and U corresponds real output and unemployment rate in the relevant time period, respectively. t subscripts stand for time period. Y^* and U^* shows potential output level and natural unemployment level, respectively. ε_t is error term. Moreover, in the model Y and U are used in logarithmic form. Okun calculated that one percentage unemployment increase over its natural level, which is assumptionally four percent, causes approximately three percent decrease in output.

Okun used three different types of models in order to fathom the relation more deeply, “difference model”, “gap model” and “fitted trend and constant elasticity model”.

1.2.1. The Difference Model

The difference model is a regression, where the variables are used in their first difference. Formally, it could be written as

$(U_t - U_{t-1}) = \beta_0 + \beta_1(Y_t - Y_{t-1}) + \varepsilon_t$, where $\beta_1 < 0$ [Equation-2]

β_0 is intercept term, which shows the average growth. β_1 is known as the Okun’s coefficient, which shows the percentage decrease in output when unemployment increased one percent. Okun reached the following results by using the difference model.

$(U_t - U_{t-1})$ =0,3 -0,30$(Y_t - Y_{t-1})$ [Equation-3]

According to the results, if real output stands the same, economy grows 0,3 percent per quarter and %3,3 decrease in unemployment rate is necessary for one percent real output increase.

1.2.2. The Gap Model

In the gap model output gap (difference between potential output and actual output) is related to unemployment gap (difference between natural unemployment and observed unemployment). This relation can be formalized as following

$(U_t - U_t^*) = \beta_0 + \beta_1(Y_t - Y_t^*) + \varepsilon_t$, where $\beta_1 < 0$ [Equation-4]

β_0 coefficient is full equilibrium level of unemployment and β_1 is the Okun's coefficient, which exhibits the percentage decline in output gap when unemployment deviates one percent from its natural level. Okun calculated the following by employing the gap model.

$(U_t - U_t^*) = 3{,}67 - 0{,}35(Y_t - Y_t^*)$ [Equation-5]

Equation-5 states that 2.8% output increase results in one percent unemployment decrease. Moreover, full employment level of unemployment is 3,67 percent, which is near 4% natural level of unemployment.

1.2.3. The Fitted Trend and Constant Elasticity Model

As it was aforementioned, the difference model relates changes in unemployment and changes in real output while the gap model relates unemployment gap and output gap. The fitted trend and constant elasticity model captures the output-unemployment coefficient by excluding the trend from the model. The model captures the Okun's coefficient as following.

$$\frac{N}{N_f} = \left(\frac{A}{P}\right)^a \qquad \text{[Equation-6]}$$

where N is actual employment rate, N_f is potential employment rate, A is actual output, P is potential output and a is a constant. A/P ratio have a constant elasticity relation with N/N_f ratio, which is a.

P grows at a constant rate (r) beginning from P_0 to P_t, where t is any time point. This growth relation could be shown as following.

$$P_t = P_0 e^{rt} \qquad \text{[Equation-7]}$$

When Equation-6 and Equation-7 are combined N_t can be calculated as

$$N_t = \frac{A_t^a N_f}{P_0^a e^{art}} \qquad \text{[Equation-8]}$$

When we take the logarithm of the both sides of the Equation-8, we reach

$$\log N_t = \log(\frac{N_f}{P_0^a}) + a \log A_t - art \qquad \text{[Equation-9]}$$

It can coherently be seen that logarithm of employment rate depends on a time trend and logarithm of actual output. In this framework, coefficient of logarithm of actual output gives output elasticity of employment and ar coefficient shows the potential growth rate. Then, Okun reached the following results by using this model.

$$\log N_t = 212 + 0{,}40 \log A_t - 0{,}32t \qquad \text{[Equation-10]}$$

Equation-10 states that one percentage increase in unemployment decreases output less than three percent since the difference between coefficients with and without trend is 0,30. It could be shown as (1/0,35) - (1/0,40) = 2,8 - 2,5 = 0,30

After all, Okun combined these three models which relate unemployment and output, and calculated Okun's coefficient as 3 on the average and 3,2 on the weighted average. Then, he formulated the relation as

$$P = A[1 + 0{,}32(U - 4)] \qquad \text{[Equation-11]}$$

Equation-11 shows that actual output is equal to potential output when unemployment rate is four percent, which is natural level of unemployment. One percent increase in unemployment over four percent causes 3,2% decline in

output. Three different models which Okun used and their results are given in the Table-1.

Table-1: Okun's Models And Their Results

Model	Estimation	The Okun's Coefficient
The difference model	$\Delta U_t = 0{,}3 - 0{,}30\Delta Y_t$	TOC=1/0,30=3,33
The gap model	U_{gap} = 3,67- 0,35Y_{gap}	TOC=1/0,35=2,8
Fitted trend and constant elasticity model	$\log N_t = 212 + 0{,}40 \log A_t - 0{,}32t$	TOC < (1/35)-(1/40)=0,30

1.3. EMPIRICAL LITERATURE REVIEW ON THE OKUN'S LAW

In the previous chapters, theory of the relation between unemployment and growth and the theory of Okun are given. This chapter explains the empirical studies about the Okun's Law since Okun (1962). When the literature about the relationship between unemployment and growth is reviewed, it is not possible to state that there exists a consensus among the studies. Furthermore, these studies vary in terms of many aspects such as method, region, time period, whether it includes other explanatory variables, etc. Thus, the studies were given by dividing them into four sub-groups. In the first sub-group, studies which vary with model specification are given. The studies which regionally and demographically approach to the Okun's law are given in the following two subgroups. Then, studies that make comparisons in terms of Okun's law are given in the fourth sub-group and lastly, studies concerning with the Turkish economy are given in chapter 2.6. Moreover, they are summarized in Table-2.

1.3.1. Model Specification

One of the most important difference across the studies is their model specification and it was examined under three sub-headings; whether model includes another explanatory variable(s) in order to investigate the relation between unemployment and growth, static versus dynamic model comparison and asymmetric structure of the relation.

1.3.1.1. Models Including Extra Explanatory Variable(s)

Okun (1962) assumes that factors could affect the growth rate through labor force channel e.g., productivity, working hours or capacity utilization changes simultaneously. Therefore, it is expected that models including extra explanatory variable(s) give smaller coefficients for the relation between unemployment and growth (Mıhçı and Atılgan, 2010).

Prachowny (1993) investigated the relationship between production gap and unemployment gap for the U.S.A economy over 1947Q1-1986:Q2 and 1965:Q1-1988:Q4 time periods by using a production function model including working hours, productivity and capacity utilization as explanatory variables. He found that unemployment gap explains production gap, and calculated the Okun's coefficient as -0,67 which is absolutely smaller than Okun calculated. This study concludes that reason beyond such a low coefficient is added new explanatory variables to the production function.

Attfield and Silverstone (1997) investigated the unemployment and growth association for the U.S.A economy over time period 1967-1986 in order to test the results of Prachowny (1993) contradicting the results of the Okun Law by

employing Johansen cointegration and dynamic regression. They concluded that unemployment gap and growth gap variables are cointegrated but they could not find strong evidences for the contributions of extra explanatory variables like Prachowny (1993) suggests. Furthermore, the Okun's coefficient was computed as -2,2662, which is close to the computation of Okun (1962).

Özel et al. (2013) investigated the relationship among unemployment, productivity and economic growth for G-7 countries by using POLS method for 2000-2011 periods. The results show that the response of unemployment to growth is -0,35 per unit increase while the response of unemployment to productivity is -0,06 per unit increase. The number -0,35 is close to the Okun's original coefficient and coefficient of productivity is quite small. Therefore, the study reveals that growth is more influential over unemployment rather than productivity.

Meyer and Sanusi (2019) researched the causal relationship among growth, employment and domestic investment. In this study 1995-2016 quarterly South African data was used with Johansen cointegration technique and VECM models. The results suggest that all the variables are cointegrated and there is a two-way causality between economic growth and employment. But, there is an inverse relation between growth and employment in the long-run. Then, it could be said that the Okun's coefficient is 2,06 while coefficient of domestic investment in the same perspective is -3,62 depending on their results.

Connolly (2019) examined the effects of inflation, education, consumption and GDP on the unemployment rate for the Philippines economy over the time period from 1976 to 2006 by using CLRM. She estimated the coefficients 0,16 for education, -0,09 for inflation, 0,97 for consumption and -0,56 for GDP growth. Therefore, the Okun's coefficient could be calculated as -1,79 depending on her

study. Thus, she reached a smaller coefficient than Okun's calculation for the Philippines economy.

In sum, several studies show that adding new extra explanatory variable(s) is expected to decrease the Okun's coefficient, but the studies offering contradictory results also exist in the literature.

1.3.1.2. Dynamic Models versus Static Models

Some studies conducted in order to examine the Okun's relation put forward that Okun's coefficient is bigger than the Okun's calculation since static model specification of Okun (1962) constraints the lagged effects (Kır, 2011).

Gordon (1984) calculated the Okun's coefficient for the U.S.A economy over the period of time 1947-1986 by employing ARDL model in order to incorporate dynamic effects. He calculated the Okun's coefficient as -0,23 and -0,5 in the short-run and long-run, respectively. This bigger coefficient is attributed to the dynamic model specification.

Weber (1995), investigated the relationship between unemployment and GNP for the U.S.A economy over 1948-1988 period with quarterly data by using six different models; static OLS, cointegrating regression, dynamic regression with two and four lags and VAR model with two and four lags. Weber calculated the coefficient of the GNP as -0,314 by static OLS, -0,34 by cointegrating regression, -0,26 by dynamic OLS with both two and four lags, and -0,224 by VAR model with both two and four lags. This implies that the Okun's coefficient gets bigger when

dynamic models are employed since reciprocal of those coefficents must be taken in order to reach the Okun's coefficient.

Moosa (1999) calculated the Okun's coefficient for the U.S.A economy over 1947:Q1-1992:Q2 time period. He used Kalman filter to remove the cyclical component of the series and employed ARDL model. According to the results, the long-run coefficient of growth is -0,38 and the short run coefficient of growth is -0,16. Therefore, it could be said that the long run coefficient is close to the coefficient which Okun calculated as -0,32 and dynamic modelling make the Okun's coefficient bigger.

Lal et al. (2010) conducted a study which includes the analysis of the Okun's Law in China economy over 1980-2006 period. In this study Engle-Granger cointegration end ECM were used, and it was captured that the Okun's Law is invalid for China economy in the relevant period of time.

Pehlivanoğlu and Tanga (2016) researched on the Okun's Law for BRICS countries and Turkey economy over 1990-2014 period with Engle-Granger cointegration, FMOLS and HP filter. The research suggests that Engle-Granger cointegration test is positive in all the countries save Brasilia. The Okun's coefficient for Russia, China and India was computed as -0,6, -0,24 and -5,9, respectively.

Karikari-Apau and Wilson (2019) investigated the validity of the Okun's Law for China economy over 1991-2018 by using ARDL boundary test. According to the results there is an inverse relation between growth and unemployment rate, which indicates the validity of the Okun's Law. Furthermore, the Okun's coefficient was calculated as -0,333 and -0,320 in the short-run and long-run, respectively. Thus,

it is likely to deduce that static models give smaller coefficient or does not support the Okun's Law compared to the dynamic model when those four studies concerning with China are combined.

Then, it could be deduced that dynamic modelling is a possible reason for calculating the bigger Okun's coefficient based on those studies.

1.3.1.3. Asymmetry in the Okun's Law

There exists lots of studies give results in a way that supports the theory of Okun in a symmetric framework e.g. Gordon (1984), Adams and Coe (1989), Barreto and Howland (1993) or Attfield and Silverstone (1997) despite the fact that power of the Okun's relation varies among countries and over time periods. Therefore, possibility of asymmetry in the Okun's relation attracted the attention of researchers (Silvapulle et al., 2004). Then, in this part, studies concerning with asymmetry in the Okun's law are given.

Not surprisingly, the first studies concerning with the asymmetry in the Okun's Law were conducted for the U.S.A economy. Courtney (1991) and Palley (1993) investigated the asymmetry of the Okun's Law for the U.S.A economy over the 1970-1989 and 1948-1991 time periods, respectively. Then, both studies provide evidence for the existence of asymmetry in the Okun's Law though they disagree on the direction of asymmetry. Courtney (1991) found that, when Okun's coefficient is calculated by symmetric regression model, unemployment rate is underestimated in recession periods while unemployment rate is overestimated in the boom period. On the other hand, Palley (1993) calculated the Okun's coefficient as -0,94 and -1,47 in the recessionary and expansionary periods, respectively. Schorderet (2001) reached the results which implies the existence

of persistence (hysteresis effect) in the unemployment series of the U.S.A economy for 1970-1998 period of time, which supports Palley (2003) while Cuaresma (2003) calculated the Okun's coefficient as -0,20 in expansionary periods while it was calculated as -0,44 in recessionary periods, which supports Courtney (1991).

Harris and Silverstone (2001), Sögner and Stiniassy (2002) and Virén (2001) examined the asymmetry in the Okuns law for 7, 15 and 20 OECD countries, respectively. All studies suggest that the Okun's relation generally treats in an asymmetric manner. Harris and Silverstone (2001) found that unemployment and growth series are asymmetrically cointegrated in all economies except for Canada in 1978-1999 period. Sögner and Stiassny (2002) examined the consistency of the Okun's coefficient over 1960-1999 period by using Kalman filter in a Bayesian approach. According to the results, the Okun coefficient does not change over time in only Italy. Furthermore, the Okun's coefficient varies between -0,12 and -0,82. Virén (2001) concluded that only Iceland and Finland do not have asymmetric Okun's Law in 1960-1997 period by using TECM (Threshold Error Corecction Model).

Huang and Chang (2005) and Silvapulle et al. (2004) investigated the existence of asymmetric structure of the Okun's Law for the U.S.A and Canada economies, respectively and both reached the results in favor of the existence of asymmetry in the Okun's Law. Silvapulle et al. (2004) conclude that the Okun's coeffiecient varies between -0,25 and -0,61 and it gets absolutely bigger as output declines for 1947:Q1-1994:Q4 time period by using 1986 Harvey method. Huang and Chang (2005) found an inverse association between unemployment and growth in a non-linear framework for 1960-2002 period by using Cuaresma (2003) and Huang (2003) structural break model with HP and band-pass filters.

Huang and Lin (2008) investigated whether the Okun's Law has an asymmetric structure or not for the U.S.A economy over 1948:Q1-2006:Q1 period by using STVC (Spatiotemporally Varying Coefficents) model. The findings show the association between unemployment and growth has an asymmetric structure, which means the Okun's coefficient is not constant over time. Moreover, it is always negative, which supports the Okun's Law.

Österholm (2016) made a research about time-varying structure of the Okun's Law for Sweden economy over 1982-2014 period with OLS and Quandt-Andrews test. The analysis shows that the Okun's Law is not consistent over time and necessary growth rate to keep the unemployment rate stable tends to decrease.

Then, it is a high probability for developed countries that there exists an asymmetry in the Okun's Law, considering the studies given. But there exist studies which provide evidence for non-existence of asymmetric version of the Okun's Law in developed countries e.g., Vougas (2003) and Pierdzioch et al. (2011).

Vougas (2003) and Pierdzioch et al. (2011) investigated the asymmetric version of the Okun's Law for Greece in the time period 1960-1997 and G-7 in the time period 1989-2007, respectively. Vougas (2003) concluded that effect of growth on employment is too weak to be a growth policy tool by employing NECM. Pierdzioch et al. (2011) found that when asymmetry is not allowed in POLS model, the Okun's coefficients are negative like it is expected. Also, the study suggests that the asymmetry is not much powerful at explaining the association between employment and growth.

Asymmetric version of the Okun's Law is not unique to developed countries. Francis (2006), Marinkov and Geldenhuys (2007), Caraiani (2012) and Flórez et al. (2018) researched into the existence of asymmetry in the Okun's Law for Côte d'Ivoire, South Africa, Romania and Colombia, respectively. All of those studies gave results in a way that support the existence of asymmetry in the law of Okun's. Francis (2006) concluded that unemployment and growth is asymmetrically cointegrated for the time period 1975-2003 by using MTAR model. Marinkov and Geldenhuys (2007) calculated that the Okun's coefficient varied between -0,16 and -0,77 over the time period 1970-2005 by using cointegration and structural break test. Caraiani (2012) computed the Okun's coefficient as -0,09 in the expansionary cycles while he calculated it as -0,32 in the recessionary cycles for 1991-2009 period of time by using Markov switching model. Flórez et al. (2018) employed threshold and linear cointegration together for the time period 1984-2016. The Okun's coefficient is computed -0,45 by using VECM, the linear case. The coefficient was computed as -0,6 in the lower regime and -0,2 in the higher regime in the nonlinear (two-regimed threshold) case.

1.3.2. The Okun's Law in Terms of Demographic Features

Another difference approach to the Okun's Law is assessing the relation in terms of different demographic groups such as gender, age or color.

Lynch and Hyclak (1984) investigated the effect of aggregate output changes on unemployment rate in terms of age, gender and color cohorts for the U.S.A economy by using 1954-1979 data sets. They found that blacks compared to whites, teenagers compared to adults and males compared to females are more sensitive to the aggregate output deviation from its potential. Furthermore, they stated that natural level of unemployment raised from 4,70 to 5,14 percent, which was mainly contributed by the decline in employment rates of sub-group of

teenagers, and unemployment rate was not contributed by the changes in the ratio of sub-groups to the total population.

Ewing et al. (2002) investigated the effects of the output shocks on the employment with respect to gender and color cohorts for the U.S.A economy over 1972-1999 time interval by using VAR, GARCH and TARCH models with monthly data. According to the results, employment of black people and women are more sensitive to downward output shocks while white male employment has asymmetric structure in positive shocks cases.

Bisping and Patron (2005) tested whether the response of unemployment to growth shocks varied with respect to regions, gender and color cohorts for the U.S.A economy by using generalized variance decomposition technique. According to this study, response of unemployment to shocks differs among regions while demographic cohorts in different regions do not behave in the same manner.

Zanin (2014) researched on the association between unemployment and economic growth with respect to the demographic cohorts for OECD countries over 1998-2012 time interval by employing OLS. This research suggests an inverse relation between variables is present, and coefficient of this association is higher for males compared to women. Moreover, the age group which was affected most by unemployment is 15-24 cohort.

Ben-Salha and Mrabet (2019) investigated the validity of the Okun's Law in terms of gender and age cohorts by using 4 African countries data over the 1991-2013 time interval. They used HP and BP filters, quadratic detrending with structural time series model. Furthermore, possible existence of non-linearity was taken

into account differently from the classical Okun's method. The findings indicate that the Okun's coefficient is higher in the young and the most sensitive group to growth in terms of employment is 15-24 age cohort.

Esmeraldo and Veton (2019) investigated whether the Okun's Law is valid throughout the time period from 1993 in which communism fell down to 2017 for Albania economy by using gap version of the Okun's method with rolling regression. According to the study, there is not a strong inverse relation between unemployment rate and growth in upheaval era after the fall of communism and in 1990's while it reverses after 1990's. Moreover, females are at more unemployment risk, the young enjoy growth more to be employed and the estimated Okun's coefficient is 2,07% in general while it is 1,12% in young population.

Bonaventura et al. (2020) provides evidence which supports that regional growth has different effects on male and female unemployment. In this research Lagrange Multiplier test was used with 1995-2015 Italian data and the results suggest that the Okun's Law is valid in the both male and female cases for Northern Italy while the Okun's Law is not valid in Southern Italy for the female.

As a conclusion, the studies reveal that unemployment is often a deeper issue for the young, women and blacks regardless of the development level of countries.

1.3.3. The Regional Okun's Law

Some studies concerning with the Okun's Law based on the idea that the Okun's Law is sensitive to the characteristics of the regions such as their industrialization

levels, development level, etc. Therefore, they focused on the regional structure of the Okun's Law. This sub-section gives several examples of such studies.

Blackley (1991) tested the regional validity of the Okun's Law for 26 states of the U.S.A. The study indicates that the Okun's coefficient varied among states; the biggest Okun's coefficients was 6,803 in Louisiana while the smallest one is 2,137 in Alabama and it is 3,1 on the average.

Freeman (2000) tested the Okun's Law for the U.S.A economy and its 8 states by using 1958-1998 quarterly data and 1977-1997 annual data by employing OLS with band-pass filter. According to the results, the Okun's coefficient is constant over time and it is approximately 2 for all states and there is not much statistically significant difference among states.

Adanu (2002) estimated the Okun's coefficient for the Canadian economy for the 1981-2001 period by using HP filter and quadratic detrending. The estimated Okun's coefficient is -1,58 when HP filter is used while it is -1,32 when quadratic detrending is employed. Furthermore, 10 states of Canada were compared in terms of Okun's coefficient. The findings show that the Okun's Law works in 7 out of 10 states and the Okun's coefficient is smaller in the more industrialized states.

Apergis and Rezitis (2003) investigated the relationship between GDP and unemployment for 8 regions of Greece over 1960-1997 period by using HP and band-pass filters with Zivot-Andrews unit root test. According to the results, there does not exist any difference in terms of the Okun's coefficient among regions except two regions, and it was found that 1981 observation is a structural break point. After 1981, the Okun's Law began to deteriorate.

Christopoulos (2004) investigated the relationship between GDP and unemployment relation for 13 regions of Greece by using panel cointegration technique over 1971-1993 period. The findings suggest that GDP and unemployment are cointegrated in 6 regions while they are not in the rest.

Villaverde and Maza (2007) researched the Okun's Law for Spain and its 17 regions over 1980-2004 period by using panel data analysis with HP filter and quadratic detrending method with gap version of the Okun's method. The findings suggest that there exists an inverse relation between unemployment and output gap for Spain and across its almost all regions (except for two regions) though intensity of response of unemployment to growth varies between -0,32 between -1,55 among the regions due to their demographic and structural differences.

