TÜRKİYE CUMHURİYET MERKEZ BANKASI

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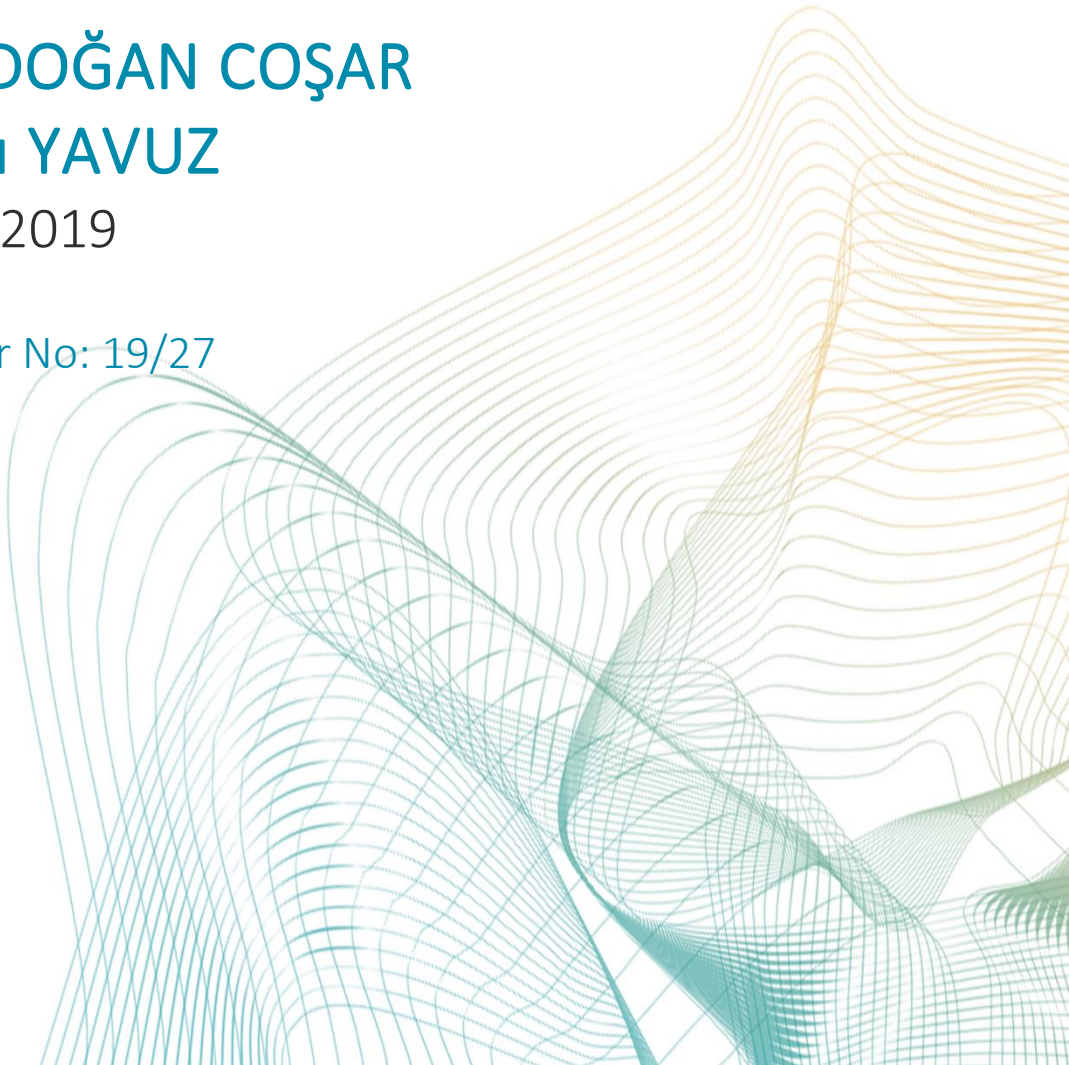