Elhorts (2009) researched the Okun's Law for West Europe area over 1986-2001 period by designing a spatial econometric model with simultaneous-equations system, and the Okun's coefficient was computed as -1,45 on the average. Therefore, one could state that the Okun's Law works in a regional spread framework in West Europe in the aforementioned period.

Giha et al. (2012) investigated the Okun's relation for Scottish economy by making a rural-urban region comparison over 1995-2009 period by using panel cointegration technique, and they found that the Okun's coefficient is -1,7 for both rural and urban regions in the short-run while it was calculated as -0,33 for the rural area and -0,65 for the urban area in the long-run.

Montero Kuscevic (2012) examined the regional spread of the Okun's Law across metropolitan regions throughout 2002-2010 period by using panel spatial model

and it was uncovered that the growth rate of metropolitan regions is weak at explaining the variations in unemployment in metropolitan regions.

Binet and Facchini (2013) made a research about the Okun's Law for 22 regions of France over 1990-2008 period by using panel OLS method. This study suggests that the Okun's Law is valid in 14 regions of France since the Okun's relation has a negative and statistically significant coefficient.

Durech et al. (2014) carried out a research about the regional Okun's Law for Czechsia (14 regions) and Slovakia (8 regions) by using HP filter with 1995-2011 era data sets. The analysis suggest that the Okun's Law does not work in those regions where long-run unemployment rate is high and growth rate is low.

Palombi et al. (2015) employed a panel spatial model in order to analyze the regional Okun's Law for England throughout 1985-2011 period. The analysis shows that the Okun's Law works in the English economy for that time interval. Furthermore, the results show that spillover effects and interregional linkup play an important role in the validity of the Okun's Law.

Although there are studies showing that regional differentiation does not have an effect on the Okun's Law, it is possible to come to a general conclusion that the Okun's Law could take dissimilar forms for the distinct regions due to the fact that regions could have different characteristics.

1.3.4. The Comparing Studies

Several studies have approached to the Okun's Law to make comparison between and within the country groups such as OECD, MENA or EU. In this context, such studies are given in this sub-section.

Moosa (1997), tested the validity of the Okun's Law for G-7 countries over 1960-1995 period by using Harvey's structural time series analysis to get cyclical output and unemployment series. Then, OLS, ROLS and SUR methods were employed in order to calculate the Okun's coefficient. According to this study, employment performance of the U.S.A and Canada economies are more sensitive to output change than European and Japan economies. They attribute this difference to the flexibility of labor markets of economies since they calculated the biggest Okun's coefficient for Japan whose labor market is not quite flexible while they computed the smallest Okun's coefficient for the U.S.A whose labor market is pretty flexible.

Padalino and Vivarelli (1997) investigated the association between employment and growth for G-7 countries over 1960-1994 period by using labor elasticity. The results suggest that labor elasticity is 0,5 for the U.S.A and Canada while it is extremely low for the rest, which means that the Okun's Law is more significant in the U.S.A and Canada economies.

Izyumov and Vahaly (2002) tested the validity of the Okun's Law in 25 economies in transition which is made up of two groups; leaders (10 EU accession countries) and laggers by using 1991-1994 and 1995-2000 data sets. According to the results of the first-difference method of Okun (1962), the Okun's Law is valid in the leader countries in both 1991-1994 and 1995-2000 time intervals while the

Okun’s Law is valid in the rest only for 1995-2000 period on the condition of excluding the wars-affected countries from the sample.

Tatoğlu (2011) researched the relation between unemployment and economic growth for 19 European countries both separately and as a whole over 1977-2008 period by using regression analysis (FMOLS, DOLS, OLS), panel cointegration (Kao and Pedroni) and PECM. The findings suggest that the Okun’s Law is not valid in all countries in the short-run while it is valid in the long run and the Okun's coefficient for the whole sample is -0,70 according to the results of Hausman test.

Huang and Yeh (2013) analyzed the Okun’s Law for 21 OECD countries and 23 different countries by using 1980-2005 and 1976-2006 data sets, respectively through PARDL method. According to the analysis, the Okun’s Law is valid for all countries and the Okun's coefficient is identical in the long-run.

Hamia (2016) carried out a study concerning with the association between employment and growth for 17 MENA countries over 1980-2013 period of time. In this study, ARDL model and panel data analysis were used for the single country analyses and entire sample analyses, respectively. They used three different filters in order to increase the robustness of the model; HP, BK and quadratic trend. They found that the Okun’s Law works for the entire sample. When come to the single country analyses, the Okun’s Law is valid in Turkey, Lebanon, Jordan, Iran, Egypt and Algeria. Further, the Okun’s coefficient is relatively bigger in the Arab countries and the Okun’s relation is not stable in Jordan, is ambiguous in Turkey and Lebanon and is stable in the rest according to the results of the CUSUM squares test.

Oktar and Yüksel (2017) conducted a research concerning with the association between unemployment and growth for 10 developing and 10 developed countries for 1993-2015 period of time with panel causality test of Dumitrescu-Hurlin. The research shows a causal relation from growth towards unemployment in the short-run but it is not present in the long-run for developed countries. For developing countries, the Okun's Law works in the short-run but not in the long run.

Obst (2019) investigated the validity of the Okun's Law for EU15 countries by using two different data set; 1980-2018 annual data set and 1985-2018 quarterly data set. In the analysis, Hodrick-Prescott filter was used in order to remove trend in the data sets. Then, a dynamic model which includes delayed values of the variables (unemployment and output) and themselves was employed both in the framework of the gap version and difference version. According to the results, the Okun's coefficient is significant for EU15 countries though it varies significantly among countries. The Okun's coefficient is between -0,085 and -0,872 and it is -0,39 on the average for quarterly data set with gap version while it is between -0,08 and 0,786, and 0,416 on the average in gap version in the annual data case. The Okun's coefficient is between -0,053 and -0,702 with -0,290 average in the case of quarterly data set and difference version of Okun while it is between -0,057 and -0,755 with -0,315 average in the last case. And it is noteworthy to mention that the lowest Okun's coefficient belongs to Luxemburg while the highest Okun's coefficient belongs to Spain in all the cases.

Tumanoska (2020) tested the validity of the Okun's Law in his study for chosen 14 the European Union member countries and 7 Southeastern European countries. In that study PARDL model and 1991-2020 data sets were used. The findings suggest that one percent increase in growth rate causes 1,5% unemployment decrease in the European Union countries and 0,25% unemployment decrease in Southeastern European countries, which supports

the validity of the Okun's Law. Moreover, it could be stated that the Okun's coefficient is smaller in European Union countries.

The literature review shows that the literature has not reached a consensus about the relationship between unemployment and growth. In other words, when combining those studies, it is not possible to reach a common conclusion about the Okun's Law. There exist studies which provide evidence for the idea that the Okun's Law is not valid or relatively weaker in the developed countries while there are also studies that show the opposite.

1.4. THE DEFINITION OF AND THE REASON FOR JOBLESS GROWTH

Though the Okun's Law postulates that there is a negative association between unemployment and growth, as the previous section reveals, many studies have provided evidence not supporting it (Cabellero, 1993; Walterskirchen, 1999; Zagler, 2003). As a result, economic literature was introduced a new term "jobless growth" by Nicholas S. Perna in the second half of 1980's in order to define situations where economic growth exists without a decline in unemployment rate (Perna, 1987). Associated with jobless growth, "jobless recovery" refers to periods after the downturns in which the recovery speed of aggregate output is relatively higher than the recovery speed of employment rate. During the jobless recovery periods, jobless growth occurs.

The jobless growth term or invalidity of the Okun's Law attracted attention of the economists and they have introduced several models in order to explain the jobless growth. Here, we give the details of some studies in order to explain the existence of the jobless growth. According to them, jobless recovery (growth) occurred as a joint result of five factors; "change in macroeconomic policies",

“globalization”, “technological progression”, “transformation of production system” and “polarization”.

First of all, the production system has gradually changed in the aftermaths of the 1973 oil crisis. Abandonment of the Keynesian policies brought the quest for ways of the increasing production given that unemployment rate could not be lowered below its natural rate, therefore cost and productivity terms came into prominence in this period (Kocabaş, 2015). Then, the mass production where production is done with a division of labor organized in such a way that no technical specialization is required (Özkalp and Sungur, 1997) is failed to be sufficient after 1973 (Saklı, 2007) and that insufficency was caused by the rigidity of the production system (Harvey, 1991), where rigidity means that it is difficult to increase the output due to the lacking of productivity enhancing features of the production system. Therefore, so-called fordist production system transformed into a more flexible structure which is called post-fordist system. Post-fordizm could be defined like following “a production regime where production is done in a flexible structure that labor and machinery are used to ensure specialization. Besides information and technologies are commonly used to improve productivity.” (Saklı, 2007).

Secondly, the neo-liberal revolution term is rooted in the liberal economic policies began to be implemented after the 1973 oil crisis with rise of the Chicago School and got popularity in 1980’s (Eğilmez, 2020). Then, neoliberal policy prescriptions for developing countries were arranged by John Williamson in 1989 as subsuming of ten principles in his article *“What Washington Means By Policy Reform”*. The consensus implies the agreement among IMF, World Bank and the U.S.A Treasury on the policy prescriptions for developing countries (Hurt, 2020). Principles of Washington Consensus could be expressed as following:

1. Fiscal deficit preventive fiscal policies must be implemented.

2. Government expenditures must shift from subsidies to growth-oriented and poor-protective areas.

3. A tax revolution must be made in a way that expand the tax base and provide moderate tax rates.

4. Interest rate must be determined in the market.

5. Exchange rates must be competitive.

6. International trade must be liberalized.

7. Direct foreign investment must be free.

8. Public economic enterprises must be privatized.

9. Competitive markets must be ensured.

10. Ownership rights must be granted (Eğilmez, 2020).

Neoliberal policies resulted in that intervention of governments on the labor market declined and flexibility of labor force gained significance; therefore, labor market began to experience a transformation (Butev, 2012). This transformation accelerated after 1980's with the contribution of globalization (Yılmaz-Eser and Murat, 2015). The labor force was split into two parts as qualified labor force and non-qualified labor force due to the need for flexible labor force since flexibility requires being qualified (Yavuz, 1995). This categorization could be named as "polarization", which is the third reason for jobbless growth (Butev, 2012). "Polarization" could be defined as the disappearance or shrinkage of the middle level qualifications required occupations. In other words, polarization indicates a clustering of the labor force mostly in the high level qualifications and low level qualifications required occupations.

Acemoğlu (1999), Goos et al. (2009), Autor et al. (2006) noted that employment is clustered at the tails of vocational qualifications, which supports the polarization hypothesis, furthermore polarization process which began to accelerate in the beginning of 1980's and jobless recovery are assumed to be linked (Jaimovich and Siu, 2018). The disappearance of the middle level qualifications required occupations caused by the polarization is related with vanishing of the routine tasks which could be done with an appropriate procedure based jobs (Autor et al., 2003).

The theory of polarization oriented jobless recovery is based on three assumptions. Firstly, employment in the middle level qualifications required occupations is a significant part of the aggregate employment. Secondly, shrinking per capita aggregate employment during recession periods is concerned with decline in the routine occupations. Lastly, jobless recoveries have existed only once middle level qualification required routine jobs disappeared. Furthermore, polarized occupations either do not shrink or rebound after a short period of time (Jaimovich and Siu, 2018). Thus, jobless recoveries could be related to polarization of labor force in terms of level of requiring qualifications.

As another reason for jobless growth, technological progression causes unemployment as it decreases the necessary labor force for any occupation by providing a new production technique, tool or automation, which may lead to an improvement in labor productivity (Léautier and Hanson, 2013; Caballero and Hammour, 1997). This implies the decline in the costs. But labor productivity which could be measured as output per worker could rise in three different ways; total factor productivity increase, higher capital labor ratio and redistribution of labor force from less productive sectors to more productive sectors (Gutierez et al., 2007). Moreover, labor force productivity increase lessens employment rate by decreasing the necessary labor force under earlier circumstances (Ekin, 2000). Furthermore, technological progression put stress on unemployment rate

as it required qualified labor force, which means that unemployment rate increase in the non-qualified labor force (Butev, 2012). That is another way of “technological unemployment increase” while technology progression feeds the growth.

Here exists three noteworthy points about the interrelationships among polarization, jobless recovery and technological progression. Firstly, vanishing of the routine task occupations linked with polarization is not a cyclic phenomenon since it takes places only after the recessions. Secondly, jobless recovery is caused by the disappearance of the routine task jobs. Lastly, the main reason for polarization is technological progression (Firpo et al., 2014; Goos et al., 2014). Moreover, technology based polarization of labor market and such a jobless recovery is not unique to the U.S.A. (Goos et al., 2014).

The last reason for jobless growth is globalization, which could be defined as following “a multifaceted and complicated process which drives the economy and societies towards cooperation, social, economic and political change through the unrestricted circulation of capital, labor and knowledge as well as goods and services” (Karayılmazlar, 2006). Therefore, globalization term implies expanding foreign trade volume, rising foreign investments, perfect capital and labor mobilization (Meçik and Afşar, 2014). Thus, it could be stated that globalization is a transformation process which integrates the all interactions of individuals (Köstekli, 2011) and restrictions of national countries disappeared thanks to globalization (Kutlu and Taban, 2007). In other words, global economy behaves like a single economy, which refers to single market economy theory, which escalated the global competition (Çelik, 2020).

In this context, another important topic which is noteworthy to mention is FDI since it could be related with globalization. Flow of FDI could be a potential reason for jobless growth. In this manner some theoritical models were developed in order to investigate this subject. Then, in the conventional economic doctrine,

developing countries are defined as dual economies which means that total economic activities are mainly driven by two sectors; agriculture sector (rural), where wages are low, and industry sector (urban), where wages are high. Consequently, that wage gap causes inter-sectoral migration (Chaudhuri, 2007). In this framework, Khan (1982) suggested that inflow of foreign direct investment brings about urban unemployment since increasing capital stock through FDI inflow begets expansion of capital intensive sector (urban) in terms of production and employment, in turn, expected wage of urban sector raises, which stimulates the migration from rural to urban. Those immigrants lead to increase in urban unemployment rate when job generative power of urban sector is insufficient to employ them. Therefore, it is possible to conclude that flow of FDI is a possible reason for jobless growth given that employment raises in the more productive and waged sector (urban) while unemployment rate increases.

Especially after 1980's, political aims of governments were formed as increasing the global compatibility through wage restrictions since low wages were wanted to use as incentive to attract capital given that low wage implies low cost for capital owners (Felipe and McCombie, 2011). Thus, firms tend to make the labor force more productive, which means that making the same production with less employment in order to stand afloat (Ertuğrul and Uçak, 2013). This has feeded the jobless growth.

1.5. OTHER EXPLANATIONS ABOUT JOBLESS GROWTH BASED ON EMPIRICAL EVIDENCES

Numerous studies which provide evidences for the existence of the jobless growth are present in the literature and they have put forward that there are various factors that cause jobless growth. Those factors could be listed as the payroll job growth pattern, existence of permanent layoff, spread of just-in-time hiring process, reallocation of labor force among sectors, increase in labor productivity, decrease in the share of agriculture sector in the total economic

activities, rapidly growing population, rapidly growing labor force, low employment elasticity of growth, income maintenance payment, unemployment insurance benefits, raising health care costs and hysteresis effect.

Structural change in the relation between unemployment and growth could be a reason for jobless growth. In this manner, Khemraj et al. (2006) examined the payroll job growth pattern after the 1990's for the US economy and concluded that unemployment responses to business cycles more quickly after recession periods. In other words, the Okun's Law is stronger in the time periods after the recessions, crisis or depressions. Moreover, they founded that slow job generation process is correlated with productivity increase, which means that productivity increase is possible to be a reason for the weakened Okun's Law. Also, it should be taken into account that productivity changes can affect the unemployment rate in terms of costs.

Another hypothesis which was claimed by Aghion and Howit (1994) in order to explain jobless growth is existence of permanent layoff, which hardens to decrease unemployment rate. This hypothesis was tested by Groshen and Potter (2003) for the US economy for post-2001 period. They stated that job losses sustain after having lost occupations throughout recessions or job gains sustains after having gained after over recession periods in order to explain their hypothesis. In other words, a part of unemployment is not related with business cycles.

Bernanke (2003) put forward that trade pattern of the US economy could be a factor of structural change in the economy, which began in November of 2001. He claims that propensity to consume of American people is relatively higher for import goods, which means that rising growth causes less unemployment decline since growth is fed by import goods rather than domestically produced goods.

Schreft and Singh (2003) put forth that spread of just-in-time hiring process throughout the U.S.A is a reason for jobless growth in post-2001 period since it causes slow job generation process. Just-in-time hiring means that a firm employs labor force when it needs, which includes temporary or part-time jobs. Therefore, firms could increase or decrease their productions by not affecting unemployment rate thanks to flexibility of labor force.

Aaronson et al. (2004) claimed that reallocation of labor force among sectors is one of the causes of jobless growth in 2001-2003 period for the US economy. Reallocation is possible to be a need due to some reasons such as changing trade pattern or demand structure. When labor force began to be reallocated, displaced labor force needs for time to get a new job and it could be a necessary condition to gain new skills in order to be employed in the new sectors, which implies temporary increase in natural rate of unemployment and decline in employment rate growth rate of employment, namely jobless growth (Aaronson et al., 2004). However, it requires to analyze whether such a reallocation of labor force happened or not in the relevant time period for the US economy. Groshen and Potter (2003) examined this question and responded affirmatively.

Sapancalı (2008) implicitly put forward that jobless growth in the Turkish economy in the time period 2000-2006 was caused by an increase in labor productivity, a decrease in the share of agriculture in the total sectoral economic activities and rapidly growing population. He claims that when agricultural employment is displaced, it is likely hard to find a new job for a worker due to the lacking skills the firms seek for. Moreover, when population grows more rapidly than employment, combating unemployment rate gets harder. Also, increasing productivity of labor means that the same output could be produced with the same amount of employment, which indicates jobless growth. He set forth his hypothesis through following statements. In the time period 2000-2006,

employment rate increased by 3,5% while population increased by 9,6% and share of agriculture in the economy declined till 28 percent therefore, displaced agricultural employment was employed in more productive sectors.

Hodge (2009) showed that rapidly increasing labor force is likely to be a potential cause for jobless growth. He investigated the economic performance of South Africa in terms of growth, unemployment and employment for the time period from 1995 to 2007 and concluded that the main reason for jobless growth for South Africa is rapidly increasing labor force in the relevant time period. He noted that WAP and labor force raised 26% and 48%, respectively in the time period 1995-2007 while employed people figure increased 32% in the same period of time. Then, it could be come to the conclusion that unemployment rate would decrease if the labor force raised in a milder way, namely labor force growing faster than employment may bring about jobless growth.

Another approach with which was come up in order to explain the jobless growth is based on income maintenance payment and unemployment insurance benefits. Theory of equilibrium labor market states that improvement of unemployment benefits influences the labor market through two channel, it affects the job searching decisions of unemployed population and the employment decisions of the employers (Hagedorn et al., 2013). For instance, it is an example of the effect of unemployment benefits improvement on the labor market through the job searching decisions channel that high payments to unemployed population for the maintenance of their income and unemployment insurance benefits in European zone became an incentive not to work thus, a structural unemployment occurred in European zone during 1980's (Lawrance and Schultze, 1987). Hagedorn et al. (2013) is an example for the effect of unemployment benefits extensions on the labor market through the employment decisions channel. They investigated the U.S.A economy for the time period from the Great depression till 2004:Q4 by employing her own empirical methodology

and found that expanding unemployment benefits increase the equilibrium level of wages and cause a serious shrinkage in job providing figures and an increase in unemployment.

Raising health care costs are one of the impediment to increase the employment level (Wessel, 2004), which makes it a possible reason for jobless growth. Moreover, it seems that there exist two different types of that approach. The first one states that increasing health care costs could increase the employment costs above its equilibrium level, which makes labor demand shrink while the other one states that health care costs are constant per worker therefore, employers may tend to decrease the costs by making employees work more or hiring more productive and less employment (Aaronson et al., 2004), which is a possible reason for the jobless growth. In this context, Aaronson et al. (2004) showed that real cost of the health care increased for the U.S.A economy since the second half of the 1990's while Wessel (2004) showed that health care costs raised more rapidly than wages for the U.S.A economy in the 1985-2004 time period.

Lastly, hysteresis theory of unemployment is accepted as a possible reason for jobless growth. The hysteresis is a term adopted from physics but also appears in economics in a similar manner, which implies a non-linear dynamic equilibrium system which possibly has multiple time trajectories. Furthermore, a system could be accepted as hysteretic when at least one of its variables has property of path dependency without ergodicity (Dosi et al., 2017). In this context, unemployment hysteresis defines the situations where temporary changes in unemployment caused by supply or demand shocks have permanent effects (O'Shaughnessy, 2011). This means that temporary changes in unemployment rate could affect the natural rate of unemployment (Blanchard and Summers, 1986). Therefore, the existence of hysteresis in unemployment is a possible reason for persistent high unemployment and jobless growth. The related literature has provided evidence for the hysteresis hypothesis. For example, Camarero and Tamarit (2004)

investigated the unemployment hysteresis hypothesis for 19 OECD countries for the time period 1956-2001 by using Multivariate Augmented Dickey Fuller (MADF) type panel unit root tests in a SURE (Stein's Unbiased Risk Estimate) framework. They concluded that the hysteresis hypothesis work in 7 countries out of 19 which are Austria, Germany, Italy, Japan, New Zealand, Norway and Switzerland. Another study related to the hysteresis hypothesis is Crato and Rothman (2000). This study examines the validity of the theory of hysteresis in unemployment for 5 countries of G-7 (except Germany and France) through ARFIMA (Autoregressive Frictionally Integrated Moving Average) model over the time period 1960-1994. They divided the sample period into two pieces as pre-1973 and post-1973 period since 1973 is the year in which oil crisis took place. According to the results of the study, it could be deduced that hysteresis hypothesis works for all the five countries except Canada in pre-1973 period while it works just for Japan and the U.K in the post-1973 period.

As it could be seen that there are many empirical studies which try to explain reasons for jobless growth. Those studies have empirically shown that there are many reasons for jobless growth such as payroll job growth pattern, existence of permanent layoff, spread of just-in-time hiring process, reallocation of labor force among sectors, increase in labor productivity, decrease in the share of agriculture sector in the total economic activities, rapidly growing population, rapidly growing labor force, low employment elasticity of growth, income maintenance payment, unemployment insurance benefits, raising health care costs and hysteresis effect. In this manner it is possible to state that each economy may have its own reason for jobless growth.

1.6. THE STUDIES CONCERNING WITH THE TURKISH ECONOMY

The main reason for reviewing the studies on Turkey separately is that this thesis was carried out for the Turkish economy.

One of the characteristics feature of the Turkey economy post-2001-crisis era is a jobless growth pattern (Yeldan and Ünüvar, 2016). Further, the 2008 global financial crisis caused a drastical increase in the unemployment rate, and sluggish job generation process became a lineament of the Turkish economy (Akçoraoğlu, 2010). In this context, studies concerning with Turkey are given.

Yılmaz (2005) examined the validity of the Okun's Law for the Turkish economy over 1978-2004 period by using Hsiao's Granger causality test (Final Prediction Error Approach). According to the results, there is a single way causal relation from unemployment towards growth, which is not sufficient so as to be able to state that the Okun's Law works in the economy of Turkey in the relevant period of time.

Kızılgöl (2006) investigated the association between output and unemployment for the Turkey economy over 1988:H2-2006:H1 time period by using Johansen cointegration, VECM and Hsiao's Granger causality test. According to the results, variables are cointegrated for the Turkish economy but there is just a single way causal relation from unemployment towards growth rate.

Yüceol (2006) investigated the relationship between unemployment and growth for the Turkish economy over 1950-2004 period by using Johansen cointegration and VECM. The findings suggest that variables are not cointegrated, and there is not any causal relationship between them, which disproves the Okun's Law for the Turkish economy throughout aforementioned period.

Saraç and Atabey (2008) investigated the relationship between unemployment and growth for Turkey over 1951-2006 period by using OLS and VAR models.

According to the results, growth affects unemployment negatively but there exists a single way causal relationship from growth towards unemployment, which contradicts the Okun's theory of mutual relation between unemployment and growth, therefore it could not be said that the Okun's Law is valid for the Turkey economy in the relevant period of time.

Aktar and Öztürk (2009) examined the association between unemployment and growth for the Turkey economy over 2000 – 2007 period by using VAR model including the export and foreign direct investment variables as extra explanatory variables. The results show growth could not decrease unemployment therefore existence of the jobless growth is a possibility for the relevant period of time.

Akçoraoğlu (2010) tested the Okun's Law for the economy of Turkey throughout 1995:Q1-2007:Q4 time interval by employing causality test of Granger and Johansen cointegration, and it was figured out that there exists a two-way causal relationship between variables and they are cointegrated. Furthermore, employment elasticity of growth was calculated as 0,20 thus, one could deduce that this study provides evidence for the validity of the Okun's Law.

When we anatomize the period up to 2010, it draws attention that almost all studies provide evidences for the jobless growth. Therefore, it is possible to conclude that jobless growth is a characteristics of the Turkey economy for this period of time. Then, many studies were carried out in order to examine the reasons for jobless growth while some studies attributed the jobless growth to asymmetric structure of the Okun's relation. Hence, they investigated the Okun's Law in an asymmetric structure.

Arabacı and Arabacı (2010) tested the existence of the asymmetry in the Okun's relation for the Turkey economy over 1999:Q1-2009:Q3 period by using TAR model with difference and gap versions of the Okun's method. Moreover, HP filter was used in the gap model case in order to decompose the series into their cyclical and trend components. Then, it was figured out that the Okun's relation is asymmetric for the Turkish economy and the Okun's coefficient was computed -1,62 and -1,18 in the difference version for downward and upward periods respectively while it is -1,31 and -1,16 for the gap version.

Barışık et al. (2010) investigated the Okun's Law and its asymmetry for the Turkish economy over 1988-2008 period by using Markov-Switching method. They found that asymmetric model specification gives better results and according to the results of the asymmetric model, the Okun's coefficient varies during recession and expanding periods; unemployment rate tend to decrease in recession periods while it tend to increase in the expansionary paths. Furthermore, they stated that jobless growth hypothesis is valid for the Turkish economy in the relevant period of time and calculated the Okun's coefficient as -0,386 in the linear case.

Ceylan and Şahin (2010) investigated whether the relationship between unemployment and GNP is asymmetric for the Turkish economy over 1950-2007 period by using TAR and MTAR cointegration techniques. The findings suggest an asymmetric Okun's relation. In other words, response of unemployment to GNP change is different in recession and expanding periods.

Demirgil (2010) conducted a research regarding whether the Okun's Law works or not in the economy of Turkey over 1989:Q2-2007:Q3 period by using rolling regression model. That research reveals the Okun's coefficient is smaller in the upward paths. Furthermore, it was figured out that the Okun's Law did not work

in the time periods when productivity increased. Therefore, after 2002 the Okun's coefficient began to decrease because of rapidly increasing productivity, and Turkey economy started to experience a productivity increase oriented jobless growth path.

Tarı and Abasız (2010) carried out a study concerning with the asymmetric Okun's Law for the economy of Turkey over 1968 – 2008 period by using two-regimed threshold cointegration technique and TECM model. The findings indicate that the Okun's coefficient is bigger as magnitude in the recession periods, which supports the opinion on the existence of the asymmetric Okun's Law. Furthermore, the Okun's coefficient was calculated as -0,48 in the long-run. Beyond this they found that growth is not influential on the unemployment rate in the typical regime, which implies the jobless growth.

Muratoğlu (2011a) examined the Okun's Law in his study for the Turkish economy by using 2000:Q1-2010:Q3 quarterly data sets. In this study, Engle-Granger cointegration was used in order to figure out whether there exists a long-run relationship between growth and unemployment. According to the results, there is not a long-run relationship between economic growth and unemployment rate. Then, Granger causality test was employed in order to find causal relationship between unemployment and economic growth in the short-run and it was found that there does not exist any causal relation, namely there is not a statistically significant relation between the series in both short-run and long-run.

Tiryaki and Özkan (2011) examined the association between unemployment and economic growth gap variables for the Turkish economy over 1998:Q1-2010:Q4 period by using Granger causality test, Johansen cointegration method and variance decomposition technique. The results state that economic growth gap and unemployment is not Johansen cointegrated and a single way causality from

growth towards unemployment is present. Thus, it is not likely to state that the Okun's Law works.

Ertuğrul and Uçak (2013) analyzed the interrelation between employment and GDP for the Turkish economy over 2000:Q1-2012:Q2 period by using quarterly data. In this study, Paseran cointegration and TVP Kalman filters were used. Paseran boundary test suggests employment and GDP variables are cointegrated. Kalman filter shows that response of the employment to growth changes over time and it responses in a stronger manner in the post-recession periods, which implies asymmetry in the Okun's Law.

Özdemir and Yıldırım (2013) examined the interrelation between unemployment and economic growth rate for the Turkish economy over 2005:M1-2013:M4 period by using bootstrapped wavelet Granger causality approach. They found that there occurs uni-directional causality from growth to unemployment and bi-directional causality relation appears as frequency declines. Furthermore, it was figured out that there is not any causal relation between variables in the long-run.

Akay et al. (2016) conducted a research about the Okun's Law for Turkey throughout 1969-2014 period by employing the difference version of the Okun's method with Markov Switching model. They calculated the necessary growth rate for stable unemployment rate as 4,57 % and the Okun's coefficient as -0,08. When come to Markov-Switching model, necessary growth rate for stable unemployment gets 5,84% and 3,03% in expansionary and recessionary periods, respectively while the Okun's coefficient gets -0,04 and -0,37.

Arı (2016), made a study about the jobless growth performance of Turkey for 1980-2014 period. Bayer-Hanck cointegration test and Hacker Hatemi-J causality

test were employed in this study to test the jobless growth. It was shown that there is neither cointegration nor causal relation between unemployment and GDP, which indicates jobless growth.

Erkuş et al. (2016) researched on symmetric and asymmetric structure of the Okun's Law for the economy of Turkey. In this research, 2000:Q1-2015:Q4 data sets were used with ARDL for the symmetric Okun's Law and NARDL for the asymmetric Okun's Law. This study gives results which support the existence of the symmetric Okun's Law and it was stated that one percent more growth rate after 4,3 percent causes %0,007 less unemployment, which supports the Okun's Law though the relation is weak. When come to asymmetric version, it was found that asymmetric Okun's Law is not present neither in the short-run nor in the long-run.

Afşar et al. (2017) researched on the association between unemployment and economic growth for the Turkish economy over 2000-2016 period by employing VAR model and causality test of Granger. The results show that mutual causality between variables is present, which means that for the given period, the Okun's Law works in the Turkish economy.

Özçelik and Uslu (2017) carried out a study concerning with the association among employment, inflation and growth for the Turkish economy over 2007:M1-2014:M12 period of time by VAR model, cointegration of Johansen and causality test of Granger. The research states that all variables are Johansen cointegrated and there exists bi-directional causal relationship between unemployment and growth both in the short-run and long-run, which means that the Okun's Law is valid for the economy of Turkey in the aforementioned period of time.

Yalçınkaya et al. (2018) researced on the Okun's Law for the Turkish economy over 2001:Q1-2017:Q4 period with gap, difference and dynamic versions of the Okun's Law. According to their results, the Okun's Law works for Turkey economy in the relevant period of time because the sign of the coefficient of unemployment-growth association is negative in the all three models they used though it varies among models.

Bayrak (2019) examined the relation between economic growth and employment, and relation between broad-defined unemployment and growth for Turkey economy over the time period from 2005 to 2017 by using quarterly data with Maki cointegration technique and Toda-Yamamoto causality test. The results suggest that there is not causal relation from growth towards employment, which indicates jobless growth. However, there exists bi-directional causality relation between broad-defined unemployment and growth. Thus, it could be deduced that definition of unemployment matters for the jobless growth.

When assessing those studies concerning with Turkey it is not possible to come to an absolute conclusion about the (in)validity of the Okun's Law for the Turkish economy. There are studies which support both validity and invalidity of the Okun's Law in the literature. Our results imply the existence of polarization as a possible reason for jobless growth in the Turkish economy. In this context, there are several studies which find that polarization hypothesis is valid for the Turkish economy.

Akçomak and Gürcihan (2013) investigated the labor market performance of the Turkish economy for 2004-2010 period, and found that there are occupation and wage polarization especially in the services sector. Furthermore, they noted that share of the services sector in the total economic activities increased.

Akçomak and Erdil (2015) examined the occupation polarization hypothesis for the Turkish economy in 1982-2019 period. They concluded that the polarization hypothesis is valid for the post-2000's period. They attributed this conclusion to expanding services sector for low qualifications required occupations tail and technological progression for high qualification required occupations tail.

Aslan (2020) studied whether job polarization exists in the Turkish economy throughout 2004-2018 period. He concluded that Turkish economy experienced job polarization in a similar manner with developed countries. Further, he listed technological and educational progression as possible reasons for the high qualification required jobs tail while increase in low qualification required jobs due to expanding services sector was attributed to the other tail.

Table-2: Empirical Literature Review

Author(s)	Time Period(s) and Region(s)	Research Topic	Method(s)	Results
Okun (1962)	The U.S.A; 1947-1960 and 1953-1960	The relationship between potential and realized GDP difference and unemployment	Difference Model Gap Model Fitted trend and elasticity model	According to the first model which is called the difference model, each 1 percent increase in growth will yield 0.3 percent decrease in unemployment. According to the gap model, when the growth rate gap is zero, unemployment rate is 3.72. According to the third model, one percent decrease in unemployment rate causes approximately three percent output increase while elasticity coefficient is between 0.35 and 0.40.
Thirlwall (1969)	The U.S.A and the UK; 1950-1967	Natural rate of growth and the validity of the Okun's Law	Regression analysis	Natural growth rate is 3,6 percent and 2,9 percent for the U.S.A and the U.K, respectively and there is an inverse relation between growth rate and unemployment rate in both the U.S.A and the U.K.
Friedman and Watcher (1974)	The U.S.A; 1954-1970	Determinants of unemployment in the U.S.A	Cochrane-Orcut	There are four determinants of the unemployment; negative effect of real output on unemployment rate, effects of real wage on unemployment, effects of real profits on unemployment and employers' reaction to inflation.
Smith (1975)	The U.S.A; 1947-1960, 1961-1973, 1947-1973	The validity of the Okun's Law for the U.S.A	OLS and Auto-installing method	There is a strong negative relationship between unemployment and growth, which means the Okun's Law is valid.
Gordon (1984)	The U.S.A; 1947-1986	Short-term and long-term Okun's coefficient	ARDL	Short-term Okun's coefficient is -0.23 while long term coefficient is -0.5.
Hamada and Kurosaka (1984)	Japan; 1953-1965, 1965-1973 and 1974-1982	The Okun's coefficient and potential growth rate for Japan	Okun's fitted trend and elasticity model	The Okun's coefficient is 18,5, 32,4 and 13,2 for the sub-sets while potential growth rate is 6,9, 7,8 and 5, respectively.

Table-2: Empirical Literature Review (Continues)

Lynch and Hyclak (1984)	The U.S.A; 1954-1979	The validity of the Okun's Law among sub-groups of the total population.	Regression analysis and CUSUM test	Natural level of unemployment went up from 4,70 percent to 5,14 percent, which was mainly contributed by decline in employment rates of sub-groups of teenagers, and unemployment rate was not due to changes in ratio of sub-groups to the total population. Furthermore, blacks compared to whites, teenagers compared to adults and males compared to females are more sensitive to the output deviation from its potential.
Adams and Coe (1989)	The U.S.A; 1965:Q1-1968:Q3, 1968:Q3-1973:Q1, 1973:Q1-1975:Q1, 1975:Q1-1980:Q1, 1980:Q1-1982:Q4, 1982:Q2-1988:Q4	The Okun's coefficient	Three-staged regression analysis.	The Okun's coefficients are 1,0, 4,0, 6,4, 4,4, 0,3, 3,1, 6,4, respectively.
Blanchard (1989)	The U.S.A; 1965-1986	Macroeconomic fluctuations	VAR Variance decomposition Granger causality	Main reasons for fluctuations in macroeconomic variables are money supply, supply of labor, productivity and wage-price adjusting shocks. Short-run fluctuations are generally explained by demand shocks which generally caused by nominal money-wage increase while supply shocks determine the long-run. Furthermore, there is a causal relation between unemployment and output in a way that unemployment explain output.
Evans (1989)	The U.S.A; 1950-1985	Unemployment and growth relationship	VAR and Granger causality test	There is bi-directional causality between unemployment and production and there exists an inverse relationship between unemployment and growth which is quite strong. Furthermore, the Okun's coefficient was calculated approximately 0,30, which means that the Okun's Law is valid in the U.S.A economy over that time period.
Blackley (1991)	26 states of the U.S.A	The validity of the Okun's Law	Elasticity of employment	Employment elasticity of output varies among the states. The biggest Okun's coefficients is 6,803 in Louisiana while the smallest one is 2,137 in Alabama and it is 3,1 on the average. Gender distribution of labor force, tax policies and growth performance of labor force significantly determine the Okun's coefficients.

Table-2: Empirical Literature Review (Continues)

Courtney (1991)	The U.S.A; 1970-1989	Asymmetry of the Okun's Law	Burns and Mithcell (1946) methodology and Prescott cubic spline deseasonalization	The Okun's coefficient is asymmetric for the U.S.A economy and when it is calculated by symmetric regression model, unemployment rate is underestimated in recession periods while unemployment rate is overestimated in the boom periods.
Hsing (1991)	The U.S.A; 1954:Q2-1988:Q2	Relationship between GNP and unemployment rate for the U.S.A	An extended BCEA model	The unemployment-GNP coefficient varied from -0,280 in 1969:Q1 to -0,801 in 1982:Q4.
Aghion and Howitt (1992)	20 OECD countries; 1974-1989	Association between unemployment rate and average annual growth rate	Panel cointegration	There is an inverse association between annual average growth rate and unemployment rate.
Barreto and Howland (1993)	The U.S.A; 1947-1960 and 1953-1960	Correction of the Okun's methodology	Inverse regression	They calculated the Okun's coefficent as 1,95% in difference method case, 2,5% in gap method case and 1,83% in trend model case by using the same data with Okun.
Bean and Pissarides (1993)	OECD countries; 1955-1985	The Okun's Law	Cross-correlation	There does not exist strong cross-correlation between unemployment and growth save for 1975-1985 time period.
Cabellero (1993)	The U.S.A and England; 1966-1989	The association between unemployment and growth	Cointegration and HP filter	There is a weak and positive association between unemployment and growth rate.
Palley (1993)	The U.S.A; 1948:Q3-1991:Q1	Asymmetry of the Okun's Law	Asymmetric regression	The Okun's coefficient is -0,94 in the recession periods while it is -1,47 in the expanding periods.

Table-2: Empirical Literature Review (Continues)

Prachowny (1993)	The U.S.A; 1947:Q1-1986:Q2 and 1965:Q1-1988:Q4	Associaton between production gap and unemployment gap	Production function	Unemployment gap explains production gap and the Okun's coefficient is -0,67.
Boltho and Glyn (1995)	16 OECD countries; 1973-1993	The Okun's Law	OLS	Production increase causes employment increase and coefficient of this relation is approximately 0,5.
Weber (1995)	The U.S.A; 1948-1988	Dynamic and static versions of the Okun's Law	Static OLS, Cointegrating regression, VAR and Dynamic OLS	He calculated the coefficient as -0,314 by static OLS, -0,34 by cointegrating regression, -0,26 by dynamic OLS with both two and four lags, and -0,224 by VAR model with both two and four lags.
Pianta et al. (1996)	G-7 countries save Canada	The relation between restructuring of economy in a sectoral framework and employment-growth association	OLS	There is a positive and statistically significant relationship between growth and employment just in the U.S.A and Germany.
Attfield and Silverstone (1997)	The U.S.A; 1967-1986	Unemployment and growth association	Johansen cointegration with dynamic regression.	Unemployment and growth data sets are Johansen cointegrated and the Okun's coefficient was computed as -2,2662.
Daveri and Tabellini (2000)	EU countries; 1965-1991	Relationship among unemployment, growth and tax in industrialized economies.	OLG growth model	High unemployment brings low growth rate. Moreover 9% increase in labor tax rate causes approximately 0,4 % decrease in the EU growth rate.
Hoon and Phelps (1997)	G-7 countries; 1965-1995	The validity of the Okun's Law	Cointegration	Decrease in labor productivity and unemployment increase are cointegrated.

Table-2: Empirical Literature Review (Continues)

Moosa (1997)	G-7 countries; 1960-1995	The validity of the Okun's Law	Harvey's, OLS, ROLS and SUR	Employment performance of the U.S.A and Canada economies are more sensitive to output change than European and Japan economies.
Padalino and Vivarelli (1997)	G-7 countries; 1960-1994	Employment and growth association	Labor elasticity	Labor elasticity is 0,5 for the U.S.A and Canada while it is extremely low for the rest.
Attfield and Silverstone (1998)	England	Relation between unemployment and output gap	Cointegration and Beveridge-Nelson decomposition	The Okun's coefficient is 1,45.
Bhalotra and Sonia (1998)	15 states of Indian; 1979-1987	Jobless growth performance	GMM	Long-run wage elasticity of employment is -0,28 for output constrained case while it is -0,44 in capital constrained case. When working hours variable is added to the model wage elasticity is -0,66 and -1,31 for output and capital constrained cases, respectively.
Apel and Jansson (1999a)	Canada, the UK and the U.S.A; 1970:Q1-1998:Q2	Unemployment and production association	NAIRU estimation	There is an inverse relation between output gap and employment gap.
Apel and Jansson (1999b)	Sweden; 1970:Q1-1996:Q3	Unemployment and output relation	NAIRU estimation	Unemployment and output coact with Philips curve and there is an inverse relation between unemployment and output gap.
Moosa (1999)	The U.S.A; 1947:Q1-1992:Q2	The Okun's Law	Kalman filter and ARDL	The Okun's coefficient is approximately -0,38 in the long-run while it is -0,16 in the short-run.
Sögner (1999)	Austria; 1977-1995	Association between unemployment and growth	Markow Chain and Monte Carlo	The Okun's coefficient is -0,416 for Austria, which implies the Okun's Law is valid in economy of Austria since the coefficient is negative and statistically significant.
Walterskirchen (1999)	EU countries; 1988-1998	Association between unemployment and growth	Cross-country analysis	There is a positive correlation between GDP growth and employment, which implies jobless growth.