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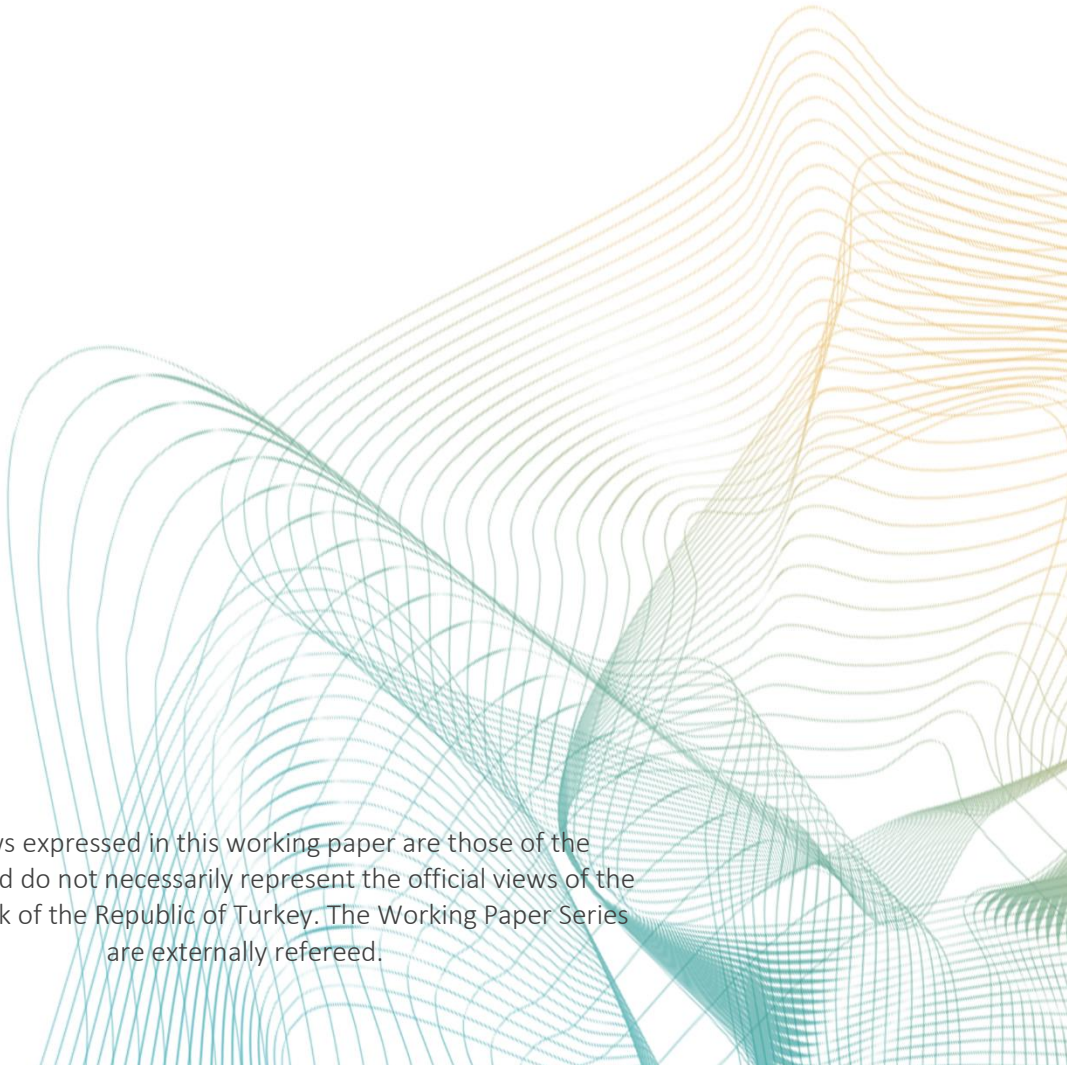

Is There Asymmetry between GDP and Labor Market Variables in Turkey under Okun's Law?

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Abstract

This study examines the long-term relationship in Turkey between Gross Domestic Product (GDP) and two labor market variables, employment and unemployment rate. Markov switching (MS) models are estimated to capture non-linear effects under Okun's law, using quarterly data for 1989 to 2018. The aim is to determine whether these labor market variables exhibit asymmetric behavior in response to GDP changes. Asymmetric effects determine the course of the recovery in GDP and employment after a crisis, so it is important to determine elasticities among these variables to implement active labor market policies. This study is novel in that we investigate the existence of these asymmetric relationships in the Turkish economy while taking into consideration the expansion and recession phases of both variables. In a MS model with two states being expansion and recession, we find asymmetric relationships between labor market variables and GDP both within and between phases. In addition, labor market variables in Turkey respond more strongly to GDP changes during recessions.