Table-2: Empirical Literature Review (Continues)

Freeman (2000)	The U.S.A and its 8 states; 1958-1998 and 1977-1997	The Okun's Law	OLS and Band-pass filter	The Okun's coefficient is constant over time and it is approximately 2 for all states and there is not much statistically significant difference among states.
Harris and Silverstone (2000)	New Zeland; 1978-1999	The validity of Okun's Law	Threshold cointegration and Error correction models	The Okun's coefficient is -0,103, which is compatible with the theory since the coefficent implies an inverse association between variables.
Lee (2000)	16 OECD countries; 1955-1996	The Okun's Law	Gap and Difference versions of the Okun's method with HP filter , Kalman filter and Beveridge and Nelson decomposition	The Okun's coefficient is greater in European countries compared to the U.S.A and the Okun's coefficient of Japan economy is the biggest one.
Mauro and Carmeci (2000)	15 OECD countries; 1965-1995	Association between unemployment and growth	GMM	There exists an inverse relationship between growth and natural level of unemployment in the long-run.
Mayes and Viren (2000)	EU and OECD members; 1960-1997	Asymmetry of the Philips and Okun's curves.	OLS	Only New Zealand, England and Japan economies do not have an asymmetric Okun's curve. Furthermore, it was figured out that change in output is significantly influential over employment rate.
Sögner and Stiassny (2000)	15 OECD countries; 1960-1999	The validity of the Okun's Law	OLS with Kalman filter	Estimated coefficients vary between -0,12 and -0,82.
Freeman (2001)	10 countries; 1958-1998	The Okun's Law	Regression analysis	Explanatory power of models is between 0,5 and 0,8 except for U.K and Italy.
Harris and Silverstone (2001)	7 OECD countries; 1978-1999	Association between unemployment and real GDP	Granger causality test and Johansen cointegration	When asymmetric structure is assumed then, unemployment rate and growth rate are cointegrated for all the economies save Canada economy.

Table-2: Empirical Literature Review (Continues)

Muscatelli and Tırelli (2001)	OECD countries; 1955-1990	Association between unemployment and growth	VAR	There exists an inverse relation between growth rate and unemployment rate for OECD countries.
Schorderet (2001)	The U.S.A; 1970-1998	The Okun's Law	Cointegration	There exists an inconsistent relation between unemployment and growth rates. The Okun's coefficient is -1,3 percent in expanding periods while it is approximately -7 percent in recessionary periods due to the hysteresis effect.
Virén (2001)	20 OECD countries; 1960-1997	Asymmetric structure of the Okun's Law	Threshold error correction model	Only Iceland and Finland economy does not have asymmetric Okun's Law.
Adanu (2002)	Canada; 1981-2001	The Okun's Law	HP filter and Quadratic detrending	The Okun's coefficient is -1,58 when HP filter is used while it is -1,32 when quadratic detrending method is used, and unemployment causes decline in output less in the more industrialized states.
Ewing et al. (2002)	The U.S.A; 1972-1999	Effects of the output shocks on the employment rate with respect to gender and color cohorts	VAR, GARCH and TARCH	Employment of black people and women employment are more sensitive to downward output shocks while white male employment has an asymmetric structure in the positive shock cases.
Izyumov and Vahaly (2002)	10 EU accession and in transition countries, and other 15 economies in transition; 1991-1994 and 1995-2000.	The validity of the Okun's Law	Difference version of Okun's method	The Okun's Law is valid in the EU accession countries in both 1991-1994 and 1995-2000 time intervals while the Okun's Law is valid in the rest only for 1995-2000 time interval.

Table-2: Empirical Literature Review (Continues)

Sögner and Stiassny (2002)	15 OECD countries; 1960-1999	Consistency of the Okun's coefficient	Kalman filter with Bayesian aprroach	The Okun's coefficient does not change over time in only Italy while it is time-varying in the other countries. The Okun's coefficient varies between -0,12 and -0,82 and countries whose labor market is more conservative has less labor elasticity compared to countries which have less conservative labor market.
Tripier (2002)	The U.S.A; 1948-2000	Unemployment and labor productivity association	VAR	There is a positive relation in the short-run and an inverse relation in the long-run between variables.
Apergis and Rezitis (2003)	8 regions of Greece; 1960-1997	Association between GDP and unemployment	HP and band pass filters, and Zivot-Andrews unit root test	There does not exist difference in terms of the Okun's coefficient among regions except two regions and 1981 observation is a structural break point.
Cuaresma (2003)	The U.S.A; 1965-1999	Asymmetry in the Okun's Law	TAR	The Okun's coefficient was calculated as -0,20 in expanding path periods while it was calculated as -0,44 in recession periods.
Vougas (2003)	Greece; 1960-1997	Association between growth and unemployment	Non-linear error correction model	Effect of growth on employment is weak therefore some different precautions should be taken in order to combat with unemployment.
Zagler (2003)	France, Germany, Italy and U.K; 1968-2000	The validity of the Okun's Law	VECM and Johansen cointegration	The Okun's Law is valid in the short-run but the Okun's coefficient is positive in the long-run, which means jobless growth takes place.
Christopoulos (2004)	13 regions of Greece; 1971-1993	GDP and unemployment relation	Panel cointegration	GDP and unemployment are cointegrated in 6 regions out of 13.
Silvapulle et al. (2004)	The U.S.A; 1947:Q1-1999:Q4	Asymetric structure of the Okun's Law	1986 Harvey model	The Okun's relation gets stronger as output declines and the coefficient varies between -0,25 and -0,61 as output changes.
Sinclair (2004)	The U.S.A; 1948-2003	Association between unemployment and growth	VAR	The Okun's coefficient changes over time for the U.S.A economy, which proves the asymmetry of the Okun's Law.

Table-2: Empirical Literature Review (Continues)

Zagler (2004)	France and Italy; 1970:Q1-2002:Q2, Germany; 1968:Q1-1997:Q4 and England; 1968:Q1-2000:Q1	Association between unemployment and growth	Granger causality test	There exist uni-directional causal relationship from growth to unemployment for France while the opposite exists in Italy and German and there exist a bi-directional causal relation for England.
Bisping and Patron (2005)	The U.S.A	Whether the response of unemployment to growth shocks varies with respect to regions, gender and color cohorts	Generalized variance decomposition	Response of unemployment to shocks differs among regions while demographic cohorts in different regions do not behave in the same manner.
Huang and Chang (2005)	Canada; 1960-2002	The validity of the Okun's Law	Cuaresma (2003) and Huang (2003) structural break model with HP and BP filters	There is an inverse association between unemployment and output in a non-linear framework.
Yılmaz (2005)	Turkey; 1978-2004	The validity of the Okun's Law	Hsiao's Granger causality test	There is uni-directional causal relation from unemployment towards growth.
Caraiani (2006)	Korean; 1970-2004	The Okun's Law	Regression analysis	Unemployment responses to output change sluggishly therefore, the Okun's coefficient was calculated as -0,07.
Francis (2006)	Côte d'Ivoire; 1975-2003	Association between unemployment and growth	MTAR and Threshold cointegration	Cointegration relation between unemployment and growth is asymmetric. Furthermore, when overemployment exists it could be fixed by wage cuts while underemployment may not be fixed by wage regulations.

Table-2: Empirical Literature Review (Continues)

Huang and Lin (2006)	The U.S.A; 1948:Q1-2006:Q1	Relationship between output and unemployment	Time-varying coefficient approach to the Okun's Law	The Okun's Law is valid because the Okun's coefficient is negative though it changes over time.
Kızılgöl (2006)	Turkey; 1988:H2-2006:H1	Association between output and unemployment	Johansen cointegration, VECM and Hsiao causality test	Variables are cointegrated for Turkey economy but there is uni-directional causal relation from unemployment towards growth rate.
Yüceol (2006)	Turkey; 1950-2004	Association between unemployment and growth	Johansen cointegration and VECM	Variables are not cointegrated and there is not any causal relationship between them.
Knotek (2007)	The U.S.A; 1948-2007	The Okun's Law	Gap version of the Okun's model and Rolling regression	The results of the gap model are compatible with the Okun's results but there is not a strong correlation between variables. According to rolling regression, the Okun's coefficient varies over time and it is bigger in the recessionary periods compared to expanding periods.
Loria and Jesus (2007)	Mexico; 1985:Q1-2006:Q4	The validity of the Okun's Law	Three versions of the Okun's method with Kalman filter and Granger causality test	The Okun's coefficient varies between -0,235 and -0,258 and there exists uni-directional causal relation from unemployment to output
Marinkov and Geldenhuys (2007)	South Africa; 1970-2005	The validity of the Okun's Law	Cointegration and Structural break test	The Okun's coefficient varies between -0.16 and -0.77, which means that the Okun's Law is valid in a time varying framework.
Noor et al. (2007)	Malaysia; 1970-2004	The validity of the Okun's Law	Granger causality test	Bi-directional causal relation between unemployment rate and growth is present. Furthermore, they calculated the Okun's coefficient as -1,75.
Sinclair (2007)	The U.S.A; 1948:Q1-2005:Q4	Association between unemployment and output	Kalman filter	Permanent component of the unemployment and growth is one of the factors which explains business cycles significantly and there exists an inverse relationship between unemployment and growth.

Table-2: Empirical Literature Review (Continues)

Villaverde and Maza (2007)	Spain and its 17 regions; 1980-2004	The Okun's Law	HP filter and Quadratic detrending method with panel version of the Okun's gap model.	There exists an inverse relation between unemployment and output gap for Spain and across its almost all regions (except for two) though intensity of response of unemployment to growth varies between -0,32 and -1,55 among regions due to their demographic and structural differences.
Fouquau (2008)	20 OECD countries; 1970-2004	Asymmetry of the Okun's Law	Panel transition regression model	There exists an asymmetric association between output gap and unemployment for those OECD countries.
Huang and Lin (2008)	The U.S.A; 1948:Q1-2006:Q1	Asymmetry of the Okun's Law	STVC model	Association between unemployment and growth has an asymmetric structure, which means the Okun's coefficient is not constant over time and more, it is always negative, which supports the Okun's Law.
Malley and Molana (2008)	G-7 countries; 1960:Q1-2001:Q4	The validity of the Okun's Law	Kalman filter and OLS	There is a positive association between unemployment and growth in G-7 countries and the strongest relation belongs to German economy.
Moosa (2008)	Algeria, Egypt, Morocco and Tunus; 1990-2005	The Okun's Law	Gap version of the Okun's method with HP and BP filters	There does not exist interrelation between unemployment and growth.
Saraç and Atabey (2008)	Turkey; 1951-2006	The Okun's Law	OLS and VAR	Growth affects unemployment negatively and there exists uni-directional causal relationship from growth towards unemployment.
Aktar and Öztürk (2009)	Turkey; 2000 – 2007	Association between unemployment and growth	VAR	Growth could not decrease unemployment effectively.
Dritsaki and Dritsaki (2009)	Portugal, Spain, Greece and Italy; 1961 – 2002	The Okun's Law	HP filter	Calculated Okun's coefficients are -0,17 for Spain, -0,24 for Italy, -0,016 for Portugal and 0.007 for Greece.

Table-2: Empirical Literature Review (Continues)

Elhorts (2009)	West Europe; 1986-2001	The Okun's Law	Spatial econometric model with simultaneous-equations system	The Okun's coefficient was computed as -1,45 on the average.
Haririan et al. (2009)	Turkey, Egypt, Israel and Jordan; 1975-2005	Association between unemployment and GDP	OLS with HP filter	The Okun's Law is valid though weak
Lang and Peretti (2009)	7 Countries; 1963:Q1-2007:Q4, 1991:Q1-2007:Q4 and 1960:Q1-2007:Q4	Hysteric version of the Okun's Law	ML Johansen cointegration and VAR	Association between unemployment and growth is not linear.
Uysal and Alptekin (2009)	Turkey; 1980-2007	Association between growth and unemployment	VAR model and Granger causality test	There exists a single way causal relationship from unemployment to growth rate.
Akçoraoğlu (2010)	Turkey; 1995:Q1-2007:Q4	The Okun's Law	Granger causality and Johansen cointegration	There exists a two-way causal relationship between variables and they are Johansen cointegrated. Furthermore, employment elasticity of growth was calculated as 0,20.
Arabacı and Arabacı (2010)	Turkey; 1999:Q1-2009:Q3	Asymmetry in the Okun's relation	TAR and HP filter with gap and difference versions of the Okun's method	The Okun's relation is asymmetric and the Okun's coefficient was computed -1,62 and -1,18 in the difference version for downward and upward periods, respectively while it is -1,31 and -1,16 for the gap version.
Barışık et al. (2010)	Turkey; 1988-2008	The Okun's Law and its asymmetry	Markov Switching	Unemployment rate tends to decrease in recession periods. Furthermore, the Okun's coefficient was calculated as -0,386 for the linear case.

Table-2: Empirical Literature Review (Continues)

Beaton (2010)	Canada; 1961:Q1-2009:Q2 and the U.S.A; 1948:Q1-2009:Q2	The validity of the Okun's Law	OLS, and Rolling Regression with QLRT	There exists a strong inverse association between unemployment and output change, and response of unemployment to output change is more in the recessionary periods.
Ceylan and Şahin (2010)	Turkey; 1950-2007	Asymmetry of the Okun's Law	TAR and MTAR cointegration	Response of unemployment to GNP change is different in recessionary and expanding periods
Demirgil (2010)	Turkey; 1989:Q2-2007:Q3	The validity of the Okun's Law	Rolling regression	The Okun's coefficient is smaller in the expansionary periods and productivity increases make the Okun's relation deteriorate.
Hussian et al. (2010)	Pakistan; 1970-2006	Unemployment-growth association	Johansen cointegration and VECM	The Okun's Law is valid in both long-run and short-run.
Javeid (2010)	Pakistan; 1981-2005	The Okun's Law	Engle-Granger cointegration and Error correction model	Unemployment rate and economic growth rate are cointegrated and association between them is negative, which supports the Okun's Law.
Korkmaz and Yılgör (2010)	Turkey; 1997:Q1-2009:Q3	The validity of the Okun's Law	Granger causality test	There exists a single way causal relation from growth towards unemployment.
Lal et al. (2010)	Srilanka, Bangladesh, China and Pakistan; 1980-2006	The validity of the Okun's Law	Engle-Granger cointegration and ECM	The Okun's Law is invalid for aforementioned countries in the relevant period of time.
Mıhçı and Atılgan (2010)	Turkey; 1991-2006	Association between unemployment and growth	HP filter and Quadratic detrending	Coefficient of this association was computed as -0,73
Takım (2010),	Turkey; 1975-2008	The Okun's Law	Granger causality test	The Okun's relation exhibits two-way causality, which supports the validity of the Okun's Law.
Tarı and Abasız (2010)	Turkey; 1968 – 2008	Asymmetry of the Okun's Law	Threshold cointegration and TECM	The Okun's coefficient is bigger as magnitude in the recession periods, which supports the opinion on the exitence of the asymmetric Okun's Law.

Table-2: Empirical Literature Review (Continues)

Tunalı (2010)	Turkey; 2000-2008	The Okun's Law	Johansen cointegration and Granger causality test	The Okun's coefficient was computed -1,42 and one percent increase in unemployment rate of the previous observation causes 0,6 percent increase in the current unemployment rate.
Muratoğlu (2011a)	Turkey; 2000:Q1-2010:Q3	The Okun's Law	Engle-Granger cointegration and Granger causality test	There is not a long-run and a short-run relationship between economic growth and unemployment rate.
Pierdzioch et al. (2011)	G-7; 1989-2007	Association between growth and output	Pooled OLS	When asymmetry is not allowed in the model, the Okun's coefficients are negative and the asymmetry is not much powerful.
Sodipe and Ogunrinola (2011)	Nigeria; 1981-2006	Association between employment and growth	HP Filter	Employment elasticity of economic growth is quite high, which implies that jobless growth hypothesis is invalid.
Tatoğlu (2011)	19 European countries; 1977-2008	Association between unemployment and growth	FMOLS, DOLS, OLS, panel cointegration (Kao and Pedroni) and PECM	The Okun's Law is not valid in all countries in the short-run while it is valid in the long-run and the global Okun's coefficient is -0,70 according to the results of Hausman test.
Tiryaki and Özkan (2011)	Turkey; 1998:Q1-2010:Q4	Association between employment and growth	Granger causality, Johansen cointegration and Variance decomposition	Economic growth and unemployment are not cointegrated and a single way causality from growth towards unemployment is present.
Alancıoğlu and Utlu (2012)	Turkey; 1980-2010	Association between employment and growth	Johansen cointegration	There is a negative and cointegrated association between employment and growth.
Caraiani (2012)	Romania; 1991-2009	The validity of the Okun's Law	Markov Switching	The Okun's coefficient was calculated as -0,09 in expanding cycles while it was calculated as -0,32 in the contracting periods.

Table-2: Empirical Literature Review (Continues)

Giha et al. (2012)	Scotland; 1995-2009	The Okun's Law	Panel cointegration	The Okun's coefficient is -1,7 for both rural and urban regions in the short-run while it was calculated as -0,33 for rural area and -0,65 for urban area in the long-run.
Hanusch (2012)	8 Asian countries; 1997-2011	Jobless growth	OLS	Growth performance of Asian countries is not jobless though their individual capacity to generate employment varies. Furthermore, the Okun's coefficient was computed -0,32 for those countries.
Kanca (2012)	Turkey; 1970-2010	Association between unemployment and growth	Engle-Granger cointegration and Granger causality test	Growth rate and unemployment rate are Johansen cointegrated and here is present a single way Granger causality from growth to unemployment.
Khalik (2012)	Sweden; 1993-2011	The validity of the Okun's Law	VAR	There are a single way causality from growth to unemployment and an inverse relation between these variables, which supports the theory of Okun.
Montero Kuscevic (2012)	Metropolitan regions; 2002-2010	Regional spread of the Okun's Law	Panel spatial model	Growth rate of the metropolitan regions is weak at explaining the variations in unemployment in the metropolitan regions.
Altuntepe and Güner (2013)	Turkey; 1988-2011	Sectoral version of the Okun's Law	OLS	The Okun's Law works in services sector for Turkey
Ball et al. (2013)	The U.S.A; 1948-2011 and 20 OECD countries; 1980-2011	The Okun's Law in the short-run	OLS and HP filter	The Okun's Law works almost in all countries though response of unemployment to growth varies among countries.
Binet and Facchini (2013)	22 regions of France; 1990-2008	The Okun's Law	Panel OLS	The Okun's Law is valid in 14 regions.
Ertuğrul and Uçak (2013)	Turkey; 2000:Q1-2012:Q2	The Okun's Law	Paseran cointegration, TVP Kalman filter	Employment and growth variables are cointegrated but response of employment to growth changes over time and it responses in a stronger manner in the post-recession periods.

Table-2: Empirical Literature Review (Continues)

Huang and Yeh (2013)	21 OECD countries; 1980-2005 and 23 different countries; 1976-2006	The Okun's Law	PARDL	The Okun's Law is valid for all countries and the Okun's coefficient is identical in the long-run.
Özdemir and Yıldırım (2013)	Turkey; 2005-2013	Interrelation between unemployment and economic growth	Bootstrapped wavalet Granger causality	There exists a causality from economic growth variable to unemployment variable in the short-run but there is not any relationship between variables in the long-run.
Özel et al. (2013)	G-7 countries; 2000-2011	Association among unemployment, productivity and growth	POLS	Response of unemployment to growth is 0,35 unit while response of productivity to unemployment is 0,06 in an inverse manner.
Pereira (2013)	The U.S.A; 1948:Q1-2012:Q4	The validity of the Okun's Law	HP filter, ARDL and Markov Switching	The Okun's Law is valid but has an asymmetric structure. In other words, the Okun's coefficient changes over time.
Akeju and Olenipekun (2014)	Nigeria; 1980-2010	The Okun's Law	Johansen cointegration	The Okun's Law does not work in Nigeria economy for that time interval.
Akram et al. (2014)	Pakistan; 1972-2012	The validity of the Okun's Law	OLS	The Okun's Law does not work in Pakistan for this time period.
Alamro and Al-dalaien (2014)	Jordan; 1980-2011	The Okun's Law	ARDL	One percent more output brings about 0,007 less unemployment, which supports the theory of Okun though weak.
Çondur and Bölükbaş (2014)	Turkey; 2001:Q1-2010:Q4	The Okun's Law in terms of youth employment	Granger causality test	A causal association from unemployment in youth towards GDP and from PPI towards unemployment in youth are present.

Table-2: Empirical Literature Review (Continues)

Durech et al. (2014)	Czech republic (14 regions) and Slovakia (8 regions); 1995-2011	Regional version of the Okun's Law	HP filter	The Okun's Law does not work in those regions where long-run unemployment rate is high and growth rate is low.
Eser (2014)	Turkey; 1970-2010	The Okun's Law	Johansen cointegration	A negative long-run Okun's relation is present.
Karfakis et al. (2014)	Greece; 2000-2012	Employment-growth association	OLS	One percent more unemployment leads to 3 percent less output.
Khaliq et al. (2014)	9 Arabic countries; 1994-2010	The Okun's Law	Pooled EGLS	Unemployment affects growth in a negative way, one percent increase in growth rate decreases 0,16 percent unemployment and one percent increase of population growth rate increases unemployment 0,37 percent.
Loría and Salas (2014)	Spain; 1995:Q1-2012:Q4	The Okun's Law for construction sector	Granger causality test.	Economic growth which was contributed by the construction sector affects unemployment rate in a non-linear way.
Madito et al. (2014)	South Africa; 1967-2013	The Okun's Law	VECM	An inverse relationship between economic growth and unemployment variables is present.
Misztal (2014)	The U.S.A, China, India, Japan and EU15 economies; 1990-2012	Jobless growth	OLS	Jobless growth hypothesis is true for only China and India.
Nikolli (2014)	Albania; 1992-2012	The Okun's Law	OLS	One percent less unemployment brings about 1,11 percent more output growth likewise expected theoretically.
Zanin (2014)	OECD countries; 1998-2012	The Okun's Law with respect to demographic cohorts	OLS	The Okun's relation is inverse and coefficient of this relation is higher for males compared to women and the age group which was affected most by the unemployment is 15-24 cohort.