Özet

Bu çalışmada Türkiye verileri kullanılarak Gayrisafi Yurtiçi Hasıla (GSYIH) ile istihdam ve işsizlik oranından oluşan işgücü piyasası verileri arasındaki ilişki farklı bakış açıları ile incelenmiştir. 1989-2018 yıllarını kapsayan dönem için yapılan eş bütünleşme modeli sonuçları, GSYIH ile işgücü piyasası göstergeleri arasında uzun dönemli bir ilişkiye işaret etmektedir. Ayrıca, işgücü piyasası verilerinin büyümeye olan tepkisinin iş çevriminin fazlarına göre değişip değişmediği, Markov değişim modeli (Markov switching model) çerçevesinde incelenmiştir. Sonuçlar, işgücü piyasası verilerinin ekonomik büyüme ve daralmaya verdiği tepkilerin iktisadi faaliyetin genişleme ve daralma dönemlerinde farklı olduğunu göstermektedir. İşgücü piyasası verilerinin büyümeye verdiği tepkinin ekonomik daralma dönemlerinde büyüme dönemlerine kıyasla daha kuvvetli olduğu görülmektedir. Bu sonuçların işgücü piyasası göstergelerine ilişkin tahmin performansını iyileştirmesinin yanı sıra iktisadi daralma dönemlerinde daha etkili politika adımları geliştirilebilmesi bakımından önemli olduğu düşünülmektedir.

Keywords: Okun's law, markov-switching models, asymmetry, Turkey

Jel Codes: C22, E24, E32

Non-technical Summary

Unemployment and economic growth relationship is a highly debated topic in empirical analysis. With this respect, the validity of Okun's law, one of the main rule of thumbs in the economic literature, is examined for many countries. An expansion of this literature is to investigate unemployment rate and economic growth relationship under the business cycle developments. This paper aims to answer two main questions. First, is there a long-run relationship between labor market variables and growth in Turkey, and is it changing over time? Second, does this relationship exhibit asymmetrical behavior between recessions and expansions under Okun's law?

Our results show that there exists a long-run relationship between employment and GDP and the transition from short-term disequilibrium to long-term equilibrium takes almost two years. Estimation results indicate a statistically significant Okun coefficient with the expected negative sign. That is, decrease in economic growth leads to an increase in the unemployment rate. In line with the findings of similar studies, the time varying parameter estimation indicates that the employment-GDP relationship has weakened in Turkey since the 2008 global financial crises. Markov switching model estimation results show that response of labor market variables to GDP developments changes according to business cycle phases. We observe that the main effects of GDP developments occur during the recessionary phase of labor market variables (that is a decrease in employment and increase in unemployment rate). In other words, labor market variables respond more strongly to GDP in bad than good times.

1. Introduction

Throughout its history, Turkey's economy has suffered from various crises, such as exchange rate and public debt problems, which have significantly impacted Gross Domestic Product (GDP) and unemployment rates. While economic growth in Turkey tends to recover quickly after each crisis, unemployment rates generally remain relatively high (Berument, 2006; Telli et al., 2006). Besides, the percentage increase in employment due to percentage rise in GDP growth – that is, the elasticity of employment – has been rather low in Turkey since 2000 (Ercan et al., 2010). In this paper, we try to answer two main questions. First, is there a long-run relationship between labor market variables and growth in Turkey, and is it changing over time? Second, does this relationship exhibit asymmetrical behavior between recessions and expansions under Okun's law?

The seminal paper of Okun (1962) addresses the relationship between GDP and unemployment rate for the United States of America (USA). Okun's law claims that each one-percentage point reduction in unemployment is associated with a three percentage point increase in GDP, *ceteris paribus*. Okun also assumes that this relationship is reciprocal without clear direction of causality. Thus, a one-percentage point increase in output causes the unemployment rate to fall by about 0.3 percentage points. Additionally, estimations include a difference version, which relates the change in unemployment rate to GDP growth rate, and a gap version, which relates the unemployment rate gap to the output gap.