Table-2: Empirical Literature Review (Continues)

Aldhiy et al. (2015)	Egypt; 2006-2013	Association between national revenue and unemployment	Johansen cointegration	Cointegration test is negative but a causal relation from unemployment towards national revenue is present in the short run.
Aslan and Yamak (2015)	Turkey; 2001:Q1-2013:Q4	Association between youth unemployment and growth	Granger causality test	A single way causal relation from growth towards unemployment in youth is present.
Göçer (2015)	Turkey; 2001:Q2-2015:Q1	The Okun's Law	Regression analysis and Granger causality test	The Okun's coefficient is -0,11 and natural rate of economic growth is 4,3%. Furthermore, unemployment is affected by growth.
Göçer and Erdal (2015)	18 countries in Europe; 2006-2012 and 10 countries in Europe; 1996-2012	Association between youth unemployment and growth	Pedroni and Kao panel cointegration	One percent increase above the average growth rate brings about 1,13 percent decrease in unemployment in youth for the first analysis and 2,06 percent for the second analysis.
Makun and Azu (2015)	Fiji; 1982-2012	The validity of the Okun's Law	Johansen cointegration	There exists an inverse relation between unemployment and growth for Fiji.
Palombi et al. (2015)	England; 1985-2011	Regional version of the Okun's Law	Panel spatial model	The Okun's Law works in England economy for that time interval.
Perman et al. (2015)	Pre-calculated 269 coefficients; unemployment and output samples	The Okun's correct coefficient	Meta regression	When bivariate MRA employed, coefficient is -0,25 in the unemployment sample and -0,61 in the output sample. When multivariate meta regression was employed, the coefficient is -0,40 and -1,02 in unemployment and output samples, respectively.
Sadiku et al. (2015)	Macedonia; 2000:Q1-2012:Q3	Short-run and long-run Okun's Law	VAR	The Okun's Law is valid neither in the short-run nor in the long-run.
Tanrıöver and Biçer (2015)	Turkey; 2005-2015	Jobless growth	Beveridge-Nelson decomposition	Output growth leads to less unemployment decrease in downturns compared to expansionary periods, which implies asymmetry in the Okun's Law.

Table-2: Empirical Literature Review (Continues)

Timur and Doğan (2015)	Turkey; 1980-2014	Employment-growth association	Granger causality test	Any causal relation could not be reached, which disproves the Okun's Law.
Akay et al. (2016)	Turkey; 1969-2014	The Okun's Law	Difference version of the Okun's method and Markov Switching	The Okun's Law works in Turkey and growth rate necessary for stable unemployment rate is 4,57% in the linear case while it gets 5,84 % and 3,03 % in expansionary and recessionary periods in the case of asymmetric model, respectively. Furthermore, the Okun's coefficient is -0,08 in the linear case , -0,04 and -0,37, in the expansionary and recessionary periods, respectively.
Arı (2016)	Turkey; 1980-2014	Jobless growth	Bayer-Hanck cointegration and Hacker Hatemi-J causality test	There is neither cointegration nor causal relation between unemployment and GDP, which indicates jobless growth.
Bhowmik (2016)	India; 1991-2014	Employment-growth association	ARIMA model and HP filter	One percent more GDP leads to 0,058 less unemployment. Furthermore, bi-directional causality was captured.
Bulut (2016)	Turkey; 2005:Q2-2015:Q4	Asymmetric version of the Okun's Law	Hatemi-J causality test	The Okun's Law has an asymmetric form for Turkey economy. Expansionary shocks on natural revenue could not be explained by unemployment fall and contractionary shocks on natural revenue could be explained with the rise of unemployment rate.
Çondur et al. (2016)	Turkey; 2000:Q1-2015:Q4	Jobless growth	Granger causality test	Unemployment and GDP are interrelated in the short-run while there is a single way causal relation from unemployment towards GDP in the long-run.
Dunsch (2016)	Poland; 1993-2014 and Germany; 1992-2014	Association between youth unemployment and growth	Regression analysis	The Okun's coefficient is higher for youth in both Germany and Poland and furthermore, Poland economy is more sensitive to business cycles with respect to unemployment in youth.

Table-2: Empirical Literature Review (Continues)

Economou and Psarianos (2016)	13 European countries; 1993:Q2:2014:Q1	The Okun's Law	Difference version of the Okun's method with Mundlak decomposition and Gap version with FGLS	The Okun's Law works and the Okun's coefficient was computed as -0,073 and -0,209 for difference and gap forms, respectively.
Erkuş et al. (2016)	Turkey; 2000:Q1-2015:Q4	Symmetric and asymmetric Okun's Law	ARDL and NARDL	The results support the existence of symmetric Okun's Law and it was stated that one percent more growth rate after 4,3 percent causes %0,007 less unemployment. When come to asymmetric version, it was found asymmetric Okun's Law is not present neither in the short-run nor in the long-run.
Hamia (2016)	17 MENA countries; 1980-2013	Employment-growth association	ARDL, HP and BK filters, Quadratic detrending and CUSUMQ	They found that the Okun's Law works for the entire sample. When come to single country analyses, the Okun's Law is valid in Turkey, Lebanon, Jordan, Iran, Egypt and Algeria. Further, the Okun's coefficient is relatively bigger in the Arab countries and the Okun's relation is not stable in Jordan, is ambiguous in Turkey and Lebanon, and is stable in the rest according to the results of the CUSUM squares test.
Österholm (2016)	Sweden; 1982:Q1-2014:Q4	Time-varying Okun's Law	OLS and Quandt-Andrews test	The Okun's Law is not consistent over time.
Pehlivanoğlu and Tanga (2016)	BRICS countries and Turkey; 1990-2014	The Okun's Law	Engle-Granger cointegration, FMOLS and HP filter	Engle-Granger cointegration test is positive in all the countries save Brasilia. The Okun's coefficient for Russia, China and India was computed as -0,6, -0,24 and -5.9, respectively. When come to Turkey and South Africa, jobless growth exists.
Abraham and Oazemhoka (2017)	Sub-Saharan 23 countries; 1991-2013	Association between unemployment in young population and growth	POLS	The Okun's Law does not work for all the countries, which supports that the Okun's Law for young unemployment is not mainly about the level of development since all developing Sub-Saharan countries have different unemployment-growth pattern.

Table-2: Empirical Literature Review (Continues)

Adarkwa et al. (2017)	Ghana; 1991-2014	Effects of sectoral growth upon unemployment	OLS	Growth performance of services sector in Ghana economy affects unemployment rate negatively, which indicates validity of the theory in a sectoral framework.
Afşar et al. (2017)	Turkey; 2000-2016	Unemployment and growth association	VAR and Granger causality test	Mutual causality between variables is present.
Aksu (2017)	Turkey; 1960-2009	Jobless growth	Granger and Toda-Yamamoto causality tests	Any causal relation between variables is not present in the short-run but a single way causal relation from unemployment to growth exists in the long-run.
Kılıç and Yıldırım (2017)	Turkey; 2006:M9-2016:M12	Jobless growth	Continuous wavelet approach	Growth performance of the Turkish economy in the relevant period of time is jobless.
Mojica and Tatlonghari (2017)	The Philippines; 1990-2014	The Okun's Law	Gap and difference models and ARDL	The Okun's coefficient was computed as -0,85 for the gap version but in the difference version, computed coefficients are positive or insignificant. When come to the dynamic version, the 2005 observation is a structural break point and the Okun's coefficient is -0,92 for the period from 1990 until 2005 and -0,72 for the rest.
Oktar and Yüksel (2017)	10 developing and 10 developed countries; 1993-2015	Association between unemployment and growth	Dumitrescu-Hurlin panel causality test	A causal relation from growth towards unemployment exists in the short-run but it is not present in the long-run for developed countries. For developing countries, the Okun's Law works in the short-run but not in the long-run.
Özçelik and Uslu (2017)	Turkey; 2007:M1-2014:M12	Association among employment, inflation and growth	VAR, Johansen cointegration and Granger causality test	All variables are Johansen cointegrated and there exists bi-directional causal relationship between unemployment and growth both in the short-run and long-run.
Acaroğlu (2018)	G-20 countries; 1991-2014	The Okun's Law	Gap and difference models of Okun with HP, CF and BW filters	For the gap version, the Okun's coefficient was computed as -0,271, -0,579 and -0,499 with HP, CF and BW filters, respectively.

Table-2: Empirical Literature Review (Continues)

Eğri (2018)	Egypt; 1970-2016	The Okun's Law	Difference and gap versions of the Okun's method, Granger causality test and Johansen cointegration	The computed Okun's coefficient is -0,082 and any causal relation between variables could not be found. Moreover, variables are not Johansen cointegrated.
Flórez et al. (2018)	Colombia; 1984-2016	Unemployment-growth associaton	Threshold cointegration and Linear cointegration	The results support the Okun's Law. VECM shows that the Okun's coefficient is -0,45, which is linear case. In the nonlinear (two-regimed threshold) case, the coefficient was calculated as -0,6 in the lower regime and -0,2 in the higher regime.
Küçükaksoy et al. (2018)	Turkey; 2005-2017	The Okun's Law	ARDL and NARDL	One percent more growth over its trend causes 0,21 less unemployment.
Soylu et al. (2018)	8 Eastern European countries; 1992-2014	The Okun's Law	Johansen cointegration and Pooled regression models.	The results support the Okun's Law, and the Okun's coefficient was computed as -0,08. Further, variables are related in the long-run as they are Johansen cointegrated.
Üzar and Akyazı (2018)	34 OECD countries; 2000-2016	Unemployment-growth association	Hurlin and Dumitrescu causality test	The causality test shows bi-directional causal relationship between variables.
Yalçınkaya et al. (2018)	Turkey; 2001:Q1-2017:Q4	The Okun's Law	Gap, difference and dynamic versions of the Okun's method	The Okun's Law works for Turkey economy because sign of the coefficient of unemployment-growth association is negative for all three models though it varies among models.
Abraham (2019)	India; 1993-1994 and 2011-2012	Jobless growth	Decomposition tools	81%, 24% and 9% of growth came from productivity increase, labor force variation among sectors and demographic activities, respectively while unemployment increase contributed to growth negatively by 14%.

Table-2: Empirical Literature Review (Continues)

Abubakar and Nurudeen (2019)	India	The Okun's Law	DF-GLS	The Okun's Law is valid, coefficients are negative and less than one, but one percent decrease in unemployment requires 25% nominal increase in GDP thus jobless growth exists for India economy because growth rate is under the limit which can decrease the unemployment rate.
Andonova and Petrovska (2019)	Macedonia; 2004-2016	The Okun's Law	Gap model	One percent increase in output gap causes 0,18 percent decrease in unemployment rate.
Akcan et al. (2019)	OECD countries; 1991-2014	The validity of the Okun's Law	Panel data causality	There is not causal relation from growth towards unemployment, which implies jobless growth.
Altun and Isleyen (2019)	Turkey; 1991 to 2017	Association between employment in industry sector and growth	ARDL and Granger causality test	There exists a causal relation from employment in industry sector towards growth but not vice versa.
Bayrak (2019)	Turkey; 2005-2017	The Okun's Law	Maki cointegration and Toda-Yamamoto causality test	There is not causal relation from growth towards employment, which indicates jobless growth. However, there exist bi-directional causality relation between broad-defined unemployment and growth.
Ben-Salha and Mrabet (2019)	4 African countries; 1991-2013	The validity of the gender and age based Okun's Law	HP and BP filters, Quadratic detrending and Structural model	The Okun's coefficient is higher in the young. And the most sensitive group to growth in terms of employment is 15-24 age cohort.
Connolly (2019)	The Philippines; 1976-2006	Effects of inflation, education, consumption and GDP on unemployment	CLRM	She estimated the coefficients 0,16 for education, -0,09 for inflation, 0,97 for consumption and -0,56 for GDP growth.
Dankumo et al. (2019)	Nigeria; 1996-2017	The validity of the Okun's Law	ARDL	Unemployment and growth are cointegrated but unemployment does not have effect on growth.

Table-2: Empirical Literature Review (Continues)

Esmeraldo and Veton (2019)	Albania; 1993-2017	The Okun's Law	Rolling regression	There is not a strong inverse relation between unemployment rate and growth in upheaval era after the fall of communism and in 1990's, while it reverses after 1990's. Moreover, females are at more unemployment risk, the young enjoy growth more to be employed and estimated Okun's coefficient is 2,07% in general while it is 1,12% in the young population.
Karikari-Apau and Wilson (2019)	China; 1991-2018	The validity of the Okun's Law	ARDL	There is an inverse relation between growth and unemployment rate. Furthermore, the Okun's coefficient was calculated as -0,333 and -0,320 in the short-run and long-run, respectively.
Kenny (2019)	Nigeria; 1981-2016	Association between unemployment and growth	Granger causality test	Growth is not influential over unemployment rate, which indicates invalidity of the Okun's Law for Nigeria economy in that time period.
López (2019)	Mexico; 2000-2018	Association between unemployment and tourism revenue	VAR	There is positive bi-directional relationship between unemployment rate and tourism growth. But when tourism volume index is used instead of tourism growth, the results support the Okun's Law.
Meyer and Sanusi (2019)	South Africa; 1995-2016	Causality among growth, unemployment and domestic investment	Johansen cointegration and VECM	All the variables are cointegrated and there is bi-directional causality between economic growth and employment. But there exists jobless growth despite the two-way causality since coefficient of this relation is negative in the long-run.
Obst (2019)	EU15 countries; 1980-2018 and 1985-2018	The validity of the Okun's Law	HP filter and dynamic Okun's Law model with gap and difference versions	The Okun's coefficient is significant for EU15 countries though it varies lot among countries. The Okun's coefficient is between -0,085 and -0,872 and it is -0,39 on the average for the first data set and gap version while it is between -0,08 and 0,786 with 0,416 average in gap version and the second data case. The Okun's coefficient is between -0,053 and -0,702 with -0,290 average in the first data set and difference version case while it is between -0,057 and -0,755 with -0,315 average in the last case.

Table-2: Empirical Literature Review (Continues)

Tekgül (2019)	Turkey; 1930-2017	Relationship between growth in manufacture sector and unemployment	ARDL	There is an inverse relationship between increase in manufacture sector output and unemployment rate.
Al-Sawaie (2020)	Jordan; 1976-2018	Unemployment-growth relationship	ARDL and Granger causality test	There exists a causal relation between unemployment and growth, which indicates the validity of the Okun's Law.
Bonaventura et al. (2020)	Italy; 1995-2015	Effects of the regional growth on the unemployment with respect to gender	Lagrange multiplier test	The Okun's Law is valid in the both male and female cases for Northern Italy while the Okun's Law is not valid in Southern Italy in the female case.
Padhi and Panda (2020)	Indian state Odisha; 2011-2012 and 2017-2018	Unemployment and production growth relationship in terms of sectors	The Shapley value decomposition	Agriculture sector could not generate employment lot while mining sector could middllingly. Only construction and some sub-sectors of services could generate employment at a desirable level. Growth is mainly contributed by industry and services sectors while contribution of the agriculture sector is low.
Tumanoska (2020)	14 EU member countries and 7 Southeastern European countries; 1991-2020	The validity of the Okun's Law	Panel ARDL	The Okun's Law is valid in both EU countries and Southeastern European Countries. The Okun's coefficient is 1,5% and 0,25%, respectively.
Alpağut (2021)	11 countries which were affected by terrorism the most; 2003-2018	Relationship among terrorism, economic growth and unemployment in the young	Panel VAR and Panel Granger causality test	Unemployment rate in the young population is affected by terrorism rather than growth rate and it causes terrorism.

CHAPTER 2

METHODOLOGY

In this chapter which is made up of two main parts, the methodology of this thesis is described. In the first part, the Shapley value is explained in a game theoretical framework. Then, how the Shapley value could be applied to growth in order to detect the jobless part of the growth is explained in the second part.

2.1. THE SHAPLEY VALUE

Game theory is an approach to the human behavior studies that tries to explain the treatments of humans by strategies of people who desire to maximize their interests. Since J. Von Neumann and O. Morgenstern wrote the pioneer of game theory – Theory of Games and Economic Behavior - the game term has begun to be used metaphorically to define the situations whose outcome relies on the mutual and interrelated behaviors of humans (García et al., 2006). In such a case, every player has strategies and intersection of the strategies determine the pay-off of the players. Then, the aim of game theory is answering the questions to be asked about how people would behave in every different case.

It is necessary to define the followings in order to be able to talk about a game in a scientific framework.

i) Set of players (decision makers in a game)

ii) Possible decisions can be made by players (strategies)

iii) Pay-offs which players get a result of the intersections of player's strategies

iv) Dependence among players

In a game, it is assumed that every player treats rationally, which means that players choose the strategy that brings the most pay-off for themselves. In this context, the best strategy may be a part of a coalition, which means an organism whose participants collaborate to achieve a common goal. When there are more than two players, a coalition may take place among some or all of the players. Then, it is necessary to draw a framework for the coalitional games in order to be able to talk about them.

Let the vector $N = \{1,2,3,4, \dots, n\}$ denote players of a game. Let the vector S denote a coalition of players, which is a subset of the vector N. Let $v(S)$ correspond the maximum pay-off which coalition S can earn regardless of choices of its participants. Then, a crucial quest appears "How the pay-off should be distributed?" In this context, Lloyd Shapley (1953) claims that each member of a coalition should get as their marginal contribution to outcome (pay-off) for the pay-off distribution to be fair. But it is not straightforward to distribute the pay-off as the marginal contributions. For instance, let us assume that $v(N) = 1$ and $v(S) = 0$ if $N \neq S$. In such a case, marginal contribution of each player is 1. However, it is impossible to distribute the pay-off of the coalition among the players as their marginal contributions since the sum of the marginal contributions of the players exceeds the pay-off. In order to address this issue, a weighting method, called the Shapley Value, could be used. Within this context, the fairness must be defined before the Shapley value to decide how a distribution is fair. Then, Shapley defined the fairness as the fulfillment of the following axioms.

2.1.1. Shapley's Axioms

The Shapley value is a unique value that satisfies the following axioms.

i) A player is called dummy player if it does not contribute to any coalition. More formally, player i is a dummy player if $\forall$ S , $v(S \cup \{i\}) = v(S)$ and any dummy player should get nothing from the pay-off of a coalition as it does not contribute any coalition of other players. This is the dummy player axiom.

ii) Players who contribute the same amount to any coalition as other players are interchangeable and these players should get the same amount from the pay-off of the coalition. More formally, players i and j are interchangeable if $\forall$ S does not including player i and player j , $v(S \cup \{i\}) = v(S \cup \{j\})$. This is the symmetry axiom.

iii) When we split a game into different components, we can decompose the pay-off of the game. Thus, the Shapley value is additive. More formally, when we are able to split a game v as $v = v_1 + v_2$ then, the pay-off of the game v is sum of the payoff of v_1 and v_2. This is the additivity axiom.

iv) Efficiency indicates that sum of the contribution of the players to coalition equals to output of the coalition. In other words, contributions of players do not coincide. More formally, it could be shown as $\sum_{i \in N} \varphi_i(v) = v(N)$. This is the efficiency axiom.

These axioms are necessary conditions for a fair distribution of a coalitional game. Then, the Shapley value divides the pay-off a coalitional game among its participants as

$$\varphi_i(N,v) = \frac{1}{N!}\sum_{S\subseteq N-\{i\}}|S|!\,(|N|-|S|-1)\,!\,[v(S\cup\{i\})-v(S)] \qquad \text{[Equation-12]}$$

for player i. $|S|$ and $|N|$ indicates the number of elements of the set S and N, respectively.

The marginal contribution of player i corresponds the difference between the pay-off of a coalition with player i and without player i. While calculating the marginal contribution of the player i, one has to take into account all possible combinations of sequence of entry to the coalition since marginal contributions of the participants of the coalition depends on the their order of entry to the coalition. For example, in the presence of n participants, coalition could be formed in a n! different ways by changing the entry order of the participants and marginal contributions of each participant could change in each ordering. Then, Let $v(S\cup\{i\})-v(S)$ represents the marginal contribution of player i. Then, the set S can be formed in $|S|$! different ways, and the rest of the player can be formed in $(|N|-|S|-1)$! different ways. Since all players can be formed in $|N|$! different ways, the value is weighted by $\frac{1}{N!}$. If the weighted values for all possible sets S is summed, one obtains the Shapley Value.

There is only one fair pay-off distribution for a coalitional game (N,v) which meets dummy player, symmetry, additivity and efficiency axioms. This unique payoff distribution is called the Shapley value.

Briefly, the Shapley value shows the fair distribution of an output generated by any coalition among its participants. When come to the relation between growth and the Shapley value, growth could be considered as the total output of an economy (coalition) and its components are could be treated like its participants. Then, we could decompose growth into its components like we could find the fair distribution of the total output generated by any coalition among its participants. In this thesis, growth was decomposed into mainly three components; productivity, employment and demographic components by using this methodology. It will be explained in detail in the part 2.2.

2.1.2. Proof On The Existence And Uniqueness Of The Shapley Value

For any given $S \subset N$, let w_s be a characteristic function like the following.

$$w_s(T) = \begin{cases} 1 \; if \; S \subset T \\ 0 \; Otherwise \end{cases}, \qquad \text{[Equation-13]}$$

On the ground of the dummy player axiom, it could be stated that $\varphi_i(w_s) = 0 \; if \; i \notin S$. From symmetry axiom, if i and j $\in S$ then $\varphi_i(w_s) = \varphi_j(w_s)$. Efficiency axiom shows that $\sum_{i \in N} \varphi_i(w_s) = w_s(N) = 1$. Therefore, $\varphi_i(w_s) = \frac{1}{|S|}, \; \forall \; i \; \in S$. For any constant c, we can calculate

$$\varphi_i(cw_s) = \begin{cases} \frac{c}{|S|} & if \; i \in S \\ 0 & Otherwise \end{cases}, \qquad \text{[Equation-14]}$$

Next step is to show the representability of any characteristic function v as a weighted sum of the characteristic functions of the form Equation-13, $v = \sum_{S \subset N} c_s w_s$ for any constant c_S. Then, additivity axiom states that the value function must be in the form of Equation-15 if it exists.

$$\varphi_i(v) = \sum_{S \subset N, i \in S} \frac{c_S}{|S|}, \qquad \text{[Equation-15]}$$

To complete the proof it is necessary to show the existence of $\varphi_i(v)$ with c_S defined below and meets the axioms of Shapley.

Then, it is possible to exhibit that any v could be written like the following form $v = \sum_{S \subset N} c_S w_S$ by finding c_S.

Let $c_\emptyset = 0$, where Ø refers empty set and let us define it with respect to the number of T's elements for $\forall\, T \subset N$. Then, $c_T = v(T) - \sum_{S \subset T, S \neq T} c_s$. Each c_T is given in terms of c_S , where S has less elements than T. Thus, $\sum_{S \subset N} c_s w_s(T) = \sum_{S \subset T} c_s = c_T + \sum_{S \subset T, S \neq T} c_s = v(T)$. Therefore, it was shown that $v = \sum_{S \subset N} c_s w_s$.

There is another way to reach the Shapley value. Let the players take from the output as output increases when players enter the coalition. Thus, the pay-off of the players depends on the order of entry to the coalition and the Shapley value is just average of the pay-off of the players with respect to their entry order. Therefore, the Shapley value function could be written in the following form.

$$\varphi_i(v) = \sum_{S \subset N, i \in S} \frac{(|S|-1)!(N-|S|)!}{N!} [v(S) - v(S - \{i\})] \qquad \text{[Equation-16]}$$

Interpretation of this formula is similar with the previous one. N players can be ordered in $N!$ different ways. When player i enters the coalition, output of the coalition changes as $v(S) - v(S - \{i\})$. $(|S| - 1)$ players, which shows the number of players in the coalition without player i (other players come first), can be ordered in $(|S| - 1)!$ different ways. The remaining part, which is $(N - |S|)$ players, can be ordered in $(N - |S|)!$ different ways. Therefore, this formula states that the Shapley value is an average of sum of contributions of players to the grand coalition by taking into all possible cases of order of entry to the coalition account. Hence, it is proved that the Shapley value is unique. Next, one must show that this value function meets the Shapley axioms so as to complete the proof. It is very straightforward to prove that the Shapley value meets additivity, dummy player and symmetry axioms by interpreting Equation-16. Also, it could be stated that in every cases, $v(N)$ is shared to the players while forming the grand coalition by using alternative form of the Shapley value. Therefore, the average of pay-off given to players is also $v(N)$, which proves that the Shapley value meets efficiency axiom, too.

2.2. SHAPLEY DECOMPOSITION APPROACH TO ECONOMIC GROWTH

In this study, the Shapley value decomposition method was used in order to decompose the economic growth, which implies the changes in real per capita value added into its different components. This chapter explains how the Shapley decomposition method was implemented so as to decompose the marginal contributions of the sectoral components of the growth in the Turkish economy during the period from 2010 to 2019. The decomposition method, which is explained below, was obtained from Gutierrez et al. (2007) but differently, labor force series was used instead WAP series.

Sohorrocks (2013) claims that the procedure can be employed in all areas of applied economics whenever one wishes to assess the relative importance of the explanatory variable(s). Several studies have employed the Shapley decomposition method to investigate jobless growth. Bbaale (2013), Malunda (2013), Byiers et al. (2015), Choudhury and Chatterjee (2015), Aggarwal (2016 and 2018) and Padhi and Panda (2020) are among them.

Bbaale (2013) studied the association between employment and economic growth for the Ugandan economy over 2006-2011 period. He used data of world development indicators, Uganda Household Panel Survey (2011) and UN. He concluded that 36 percent of growth during 2006-2011 period is caused by the changes in employment rate. Furthermore, agriculture sector has negative effect on growth and the least productivity while industry sector has the highest productivity. Intersectoral shifts of employment has positive effect on growth.

Malunda (2013) examined whether the Rwandan economy's growth performance generates occupation for 2006-2011 period. The study shows that growth is mainly fed by intersectoral shifts and productivity increases by 56,6 and 45 percent, respectively. Furthermore, the most contributing sector to productivity is agriculture while main job generating sectors are commerce and construction by 8 and 5,65 percent, respectively. Demographic changes have negative effects (28 percent) on growth.

Byiers et al. (2015) investigated the dynamics of growth for a group of countries in development progress. Their results indicate that main driver force behind growth is intersectoral movement of labor force from services sector towards manufacturing sector, which implies productivity increase.

Choudhury and Chatterjee (2015) examined the jobless growth for Indian economy over three spell; 1993-194:1999-2000, 1999-2000:2004-2005 and 2004-2005:2009-2010. They figured out that there is a negative relation between employment and growth, which implies jobless growth. Furthermore, demographic changes have positive effects on growth, and industry and service sectors generate occupation but employment generation performance of agriculture sector is so sluggish that it cancels out the positive contributions of industry and services sectors.

Aggarwal (2016) examined the relation between employment and growth for 16 states of India over 1993-94:2011-12 time period. The results show that growth is mainly fed by productivity increases, especially after 2005 and furthermore, jobless growth existed in the relevant period of time. Beyond, the main sector whose productivity increased is manufacturing.

Aggarwal (2018) researched on the structure of Indian labor market in terms of occupation generation for 1972-2012 period. He states that Indian economy passed into a high growth regime through globalization in the relevant period. However, employment is not mainly provided by high productivity sectors. He attributes this situation to the coexistence of trade oriented economic specilization and weakened intersectoral linkups.

Padhi and Panda (2020) investigated the jobless growth performance of Odisha, an Indian state, both aggregrately and sectorally for 2011-12:2017-2018 period. They found that agriculture sector could not generate employment much while mining sector could middllingly. Only construction and some sub-sectors of services could generate employment at a desirable level. Growth is mainly contributed by industry and services sectors while contribution of the agriculture sector is low.

2.2.1. The First Stage: Decomposing The Growth Into Sectoral And Demographic Components

In this thesis, we use 4 sectors: construction, services, industry and agriculture. The per capita value added may be defined as

$$\frac{Y}{N} = \left(\frac{Y_1}{E_1}\frac{E_1}{L} + \frac{Y_2}{E_2}\frac{E_2}{L} + \frac{Y_3}{E_3}\frac{E_3}{L} + \frac{Y_4}{E_4}\frac{E_4}{L}\right) * \frac{L}{N} \quad \text{[Equation-17]}$$

or equally;

$$y = (w_1 e_1 + w_2 e_2 + w_3 e_3 + w_4 e_4) * l \quad \text{[Equation-18]}$$

In the Equation-17, Y corresponds real value added, N corresponds total population, E corresponds total employment, and L corresponds total labor force. Subscripts $s \in (1,2,3,4)$ stand for the sectors, where sectors are construction, services, industry and agriculture, respectively. The ratio $y = \frac{Y}{N}$ indicates the value added per capita, the ratio $w_s = \frac{Y_s}{E_s}$ indicates the output per capita for sector s, the ratio $e_s = \frac{E_s}{L}$ indicates the employment rate share of sector s, and the ratio $l = \frac{L}{N}$ indicates the share of the labor force in the total population. A multi-staged Shapley decomposition method was used so as to decompose the growth into its different components by using Equation-18.

Let $x = \frac{Y}{L}$ be the value added per labor force, namely

$$x = \left(\frac{Y_1}{E_1}\frac{E_1}{L} + \frac{Y_2}{E_2}\frac{E_2}{L} + \frac{Y_3}{E_3}\frac{E_3}{L} + \frac{Y_4}{E_4}\frac{E_4}{L}\right) = \frac{Y}{L} \quad \text{[Equation-19]}$$

Equation-18 can be rewritten as $y = x * l$. While calculating the marginal contribution of x to y in that equation there are two possible ordering; l is the first and x is the second case and vice versa. By using the Shapley value decomposition method, the marginal contribution of x in per capita value added $\dot{x}$, can be computed as

$$\dot{x} = {}^{1}/_{2}\left[(x_{t=2}l_{t=2} - x_{t=1}l_{t=1}) - (x_{t=2}l_{t=1} - x_{t=1}l_{t=1})\right] + {}^{1}/_{2}\left[(x_{t=2}l_{t=2} - x_{t=1}l_{t=1}) - (x_{t=2}l_{t=2} - x_{t=1}l_{t=2})\right] \quad \text{[Equation-20]}$$

The first expression in the square brackets in Equation-20 indicates the gap between the real change in per capita value added and the change in the hypothetical scenario in which x had changed but l had not changed and l is equivalent to its observed value in the time period 1 (l is the second case). The second expression in the square brackets indicates the gap between the change in real per capita value added and the change in real per capita value added in the hypothetical scenario in which x had changed but l had not changed. In this case, it is equivalent to the its observed value in the time period 2. (l is the first case).

Similarly, the marginal contribution of l to changes in real per capita value added, $\dot{l}$, can be computed as follows:

$$\dot{l} = {}^{1}/_{2}\left[(x_{t=2}l_{t=2} - x_{t=1}l_{t=1})\right] - (x_{t=1}l_{t=2} - x_{t=1}l_{t=1})\right] + {}^{1}/_{2}\left[(x_{t=2}l_{t=2} - x_{t=1}l_{t=1}) - (x_{t=2}l_{t=2} - x_{t=2}l_{t=1})\right] \quad \text{[Equation-21]}$$

Let Δ corresponds the difference between the variables' value in the period 2 and in the period 1. By using Equation-20 and Equation-21, the following expressions can be derived:

$$\dot{x} = \Delta x(l_1 + l_2) * \frac{1}{2} \quad \text{[Equation-22]}$$

$$\dot{l} = \Delta l(x_1 + x_2) * \frac{1}{2} \quad \text{[Equation-23]}$$

In this case $\dot{x}$ corresponds the marginal contribution of the sectoral constituent of the economic growth, and $\dot{l}$ corresponds the marginal contribution of the demographic part of the economic growth, which means share of the labor force in the total population. Moreover, it coherently seen that $\dot{l}+\dot{x} = \Delta y$, which shows that the Shapley decomposition is additive.

2.2.2. The Second Stage: Decomposing The Sectoral Constituent of the Growth into the Contributions of the Specific Sectors

In the second stage, sectoral part of economic growth, $x = \frac{Y}{L}$, is decomposed into contributions of specific sectors. Let us define the contribution of sector s to the sectoral part of the growth as $x_s = \frac{Y_s}{L}$. Then, marginal contribution of sector s to sectoral component of the growth, let $\dot{x}_s^x$ represent it, is share of x_s in x. More formally, it could be obtained as following and sum of all sectors' contribution yields the sectoral part of growth.

$$\dot{x}_s^x = \Delta x_s * \Delta x \quad \text{[Equation-24]}$$

$$\Delta x = \sum_{s=1}^{4} \Delta \dot{x}_s^x \quad \text{[Equation-25]}$$

2.2.3. The Third Stage: Decomposing the Marginal Contribution of Sectors to Sectoral Component of the Growth into Its Productivity and Employment Components

Next, the marginal contribution of sector s to sectoral constituent of the growth, x_s, will be decomposed into its productivity and employment components. As it was defined before as $\frac{Y_s}{L} = x_s$ and this expression may be rewritten as $\frac{Y_s}{L} = \frac{Y_s}{E_s}\frac{E_s}{L}$. Firstly, $\frac{Y_s}{E_s}$ corresponds the value added per worker for sector s, which means the productivity of sector s. Therefore, it refers to the productivity part of the equation. Secondly, $\frac{E_s}{L}$ is its employment component as it is the employment rate share of the sector s. The equation $\frac{Y_s}{L} = \frac{Y_s}{E_s}\frac{E_s}{L}$ can be rewritten as $x_s = \varphi_s * \delta_s$, where $\varphi_s = \frac{Y_s}{E_s}$ and $\delta_s = \frac{E_s}{L}$. Analogously to the first stage, one can compute the marginal contributions of the productivity and employment components of the x_s to itself as following:

$$\varphi_s^{x_s} = \Delta \varphi_s \left(\delta_{s,t=1} + \delta_{s,t=2}\right) * \frac{1}{2} \quad \text{[Equation-26]}$$

$$\delta_s^{x_s} = \Delta \delta_s \left(\varphi_{s,t=1} + \varphi_{s,t=2}\right) * \frac{1}{2} \quad \text{[Equation-27]}$$

$$\Delta x_s = \varphi_s^{x_s} + \delta_s^{x_s} \quad \text{[Equation-28]}$$

2.2.4. The Fourth Stage: Computing the Marginal Contributions of The Sectoral Productivity and Sectoral Employment to Growth

Let $\dot{y}_s$ denote the marginal contribution of sector s to per capita value added. $\dot{y}_s$ can be calculated as follows:

$$\dot{y}_s = \dot{x} * \frac{\Delta x_s}{\Delta x} \qquad \text{[Equation-29]}$$

Equation-29 implies that the marginal contribution of the sector s to per capita value added is the multiplication of sectoral component of the total growth and the share of the sector s in the total marginal contribution to sectoral part of the growth.

Let $e_s^{\dot{y}}$ and $p_s^{\dot{y}}$ denote the marginal contribution of employment and productivity in sector s to per capita value added, respectively. They can be calculated as

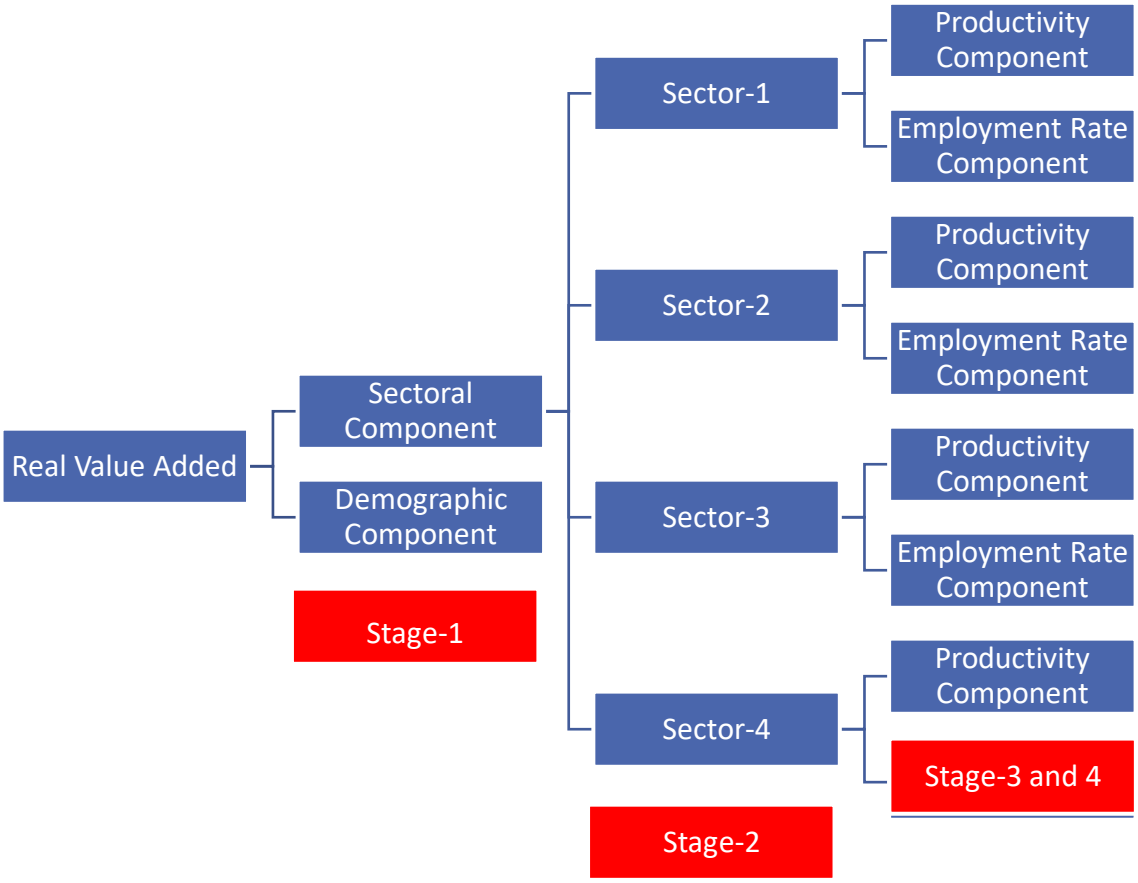
$$e_s^{\dot{y}} = \dot{y}_s * \delta_s^{x_s} \,/\, \Delta x_s \qquad \text{[Equation-30]}$$

$$p_s^{\dot{y}} = \dot{y}_s * \varphi_s^{x_s} / \Delta x_s \qquad \text{[Equation-31]}$$

As explained above $\Delta x_s = \varphi_s^{x_s} + \delta_s^{x_s}$, where $\varphi_s^{x_s}$ shows sectoral productivity, and $\delta_s^{x_s}$ is sectoral employment component for sector s. Marginal contribution of employment in sector s to economic growth is multiplication of the sector s' marginal contribution to growth and fraction of employment component of Δx_s. The marginal contribution of productivity in sector s to growth can be computed similarly.

To sum up the whole procedure, growth which is measured by the change in the per capita value added is made up of sectoral component, $\dot{x}$, and demographic component, $\dot{l}$. Sectoral part of the growth, $\dot{x}$, is the sum of the all sectors' contribution to growth. The contribution of the each sector to growth is made up of employment rate component, $e_S^{\dot{y}}$, and productivity component, $p_s^{\dot{y}}$. In other words, growth is made up of 3 components; the sum of the sectoral employment rate components, the sum of the sectoral productivity components and the demographic part of the growth. Respectively, growth was decomposed into sectoral component and demographic component then, sectoral part was decomposed into contribution of each specific sector, and the contribution of each specific sector was decomposed into employment rate component and productivity component. Once all the components are decomposed, the jobless growth is obtained by the difference between the total growth and the sum of the sectoral employment rate components. The whole process is illustrated in Figure-1.

Figure-1: The Decomposition Process



Source: Prepared by the Author

CHAPTER 3

ANALYSIS

This section gives the Shapley value decomposition analysis for the growth performance of Turkish economy over the period from 2009 to 2019. There are two main reason for choosing that time interval to investigate. Firstly, data could not go back more and secondly, it was not desired to holistically analyze a time interval including 2008 global crisis which is a severe possibility for the structural break. In this part, data which is utilized in this thesis, is introduced firstly. Their descriptive statistics are assessed. Then, the economic performance of the Turkish economy is discussed. Finally, the Shapley value decomposition is employed for the Turkish economy in order to detect the jobless part of the its growth performance over 2009-2019 period and the results are given in detail.

3.1. ECONOMIC GROWTH DATA AND THE TURKISH ECONOMY'S GROWTH PERFORMANCE

This thesis aims to decompose the economic growth rate using Turkish data over the period between 2010 and 2019. In this study, economic growth is represented by the change in per capita value added without taxes and subsidies. A linked deflator, whose base year is 2009, was obtained from World Bank, was used in order to make the value added real.

The first step is to define the economic growth. The value added per capita is represented by $\frac{Y}{N}$, where Y is value added and N is total population. Y is the sum of value added generated by each sector, which is given in terms of local currency. Real Y is obtained by dividing Y with the deflator. The reason for using

a linked deflator was to prevent any inconsistency caused by the varying base year of the deflator.

Therefore, the real value added per capita can be computed by dividing nominal value added with the deflator times population. More formally;

$$Real\ Value\ Added\ Per\ Capita\ = \frac{Nominal\ Value\ Added}{Deflator * Population} \quad \text{[Equation-32]}$$

The economic growth is computed as percentage by using the following formula, where t subscripts stand for time period.

$$\frac{(Real\ Value\ Added\ Per\ Capita_{t=2} - Real\ Value\ Added\ Per\ Capita_{t=1})}{Real\ Value\ Added\ Per\ Capita_{t=1}} * 100 \quad \text{[Equation-33]}$$

Table-3 gives the data for the time series of the value added, deflator and population to find the economic growth series.

Table-3: Population, Nominal Value Added And Deflator Data

Years	Population(N)	Nominal Value Added (1000 LCS)	Deflator
2009	72561312	898263064,187409	100
2010	73722988	1027561053,99515	107,0127
2011	74724269	1237146314,22701	115,7755
2012	75627384	1397219904,1915	124,3639
2013	76667864	1599039310,33863	132,1601
2014	77695904	1818621906,9159	141,9686
2015	78741053	2073020639,48288	153,0804
2016	79814871	2316930424,29304	165,4772
2017	80810525	2779809361,77204	183,613
2018	82003882	3369140913,66352	213,7967

2019	83154997	3891943503,81932	243,576

Source: Turkish Statistical Institute and world bank

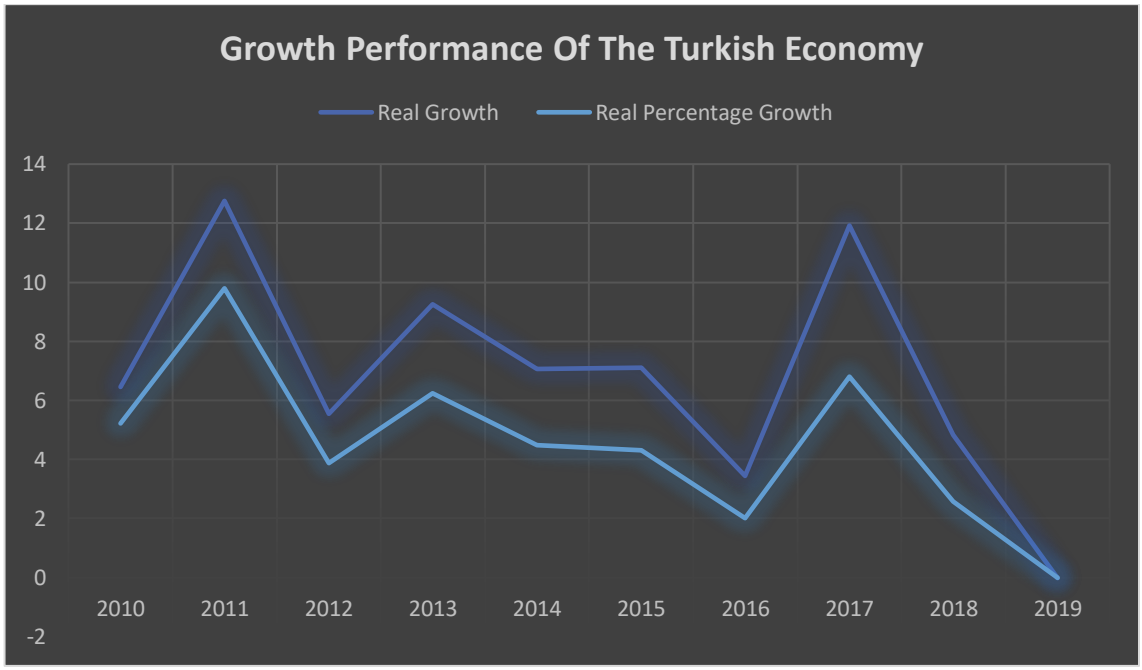
Table-4 shows the time series of real value added per capita and its growth, which are calculated using Equation-32 and Equation-33. At first glance, it draws attention that the Turkish economy has positive growth rates except for the year 2019, the average growth rate is 4,53 percent though the growth profile of Turkey is volatile.