Since Okun (1962), many studies have investigated the relationship between GDP and unemployment rate, with either being considered as the left hand side variable depending on each study. Additionally, some studies adopting the production function approach have argued that the reciprocal relationship of Okun's coefficient may be biased (Plosser and Schwert, 1979; Barreto and Howland, 1993). The choice of dependent variable depends on what each study is predicting. If the intention is to predict output given the unemployment rate, then output is regressed on unemployment rate, whereas if the intention is to predict unemployment rate given the output, then unemployment rate is regressed on output. From their meta-analysis of research into Okun's law, Perman and Stephan (2015) found that about 60 percent of models had real output as the left-hand-side variable; 75 percent of estimations used country-level data; half of the studies estimated a static model. In the present study, which takes a labor economy perspective following Van Ours (2015), we prefer to adopt the gap version to examine the impact of deviations from potential output on both unemployment rate and employment.

The relationship between changes in unemployment and economic growth has been extensively studied, especially since the 2008 global financial crisis (GFC). Before then, various studies investigated whether the relationship changes over time or across countries (Gordon, 1984; Moosa, 1997; Attfield and Silverstone, 1998; Freeman, 2001; Sönger and Stiassny, 2002). Since the GFC, many studies have questioned whether Okun's law, one of the main rule of thumbs in the economic literature, is still valid because, in most countries, unemployment rates have not fallen as much as Okun law predicts despite rising GDP. Meyer and Taşçı (2012), for example, suggest that Okun's coefficient varies over time. Using bivariate meta-regression analysis, Perman and Stephan (2015) estimate Okun's coefficient as -0.25 and -0.61 when the dependent variable is the unemployment rate and output, respectively. Using a multivariate methodology, they estimate the respective coefficients as −0.40 and −1.02, which differ substantially from Okun's original work. They also argue that results may vary considerably depending on the selected periods and countries. Ball et al. (2017) find that, although Okun's law is still strong and reliable for the USA, the coefficient varies significantly across other countries.

As well as investigating whether Okun's law still holds, researchers also wish to determine whether output has a larger effect on unemployment during recessions than expansions. Early studies testing this relationship concluded that it is asymmetric over the business cycle, in that reduced output during recession phase increases unemployment more than growth during expansion phase reduces it (Neftçi, 1984; Lee, 2000; Viren, 2001; Harris and Silverstone, 2001; Cuaresma, 2003 and Silvapulle et al., 2004). Applying a Markov regime-switching (MS) model, Holmes and Silverstone (2006) show that, for the USA, Okun's coefficient is asymmetric across expansions and recessions. In the present study, we use this model to determine whether labor market variables in Turkey also respond asymmetrically to GDP changes. A similar MS model was also used by Çevik et al. (2013) to examine the non-linear relationship between unemployment and output changes for nine transition economies.[1] They concluded that the unemployment rate in transition economies displays statistically different behavior over the business cycle. Valadkhani and Smyth (2015) also applied the MS model to the USA, while allowing for asymmetries within and between phases.

Other than the threshold and MS models, rolling regression analyses show that Okun's coefficient is not stable across the business cycle, in that the relationship between output and unemployment differs during recessions and expansions. Besides, the contemporaneous relationship between output and unemployment, the stronger relationship between past output growth and current unemployment also varies in different business cycle phases (Knotek, 2007; Owyang and Sekhposyan, 2012; Cazes, 2013). Both Huang and Lin (2008), who tested Okun's law with a smooth-time-varying parameter approach, and Chinn et al. (2014), who used a non-linear smooth transition error-correction model, conclude that the fixed Okun's coefficient is not valid and it varies over time. Grant (2018) reviews various studies, including those adopting a time variation dimension of Okun's law with different techniques.

Regarding the Turkish economy, most studies conclude that there is a statistically significant long-run relationship between unemployment and economic growth (Şahin et al., 2015; Bayar, 2014). Other studies report an asymmetrical relationship in that unemployment responds more strongly to output changes during recessions than expansions (Yüceol, 2006; Ceylan and Şahin, 2010; Demirgil, 2010; Tiryaki and Özkan, 2011). Applying an MS model, Barışık et al. (2010) conclude that unemployment rate in Turkey responded asymmetrically to growth between 1988 and 2008 under Okun's law. Using two-state threshold co-integration and threshold error correction models for 1968 to 2008, Tarı and Abasız (2010) find that the impact of growth on unemployment was asymmetrical, with recessions having more impact than expansions. Using an MS model, Bayat et al. (2013) also find that Turkey's unemployment rate responded asymmetrically to growth between 1923 and 2011. Finally, Arabacı and Arabacı (2018) used a flexible non-linear inference approach to show the asymmetric effect of economic expansion and recession on cyclical unemployment in Turkey. They find that unemployment only decreases after a certain period of growth has been maintained.

In this study, we focus on the asymmetric responses of employment and unemployment rate to output fluctuations in Turkey. Our results show that there exists a long-run relationship between employment and GDP and the transition from short-term disequilibrium to long-term equilibrium takes almost two years. OLS estimation results indicate a statistically significant Okun coefficient with the expected negative sign. In line with the previous findings, the time varying parameter estimation indicates that the employment-GDP relationship has weakened since the GFC. Following Holmes and Silverstone (2006), we apply a two-state MS model to investigate the asymmetric relationship between labor market variables and GDP. As outlined above, several studies have employed MS models to investigate

[1] The countries investigated were the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Russia, the Slovak Republic and Slovenia.

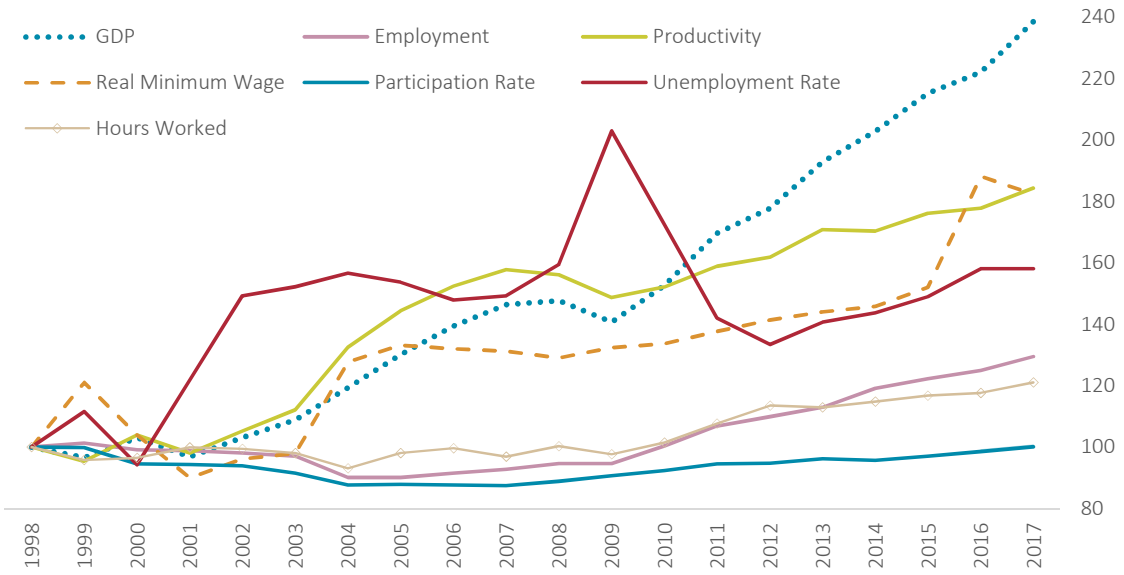
the asymmetric relationship between labor market variables and GDP in Turkey. However, to the best of our knowledge, previous studies have only considered the recession and expansion phases of GDP but not the phases of the labor market variables. We consider asymmetry both across and within phases. Our results show that there is asymmetric response to GDP changes for both across and within the business cycle phases. We observe that the main effects of GDP developments occur during the recessionary phase of labor market variables (that is a decrease in employment and increase in unemployment rate). In other words, labor market variables respond more strongly to GDP in bad than good times. We also observe slight differences in the response of labor market variables to the cyclical phases of GDP. Thus, the main contribution of this study is that it considers all types of asymmetries for the Turkish economy: both within versus between-phase asymmetries, and labor market variables versus GDP.

This paper is organized as follows. Section 2 discusses structural problems in the Turkish labor market and growth dynamics. Section 3 presents the data sources, before explaining the short-run and long-run dynamics, and asymmetric effects of the phase of the business cycle on the employment-growth relationship, and finally, same topics are presented for unemployment rate and growth relationship. Section 4 concludes.

2. Structural Problems of the Turkish Labor Market and Growth Dynamics

As well as determining whether there is an asymmetric relationship between GDP growth and labor market variables in Turkey, this study also highlights structural problems in the Turkish labor market and the growth dynamics that may cause this situation. The trends presented in Figure 1 make it clear that the growth rate of the Turkish economy is quite promising whereas unemployment rate performance is not very satisfactory. Many studies have quantified the weak relationship between Turkish employment and GDP (Şahin et al., 2015) and show how unemployment rates in different economic sectors in Turkey respond to macroeconomic policy shocks (Berument et al., 2009).