Table-4: R. Value Added P.C., R.Growth And R.Percentage Growth Series

Years	R.Value Added p.c.	R.Growth	R.Percentage Growth
2009	123,7937	NA	NA
2010	130,2475	6,453884	5,213350922
2011	143,0022	12,7547	9,792663967
2012	148,5563	5,554101	3,883926261
2013	157,814	9,257632	6,231778794
2014	164,874	7,059976	4,473620845
2015	171,982	7,108	4,311170955
2016	175,4248	3,442824	2,001837402
2017	187,3456	11,92085	6,79539039
2018	192,1692	4,823545	2,574706852
2019	192,1514	-0,0177408	-0,009262671

Source: Calculated by the Author by Using the Data of Turkish Statistical Institute and world bank

Figure-2: Growth Performance Of The Turkish Economy



Source: Turkish Statistical Institute

Figure-2 shows the growth performance in a graph, which reveals that there exists several peaks and deeps, which indicates extensive volatility. The first peak was experienced in 2011 in the aftermath of the 2008 global economic crisis. Growth was supported by domestic demand based on private sector investment and consumption expenditures in the post-crisis period but this type of growth could not be sustained due to the fact that foreign trade balance was deteriorated and domestic demand was decreased due to the shrinkage in consumption and investment expenditures (Hisarcıklıoğlu, 2013). The domestic demand decreased so much that inflation rate was 6,2 percent in 2012, which is the smallest inflation figure in the last 53 years. Furthermore, the most prominent foreign trade partner of Turkey “European Union” was in a debt crisis in 2012, which is the main driver of the deteriorating foreign trade balance of Turkey

economy (TUCCE, 2013). In this period, volume of export of the Turkish economy to EU countries declined five percent and became 59,2 billions of US dollars. Therefore, a relatively less drastical growth rate deceleration was experienced in 2012 as a deep point. Furthermore, the U.S.A congress made some decisions in order to cure the fiscal balance of the economy in 2012. The congress took precautionary measures to prevent the negative effects of the planned budget cuts coming into the effect and the expiration of tax deductions. Those measures with the sluggish economic performance of European zone countries decelerated the global economic performance (TUCCE, 2013).

The year 2013 is actually could be a deep point because of the fact that FED declared that it would give up expansionary monetary policies. It had begun implementing expansionary monetary policies to deal with the implications of the 2008 global economic crisis (Ataman-Erdönmez, 2009). The declaration of FED was followed by one percentage increase in bond interest rate in the U.S.A. Therefore, the rest of the world economies confronted a liquidity matter as well the Turkish economy. However, economic growth rate of Turkey increased thanks to increasing government expenditures and recovery in domestic demand despite the decreasing foreign demand volume and postponed investment expenditures due to the declaration of FED (TUCCE, 2014).

After 2013, growth performance of Turkey began to decelerate. One of the reasons for the decelerating performance could be the deceleration of FED in May of 2013 given that Turkey was one of 5 countries whose local currency depreciated the most after the declaration of FED (Kamacı and Konya, 2016). Then, Morgan Stanley named those 5 countries as fragile five in its 2013 report and huge current account deficit, high inflation and decelerating growth performance were stated as the reasons for the fragileness of those countries. Moreover, fragile five could experience a liquidity problem if FED abandoned the expansionary monetary policy and political uncertainty, namely the risk increased

due to the fact that general elections would be held in all of those countries (Eğilmez, 2013). Moreover, sustaining political upheaval in the neighbor countries such as Iraq, Russia and Syria, and keeping low performance of foreign trade partners of Turkey, especially European zone countries, contributed to the performance of Turkey economy negatively (TUCCE, 2016).

Together with these conditions, 2015 is the first year in the history of Turkey that two elections were held in the same year and further the year 2016 was a really hard time period for both globally and locally. Brexit which could be defined as the exiting of the U.K. from the European Union, took place in 23 June 2016 (Pettifor, 2017) and Donald Trump won the election and became the president of the U.S.A. The reason behind for voting Brexit and Donald Trump could be related to a backlash against the globalization or promoting the nationalizm (Blyth, 2016; Wilson, 2017; Adler-Nissen et al., 2017). These events which scuttled the globalization might have been possible reasons for the getting decelerated global economy.

Beyond those global events, Turkey experienced the 15 July coup attempt, which caused the lack of economic trust. When those negative situations were assessed together with sustaining upheavals in the middle-east area, which is the neighborhood of Turkey, and non-accelerating economic performance of European zone countries, which were main foreign trade partners of Turkey economy, it could be comprehended why economic performance of Turkey economy experienced a deep in 2016 after a mediocre performance (TUCCE, 2017).

The Turkish economy’s growth rate made a peak in 2017 thanks to precautions which were taken in order to increase domestic demand and to make the reaching liquidity easier for economic agents, such as increasing credits, tax cuts and

incentives. However, this high growth rate could not be sustained because of drastical depreciation in local currency and uncertainties sustained in global markets (TUCCE, 2018), which was begun in the first quarter of 2018. Dollar/TL exchange rate was 3,75 in the beginning of the year but it reached 6,53 in August of the same year while Euro/TL exchange rate raised from 4,60 to 7,80 in the same time period. This exchange rate crisis affected foreign trade negatively, and increasing prices of imported raw material due to the exchange rate crisis led to a shrinkage in the domestic production (Akcan, 2021). Further, these factors contributed to the inflation rate, which caused that the CBTR implemented a contractionary monetary policy to handle with increasing inflation rate and depreciation of local currency. Therefore, domestic demand and investment shrank dramatically, which indicates low growth performance (TUCCE, 2019).

Then, Turkey entered the 2019 with exchange rate crisis, which means that high inflation and depreciation problem kept in 2019, which caused deterioration in expectations of economic agents therefore the CBTR kept implementing a high interest rate policy in order to deal with exchange rates crisis and indirectly with inflation rate problem. (ARCI, 2020)

The Dollar/TL exchange rate which made a peak in August of 2018 depreciated from 6,53 to 5,15 up to the beginning of 2019 but it continued to climb up and reached 5,95 level at the end of 2019. Therefore, increasing cost oriented shrank in the domestic production kept and depreciation of local currency making the export cheaper led to an increase in the foreign demand but increasing foreign demand could not be met by the domestic production so the economic growth rate of Turkey experienced a drastical deep in 2019 which began after the peak in 2017 (ARCI, 2020).

3.2. DECOMPOSITION OF GROWTH INTO SECTORAL AND DEMOGRAPHIC COMPONENTS

The economic growth figures given in Table-3, Table-4 and Figure-2 are measured by the changes in real value added per capita and are made up of demographic component and sectoral component, which are denoted by $\dot{x}$ and $\dot{l}$, respectively. Demographic component is the part of the growth rate which was caused by the changes in the population while sectoral component is the part of the growth which was caused by sectoral economic activities. Therefore, the sum of these two components gives the total change in real per capita value added and can be calculated through Equation-22 and Equation-23.

Hence, the sectoral and demographic parts of the economic growth can be written as follows, respectively:

$$\dot{x} = \left(\frac{Y_{t=2}}{N} - \frac{Y_{t=1}}{N}\right) * \left(\frac{L_{t=1}}{N} + \frac{L_{t=2}}{N}\right) * \frac{1}{2} \qquad \text{[Equation-34]}$$

$$\dot{l} = \left(\frac{L_{t=2}}{N} - \frac{L_{t=1}}{N}\right) * \left(\frac{Y_{t=1}}{N} + \frac{Y_{t=2}}{N}\right) * \frac{1}{2} \qquad \text{[Equation-35]}$$

Table-5 lists the time series of the demographic component of growth, $\dot{l}$**,** and sectoral component of the growth, $\dot{x}$., and labor force since other series necessary for calculating $\dot{x}$ and $\dot{l}$ were given before except for labor force series.

Table-5: Labor Force, Demographic And Sectoral Parts Of Growth

Years	Labor Force	Demographic Component	Sectoral Component
2009	*23710000*	*NA*	NA
2010	24594000	2,631722	3,822162
2011	25594000	3,60034	9,15436
2012	26141000	1,331378	4,222723
2013	27046000	3,119631	6,138001
2014	28786000	7,909643	-0,8496665
2015	29678000	2,888959	4,219041
2016	30535000	2,591968	0,8508561
2017	31643000	4,215252	7,705594
2018	32274000	0,9650083	3,858536
2019	32549000	-1,048243	1,030502

Source: Labor force series was retrieved from Turkish Statistical Institute. The demographic and sectoral components were calculated by the Author by Using the Data of Turkish Statistical Institute and world bank

Labor force indicates the population over 15 aged who supply labor in order to contribute to the production of goods and services. Population is the number of people lived in the country in the relevant period. Reel value added is the sum of value added which is the difference between the added value of a good or service in each step of production, which excludes earlier costs, generated by all sectors.

3.3. SECTORAL DISTRIBUTION OF VALUE ADDED

As it was explained in the methodology section, the sectoral component of the growth could be decomposed into the contribution of the specific sectors to the economic growth. Sectors are construction, services, industry, agriculture, respectively in this thesis. Then, the total sectoral growth is the sum of the all sectors' marginal contribution to the growth.

Let $x_s = \frac{Y_s}{L}$, subscript $s \in \{1,2,3,4\}$ stands for sectors e.g., Y_1 implies value added generated by sector 1, and sector s' marginal contribution to the sectoral part of the growth is – let $\dot{x}_s^x$ denote it - So then;

$$\dot{x}_s^x = \Delta x_s * \Delta x \qquad \text{[Equation-36]}$$

$$\Delta x = \sum_{s=1}^{4} \Delta \dot{x}_s^x \qquad \text{[Equation-37]}$$

To make it clear, $\dot{x}_s^x = \left(\frac{Y_{s,t=2}}{L_{t=2}} - \frac{Y_{s,t=1}}{L_{t=1}}\right) * \left(\frac{Y_{t=2}}{L_{t=2}} - \frac{Y_{t=1}}{L_{t=1}}\right)$, where subscript s stands for sector s and subscript t corresponds the time period. Namely, $Y_{s,t=1}$ corresponds the value added generated by sector 1 in the time period 1, $L_{t=1}$ corresponds the labor force in the time period 1. Y_s, the value added generated by the sector s, which is necessary and the only missing series for calculating $\dot{x}_s^x$ are given in

Table-6 and $\dot{x}_s^x$ series are given in table-7. Sectors are construction, services, industry and agriculture, respectively.

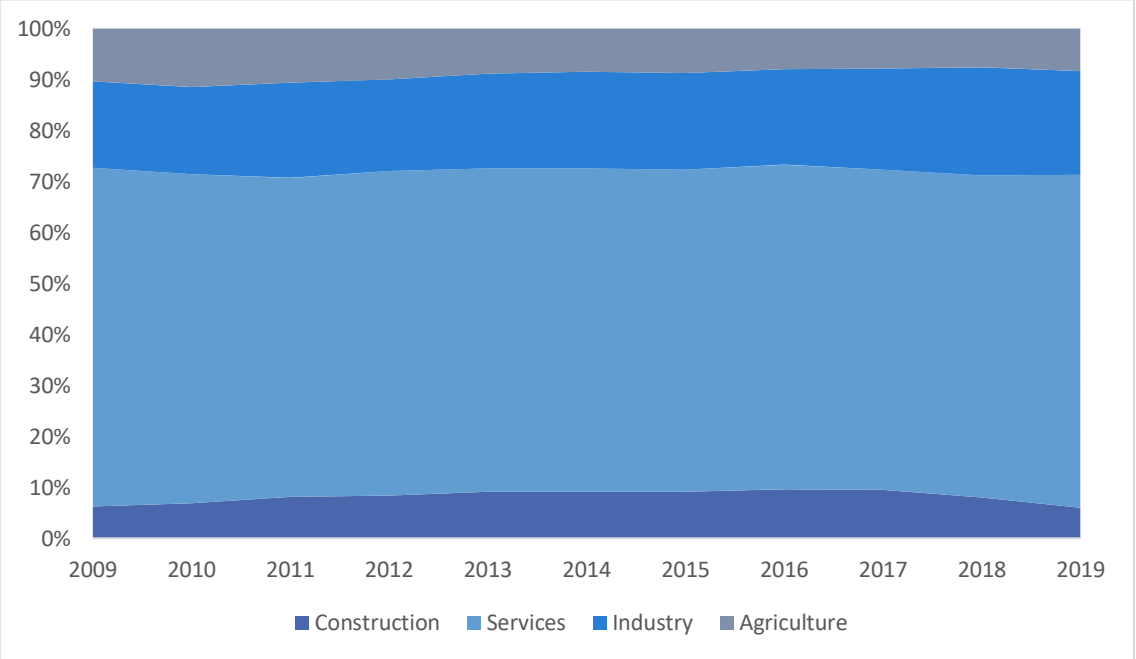
Table-6: Sectoral Distribution Of The Value Added

Years	Y1(Construction)	Y2(Services)	Y3(Industry)	Y4(Agriculture)
2009	563046145,4	5969124860	1525419747	925039890
2010	660185203,1	6202633514	1642607961	1096811736
2011	864188133,8	6697520941	1996035399	1127993999
2012	943693288,8	7160608997	2013505329	1117120440
2013	1106157751	7677603911	2246149750	1069349423
2014	1165749757	8129970582	2427588150	1086722662
2015	1244707369	8551819305	2564127003	1181386723
2016	1345887815	8916311469	2634136550	1105170426
2017	1449105874	9504044947	3002379114	1183968560
2018	1251882752	9966484586	3346824874	1193425876
2019	957713072,4	10447738108	3242006634	1330893856

***Source**:* Turkish Statistical Institute and world bank

The graph of the cumulative percentage of the sectoral contributions to the growth is given in Figure-3. As can easily be observed, the main contributor of the total economic growth is the services sector. The percentage contributions of the sectors to per capita real value added growth are approximately 65%, 20%, 10% and 5% by services, industry, agriculture and construction services, respectively. This implies that the Turkish economy can be classified as a developed country according to the three-sector theory which was developed by Allan Fisher (1935; 1939; 1946), Colin Clark (1940) and Jean Fourastié (1949). According to three-sector theory, economy is made up of three sectors; primary (extraction), secondary (production) and tertiary (services). Furthermore, share of the sectors in the total economic activities shifts from the first sector towards secondary and tertiary sectors as economies develop.

Figure-3: Sectoral Distribution Of The Value Added



Source: Turkish Statistical Institute and world bank

3.4. DECOMPOSING CONTRIBUTONS OF THE SPECIFIC SECTORS

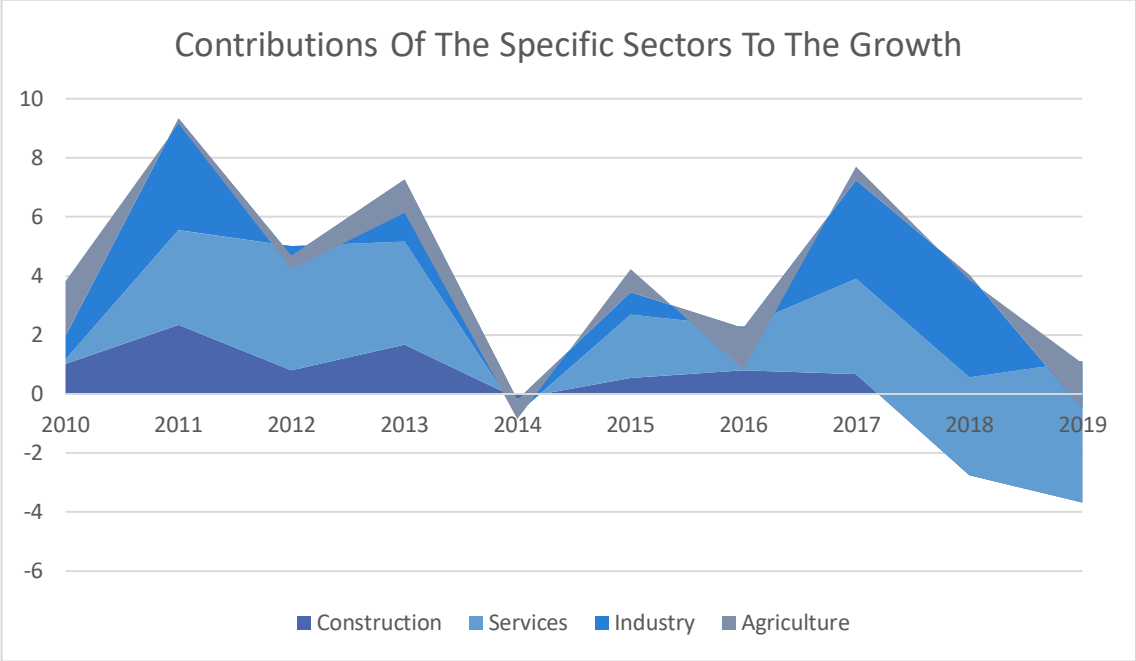
Marginal contributions of the all 4 sectors were calculated by using Equation-24, which are given in Table 7. Figure-4 depicts the calculated marginal contributions of each sectors separately to real value added per capita.

Table-7: Contribution Of The Specific Sectors To The Growth

Years	Contribution of Construction Sector	Contribution of Services Sector	Contribution of Industry Sector	Contribution of Agriculture Sector
2010	1,022282	0,147096	0,8097364	1,843048
2011	2,339999	3,205504	3,786042	-0,1771838
2012	0,8033875	4,211343	-0,3315627	-0,4604449
2013	1,675869	3,474494	2,103805	-1,116167
2014	-0,1453824	-0,5222437	0,4639775	-0,6460179
2015	0,5393618	2,139646	0,772063	0,7679705
2016	0,8113072	1,461809	-0,05016449	-1,372096
2017	0,6652114	3,231743	3,335297	0,473343
2018	-2,750437	3,319662	3,461457	-0,1721451
2019	-3,675912	4,779209	-1,607847	1,535052

Source: Calculated by the Author by Using the Data of Turkish Statistical Institute and world bank

Figure-4: Contributions Of The Specific Sectors To The Growth



Source: Calculations by the Author with Data Gotten from Turkish Statistical Institute and world bank

As can be seen from Figure-4, the heading sectors in terms of contribution to growth is services and industry. It is also noticeable that agriculture sector did not contribute much to growth for 2010 and 2015. Moreover, its contribution to growth was negative in several years. The contribution of the construction sectors is moderate except for the 2018-2019 period, in which it contributed drastically and negatively to the growth. When the period from 2010 to 2019 is assessed as a whole in terms of growth performance, it is seen that 63,37964, 31,73632, 3,20204 and 1,682001 percent of the growth is contributed by services, industry, construction and agriculture sectors, respectively. This suggests that the Turkish economy exhibits features similar to developed countries according to three-sectors theory.

3.5. EMPLOYMENT, UNEMPLOYMENT AND GROWTH

Marginal contribution of each sector to the sectoral part of growth is made up of two components; productivity component, $p_s^{\dot{y}}$, and employment rate component, $e_S^{\dot{y}}$. The sum of these two components equals to the marginal contribution of the related sector to sectoral part of the growth. These components could be computed using the following equations:

$$e_S^{\dot{y}} = \dot{x}_s^x * \frac{E_S}{L} / (\frac{E_S}{L} + \frac{Y_S}{E_S}) \quad \text{[Equation-38]}$$

$$p_S^{\dot{y}} = \dot{x}_s^x * \frac{Y_S}{E_S} / (\frac{E_S}{L} + \frac{Y_S}{E_S}) \quad \text{[Equation-39]}$$

where $e_S^{\dot{y}}$ corresponds employment rate component of sector s while $p_s^{\dot{y}}$ corresponds the productivity component of sector s, where sectors are construction, services, industry and agriculture, respectively. $\dot{x}_s^x$ is marginal contribution of sector s to sectoral component of the growth. E_s is employment in sector s, L is labor force, and Y_s is value added generated by sector s. The only lacking necessary series to compute $e_S^{\dot{y}}$ and $p_s^{\dot{y}}$, sectoral employment series, are given by Table-8, where sectors are construction, services, industry and agriculture, respectively.