Figure 1: Relative Changes in Selected Macro Economic Variables for the Turkish Economy (1998=100)



There are five main types of drivers of the asymmetric response of employment and unemployment rate to output changes in Turkey: productivity developments (technology, transition to a non-agricultural economy, mismatches, the informal sector etc.), hours worked, growth dynamics (sectoral reallocation and growth rates, adjustment costs between expanding and contracting firms, factor substitution, uncertainty regarding growth prospects, etc.), labor force participation (LFP) decisions (female participation dynamics along with production shift to non-agricultural sectors, neither in the employment nor in the education (NEET), social aid, etc.) and labor market institutions (employment protection legislation, unemployment insurance, etc.).

Okun (1962) considers productivity changes as the lagged response of employment and working hours to demand and output fluctuations (Gordon, 2010). Labor hoarding during recessions (i.e. retaining excess labor despite falling output to avoid the firing and retraining costs of new workers) reduces overall productivity. Average working hours also decline due to labor hoarding during recessions and increase during expansions. Thus, both productivity and working hours are procyclical. Cazes et al. (2013) report that the tools that companies preferred for labor adjustment due to declining output during the GFC had very different effects. These tools were either internal adjustment mechanisms (hours worked and/or wages) or external adjustment (layoffs). More specifically, post-GFC layoffs (e.g. as in Spain) initially caused large increases in both unemployment and productivity, whereas the effect on hours worked was ambiguous. In contrast, reducing working hours in response to shrinking demand (e.g. as in Japan and Germany) reduced productivity but increased unemployment rate much less than layoffs did. As in Spain, post-GFC employment losses in Turkey accounted for most of the rise in unemployment rate for the manufacturing and motor vehicles industries (Ercan et al., 2010).

Meanwhile, the surge in productivity due to the recent dramatic technological improvements, particularly in the information and communication sectors, has acted as a positive structural productivity shock. This has caused significant cut backs on labor despite continued output expansion (Daly and Hobijn, 2010). Overall, procyclical productivity is not as evident as it was before the 2000s. Consequently, Okun's coefficient has changed fundamentally. The technological changes mean that jobs are shifting toward more skill-based white-collar work and less dependent on manual work. Another process affecting productivity in countries like Turkey is the economic transformation to a non-agricultural economy. Structural changes in technology have shifted the economic focus from agriculture to industry, and then to the service sector. This has caused changes in multifactor productivity, hours worked per worker, capital utilization and the labor force shifts. These developments mean that Okun's coefficients may need to be time varying, especially for developing and transitional countries (Çevik et al., 2013).

In Turkey, employment increased after the GFC more than working hours. However, neither has grown as much as productivity. One of the fundamental reasons is believed to be Turkey's agricultural transformation, which started during the 1960s alongside technological changes that created surplus labor (İlkkaracan and Tunalı, 2010). In 1988, with 17.8 million employment, the agricultural sector accounted for 47 percent, while services had around 32 percent, followed by manufacturing at 16 percent and construction at 6 percent. In 2018, of Turkey's total employment of 28.7 million, the shares of services and manufacturing went up to 55 and 20 percent respectively, construction remained stable at 6 percent while agriculture fell to 18 percent (Table 1). While most of Turkey's agricultural labor surplus has been absorbed by services sector employment, the urban-rural transition remains incomplete. Transition dynamics and low levels of education have made informal employment much easier. This work force composition makes it harder to translate technological advances into improved productivity (Ercan et al., 2010).

Table 1: Selected Indicators for Turkey

	Share of Informal Employment	Female LFPR	Non-Farm Female Unemployment Rate	Share of Agricultural Employment	15-24 Unemployment Rate
1990	55.6	34.2	27.5	47.0	16.0
1995	49.2	30.9	20.3	44.1	15.6
2000	50.6	26.6	13.5	34.3	13.1
2005	48.2	23.3	18.7	25.7	19.9
2010	43.3	27.6	20.2	25.1	21.7
2018	33.4	34.2	17.8	18.4	20.3