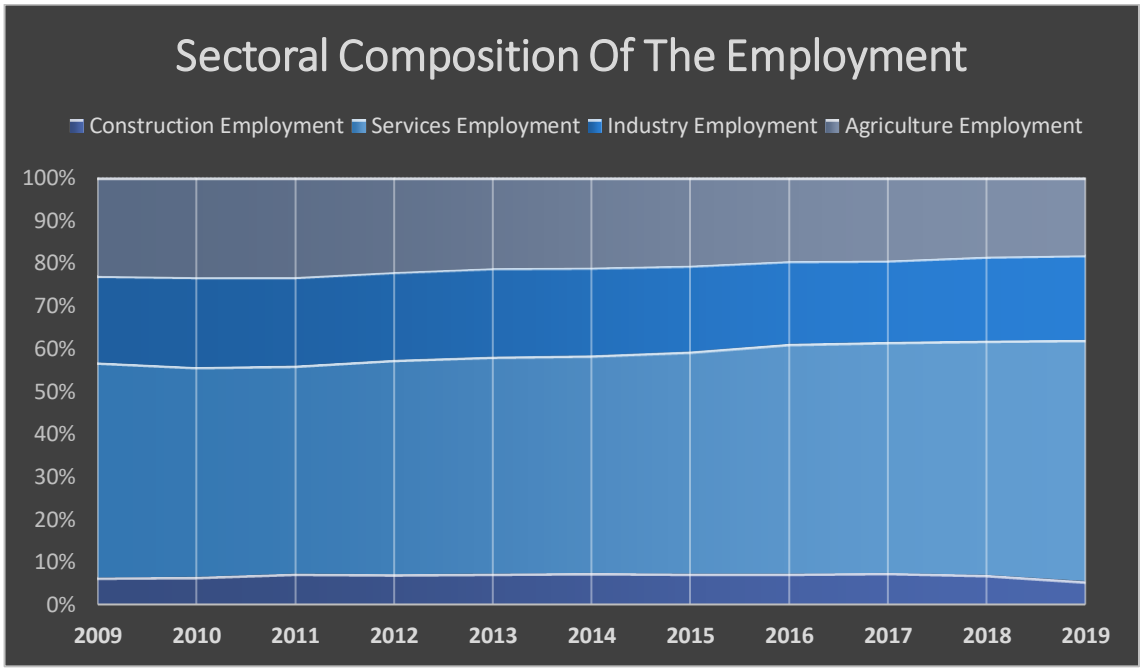
Table-8: Sectoral Distribution Of The Employment

Years	E1(Construction)	E2(Services)	E3(Industry)	E4(Agriculture)
2009	1305000	10380000	4179000	4752000
2010	1434000	10725000	4615000	5084000
2011	1680000	11332000	4842000	5412000
2012	1717000	12016000	4903000	5301000
2013	1768000	12528000	5101000	5204000
2014	1912000	13235000	5316000	5470000
2015	1914000	13891000	5332000	5483000
2016	1987000	14617000	5296000	5305000
2017	2095000	15246000	5383000	5464000
2018	1992000	15774000	5674000	5297000
2019	1550000	15872000	5561000	5097000

Source: Turkish Statistical Institute

The last step is to calculate jobless growth. Before it, examining the total and sectoral employment performance of Turkey might provide useful insights. The sectoral composition of total employment is given by Figure-5. The cumulative percentage area graph of the sectoral employment shows that approximately 52, 21, 20 and 7 percent of employee works in the service, agriculture, industry, and construction sectors, respectively. Surprisingly, the level of employment in the agriculture sector seems high considering that agriculture sector is not such a big part of the total economic activities, especially given that the Turkish economy exhibits similar features with developed countries according to three-sectors theory. Except for the agriculture sector, the employment composition of the Turkish economy exhibits similarities with the developed countries.

Figure-5: Sectoral Composition Of The Employment



Source: Turkish Statistical Institute

The unemployment rate is calculated by using over 15 aged non-institutional population.[1] Non-institutional population indicates the part of the total population that does not include the individuals who stay at institutions such as dormitories, nursing homes, private hospitals, prisons, barracks, etc. Individuals who supply labor in order to contribute to the production of goods and services in the over 15 aged non-institutional population is accepted as labor force. In other words, the part of population which is made up of individuals could work and want to work is labor force. The ratio of unemployed individuals to labor force gives unemployment rate.

Table-9: Non-Instituional Population By Labor Force Status

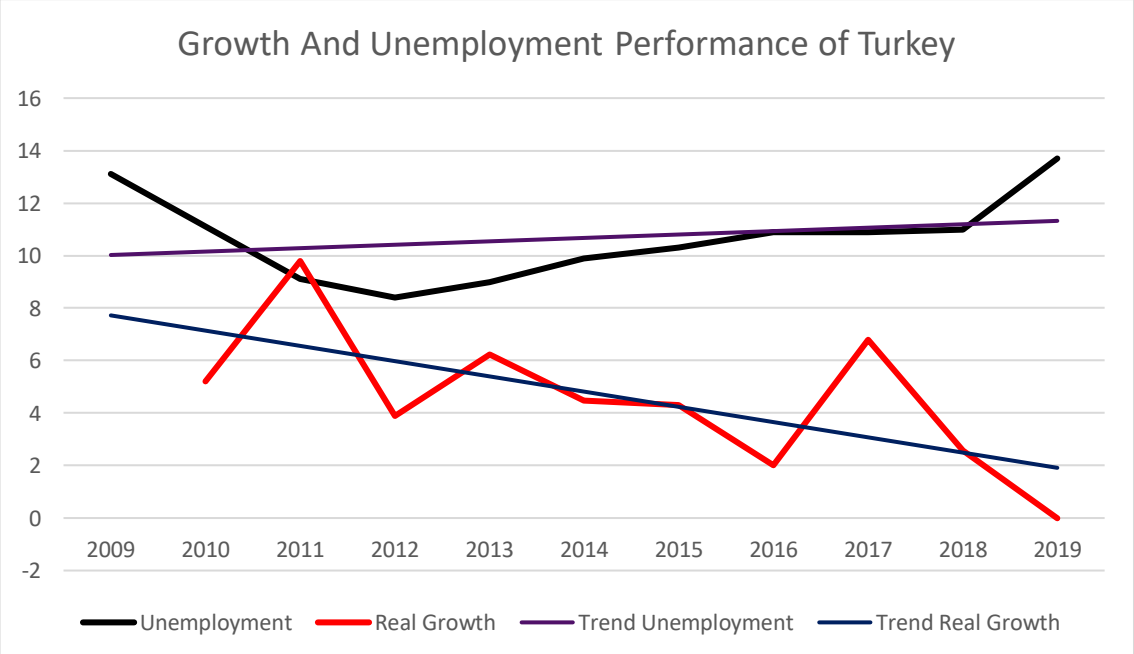
Years	Population +15	Labor Force	Unemployed	Unemployment Rate
2009	51 833000	23710000	3095000	13,1
2010	52904000	24594000	2737000	11,1
2011	53985000	25594000	2328000	9,1
2012	54961000	26141000	2204000	8,4
2013	55982000	27046000	2445000	9
2014	56986000	28786000	2853000	9,9
2015	57854000	29678000	3057000	10,3
2016	58720000	30535000	3330000	10,9
2017	59684000	31643000	3454000	10,9
2018	60654000	32274000	3537000	11
2019	61469000	32549000	4469000	13,7

Source: Turkish Statistical Institute

1 Turkish Statistical Institute also calculates unemployment/employment rate by using over 15 aged non-institutional population.

Figure-6 shows the growth and unemployment performance of the Turkish economy over the period between 2009 and 2019. The figure reveals that having the average rate of approximately 11%, unemployment has been a crucial problem for Turkey since 2009. Also, it is noteworthy that unemployment curve has a pretty smooth linear trend and does not exhibit drastic booms or deeps, which supports the idea of continual chronic unemployment problem of the Turkish economy. When come to the growth performance, contrary to unemployment, it exhibits several deeps and booms, and the real growth has a negatively sloped steep linear trend. As can be seen from Figure-6, the curves do not exhibit similar or contra patterns. This implies that unemployment and growth series are independent. This observation might be an indicator of the jobless growth.

Figure-6: Growth And Unemployment Performance Of Turkey



Source: Turkish Statistical Institute

3.6. DECOMPOSING PRODUCTIVITY AND EMPLOYMENT RATE COMPONENTS AND CALCULATING JOBLESS GROWTH

As the last step of decomposition analysis, it is necessary to calculate employment rate components and productivity components of sector's contribution to sectoral part of the total growth by using the following formulas:

$$e_S^{\dot{y}} = \dot{x}_S^x * \frac{E_S}{L} / (\frac{E_S}{L} + \frac{Y_S}{E_S}) \quad \text{[Equation-40]}$$

$$p_S^{\dot{y}} = \dot{x}_S^x * \frac{Y_S}{E_S} / (\frac{E_S}{L} + \frac{Y_S}{E_S}) \quad \text{[Equation-41]}$$

where $e_S^{\dot{y}}$ is employment rate component of sector s and $p_S^{\dot{y}}$ is productivity component of sector s. The calculated productivity and employment rate components are given in Table-10 and Table-11.

Table-10: Employment Components Of The Growth

Years	Employment of Construction	Employment of Services	Employment of Industry	Employment of Agriculture
2010	0,000129455	0,000110831	0,000426673	0,001764292
2011	*0,0002985605*	0,002399562	0,001736718	-0,000179579
2012	0,00009599767	0,003245887	-0,000151362	-0,000442643
2013	0,000175081	0,002624207	0,000900717	-0,001044178
2014	-0,00001583629	-0,000390594	0,000187558	-0,000617311
2015	0,00005348342	0,001625495	0,000288335	0,000657934
2016	0,00007793501	0,000730159	-0,00001748658	-0,001143315
2017	0,00006366613	0,002495899	0,001016969	0,000376906
2018	-0,000270098	0,002565943	0,001031389	-0,000125311
2019	-0,0002832839	0,002565943	-0,000471055	0,000920049

Source: Calculated by the Author by Using the Data of Turkish Statistical Institute and world bank.

Table-11: Productivity Components Of The Growth

Years	Productivity Component of Construction Sector	Productivity Component of Services Sector	Productivity Component of Industry Sector	Productivity Component of Agriculture Sector
2010	1,022152	0,1469852	0,8093097	1,841284
2011	2,3397	3,203104	3,784305	-0,1770042
2012	0,8032915	4,208097	-0,3314113	-0,4600023
2013	1,675694	3,47187	2,102905	-1,115123
2014	-0,1453665	-0,5218531	0,4637899	-0,6454006
2015	0,5393084	2,13802	0,7717747	0,7673126
2016	0,8112293	1,461079	-0,05014701	-1,370953
2017	0,6651478	3,229247	3,33428	0,4729661
2018	-2,750167	3,317096	3,460425	-0,1720198
2019	-3,675628	4,775672	-1,607376	1,534131

Source: Calculated by the Author by Using the Data of Turkish Statistical Institute and world bank.

When we look at closer to the productivity component of the total growth it seems that construction, services, industry and agriculture sectors contributed to the productivity component by 3,203176, 63,37094, 31,74328 and 1,682604 percent, respectively. Therefore, it is possible to deduce that the main driver sectors of the growth are services and industry.

As a conclusion, per capita real value added, which is our proxy variable for growth, increased 68,3577712 units over the 2010-2019 period. The contribution of the demographic component to the growth is 28,2056583 units, which accounts for 41,30 percent. The sum of the all sectors' productivity component's contribution to the growth is 40,12772439 units, which corresponds to 58,665 percent. Then, the sum of the all sectors' employment component contributes to growth is only 0,02438851 units, which corresponds 0,035 percent. Therefore, this study suggests that 99,965 % of the growth in Turkey over the relevant period is because of productivity increases and demographic changes rather than an increase in employment. It is noteworthy to state that this calculations are done seperately for each year. However, contributions of the components could be added since the Shapley decomposition exhibits additivity feature. In this manner, those results are summation of seperately made the Shapley decomposition for each observation point and they imply that the main drivers of the growth performance of the Turkish economy are productivity increases and demographic changes rather than unemployment rate decrease. Moreover, only 0,035 percent of the growth stems from the increase in employment, hence, 99,965 % of the growth could be considered as "jobless growth". This result reveals that the Turkish economy grows, but the growth does not creat job. Those results are summarized in Figure-7 and Figure-8.

Figure-7: Shares of Economic Growth's Components in Economic Growth

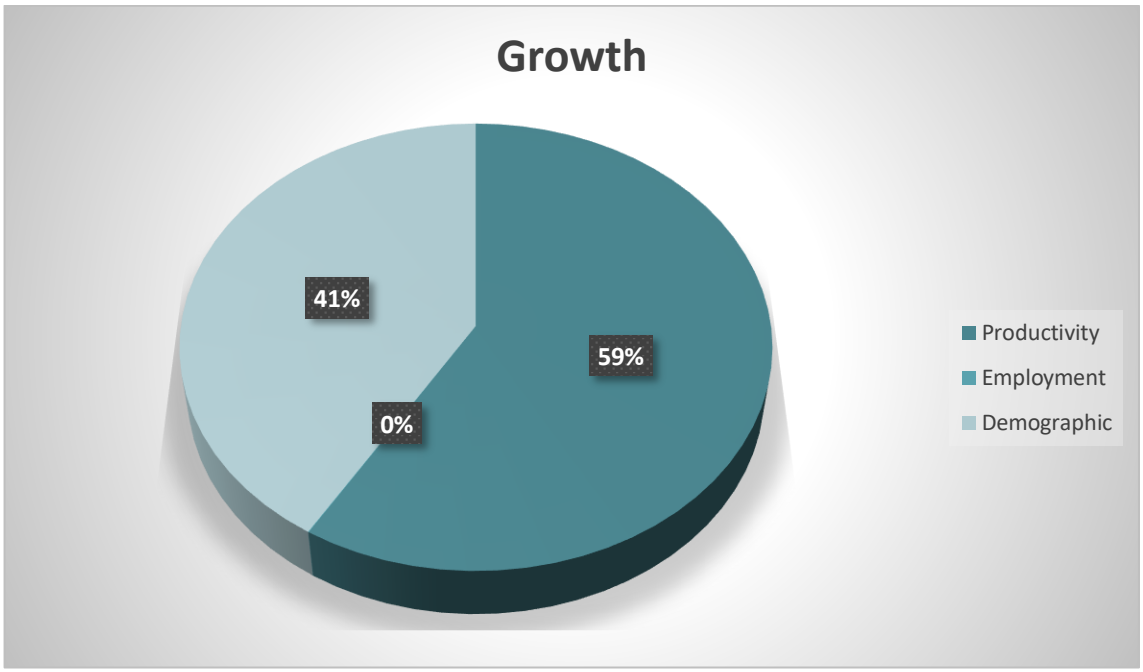
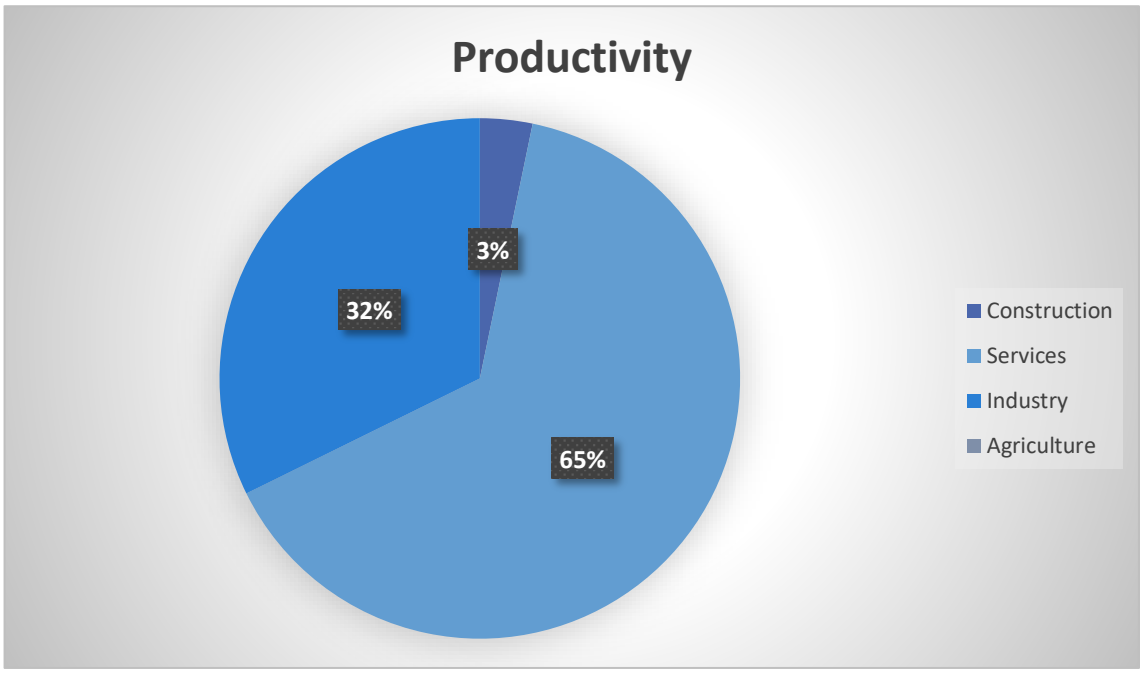


Figure-8: Shares of the Sectors in the Productivity Components



CONCLUSION

Arthur Okun Melvin (1962) examined the relationship between deviations from potential GNP and unemployment, and reached the conclusion that there exists bi-directional negative relation between the variables. After the Okun's study, this relation was named as the Okun's Law and it was thought to be valid until 1990's. However, many studies has provided evidences against it. Then, a new term, "*jobless growth,* is introduced by the economic literature to refer to co-existence of growth and non-decreasing unemployment rate. Existing of jobless growth is mainly attributed to the rise of liberal economic policies, transformation of production system from fordizm to post-fordizm, globalization, technological progression, and polarization. Many studies attempted to explain the other reasons for jobless growth. Those reasons could be listed as abandonment of Keynesian policy recommendations, transformation of the production system, productivity increases, increasing production costs, permanent lay-off, unemployment insurance benefits, rising health care costs of employment, inter-sectoral migration, just-in-time hiring, reallocation of the labor force, foreign direct investment increases, rapidly growing population and labor force, high propensity to consume imported goods and hysteresis effect. The literature reveals that the reasons for jobless growth could vary among the economies.

In this thesis, the Shapley value decomposition method was employed in order to detect the jobless part of the growth of the Turkish economy. The Shapley value is a game theoretic concept, which answers the question "how should the economic output generated by a coalition distributed among its participant so that it is fair?". To this end, the growth is considered as the output generated by the coalition, which is the Turkish economy, and the components of the growth as the participants of the coalition. The Shapley value decomposition is used to derive the jobless part of the growth. Specifically, the growth, which corresponds the change in per capita value added, is made up of two components: demographic component and sectoral component. The sectoral component of the

growth is made up of 4 sector's contribution, and contribution of each sector is made up of two components: productivity component and employment rate component. Therefore, the decomposition process is based on the equation which relates per capita real value added to the product of productivity as output per employment, employment rate per labor force, and the ratio of labor force to population (independent population rate) as demographic component. The jobless growth is the difference between the whole growth and the sum of all sector's employment rate components. In other words, the part of the growth that is not contributed by employment components of the sectors corresponds the jobless growth.

The first stage of the decomposition yields that 58,7% of the growth experienced in Turkey is accounted for its sectoral component and its 41,3% is accounted for its demographic component. The contribution of the construction, services, industry, and agriculture sectors to growth is 1,8%, 37%, 19%, and 0,9%, respectively. The sum of the all sectors' employment component contributes to growth just 0,035% and 58,665 % of the growth is contributed by productivity components of the sectors. Thus, 99,965 % of the growth is jobless and just 0,035% part of the growth causes a decrease in the unemployment rate. Briefly, the Turkish economy grew thanks to productivity increases and demographic changes in the relevant period. Furthermore, the increase in productivity comes from mainly industry and services sectors.

However, existence of jobless growth does not mean that the Okun's Law is not valid since there might still exist a positive relationship between the growth rate and the employment rate albeit it is weak. Furthermore, Okun did not claimed that the whole of the growth is contributed by an increase in employment. Rather, he assumed that the factors such as productivity, changes in working hours or capacity utilization could affect the growth rate through labor force channel. In other words, he was aware of that a part of the growth is contributed by the

decrease in unemployment rate. However, this thesis concludes that the part of the growth fed by employment is considerably low in case of Turkey.

There is a triple trade-off among productivity, employment rate per labor force, and the independent population rate in terms of the shares in the growth. This means that a decline in jobless part of the growth requires a decline in the share of productivity or independent population or both. The results of the decomposition show that labor force increased more rapidly than population given that demographic component accounts for 41,30 percent of the growth. Furthermore, since the contribution of employment rate per labor force to growth is quite little, 0,035 percent, it is possible to conclude that employment and labor growth rates are almost the same. When those are combined, the results suggest that the main reason for the jobless growth is rapidly increasing labor force. Per capita value added could rise without high employment rate increase thanks to high productivity increase. Thus, there exists a rapidly increasing but could not be employed labor force but the employment is so productive that growth rate is quite high. This cleavage is likely to be sign of the polarization.

One of the facts that theory of polarization causes jobless growth is that middle level qualification required occupations are made up of a huge part of the total employment (Jaimovich and Siu, 2018). Therefore, polarization causes a severe unemployment. On the other hand, high level qualification required occupations makes economy grow. This scenario matches up with our results. It could be stated that there is a severe unemployment given that there exist a rapidly growing but could not be employed labor force.

This result is in line with Akçomak and Gürcihan (2013), Akçomak and Erdil (2015), and Aslan (2020). Moreover, these studies verify the existence of a technology based occupation polarization for the Turkish economy. In other

words, they attributed polarization to technological progression like Firpo et al. (2014) and Goos et al. (2014). Since technological progression oriented occupation polarization is a possible reason for jobless growth (Butev, 2012), it is possible to reach the conclusion that Turkey experienced jobless growth during 2010-2019 period due to a technological progression based on occupation polarization.

Lastly, since we calculated the jobless part of the growth as a series , this series could be used to test whether there is a statistical relation between job polarization and jobless growth, which is the main possible reason for jobless growth in the Turkish economy we found. Moreover, it could be used in order to detect the reasons for jobless growth or to investigate the relation between variables considered to be related with jobless growth by employing classical econometric models.

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