Source: TurkStat

Inefficient growth dynamics may also cause structural defects for both productivity and labor market developments. For many developing countries, trade liberalization improves growth rates (Krueger, 1998), however, it also imposes adjustment costs like reallocating factors of production from the least productive to more productive sectors. These adjustment costs are very large relative to the standard gains from trade liberalization (e.g. obsolescence of skills, training costs, increased unemployment rate, low wages, underutilized capital, technologically obsolescent machines or vacant buildings, transition costs of shifting capital to other activities). The magnitude of these adjustment costs directly reflects the speed at which the economy redirects resources in response to liberalization. They depend on many factors that determine how easily firms can expand or contract and the likelihood of expansion being accompanied by employment creation or vice versa. Thus, the flexibility of labor markets and credit markets are critical. Parallel arguments also apply when there are sudden shocks to growth such as the GFC, where reallocation of resources may be required during growth rate uncertainty and from low demand sectors affected by the crisis to others.

Considering these arguments in relation to the Turkish economy, the consensus is that Turkey's trade liberalization policy during the 1980s and financial liberalization since 1989 shifted the country away from an import-substitution industrialization strategy. This enabled the Turkish economy to grow faster. Resources were reallocated to export-oriented and more labor intensive sectors, which have favorable relative prices through real depreciations, export subsidies and low real wages (Taymaz, 1999). With the liberalization of capital accounts in 1989, Turkey tried to foster growth based on capital inflows. However, the resulting growth led by short-term capital inflows was volatile, and interrupted by two major currency crises in 1994 and 2001. Thus, the low-wage strategy seems to have been relatively successful for stimulating stable long-term growth and investment, as well as employment (Aydıner-Avşar and Onaran, 2010). It has also sharply increased the number of discouraged workers because the industrial sector has been unable to absorb the disguised unemployed in the agricultural sector.

Another important aspect of the production chain affecting Turkey's employment and growth dynamics is that imported inputs have penetrated highly technological sectors more than labor intensive ones (Saygılı et al., 2010). That is, although highly technological sectors have a lower share of total employment, small firms linked with these sectors force them to switch from domestic to imported products to adapt to their input requirements. This indirectly reduces labor demand within Turkey. Similarly, Turkey's expansion of the construction sector during the 2000s did not create employment opportunities for other sectors. This may be because of the significant penetration of intermediate imports (Şenesen et. al., 2012).

Ball et al. (2017) argue that USA unemployment rates are lower than expected from Okun's coefficient because of falling LFP levels. Data show that LFP was pro-cyclical in the USA before GFC: that is, it rises

as unemployment falls. Consequently, when unemployment is high, discouraged workers may give up looking for jobs while others may only re-enter the labor force once unemployment falls. For developed countries, the decline in LFP rates after the GFC are attributed to the following additional factors: a young workforce being more sensitive to cyclical downturns than other age groups due to relatively weak labor force attachment and low skill levels (Kwok et. al., 2010); accumulation of more discouraged workers because of the unusual depth and duration of the GFC (Erceg and Levin, 2013), rising school enrolment, increased access to social security disability benefits and decreased demand for less-skilled workers (Krueger, 2016).

LFP trends in developed and developing countries differ substantially because of structural problems in the latter, such as low female LFP and the large percentage of people who are neither in employment nor in education (NEET). As mentioned above, Turkey's transition to a non-agricultural economy has also had substantial effects on participation rates (İlkkaracan, 2012). Specifically, surplus female agricultural workers have been unable to integrate into the urban labor market due to social conservatism, or the lack of skills or educational qualifications needed for the services or industrial sectors. Uneducated or unskilled workers, mostly female, have dropped out of the labor force. In 2018, OECD countries still had a very low overall female participation rate of 34.2 percent. Having said that, after the GFC, female LFP increased, partly because of the added worker effect. Using a synthetic panel analysis for 1988-2013, Tunalı et al. (2017) forecast a jump in female LFP in Turkey, due both to later birth cohorts among less-educated women, who constitute the majority of Turkey's female workforce, and also rising education levels.

In relation to non-participation, another striking percentage for the Turkish economy concerns young NEETs. Turkey has the highest NEET rate among the OECD countries, at around 32 percent of young people aged 15–24, of whom 46 percent are young women. Using probit estimations, Suzanlı (2016) shows that higher levels of education and a greater number of household members in employment are associated with a significantly lower likelihood of being a NEET, with a stronger relationship for women. Whereas marriage is a fundamental reason for young women to become NEETs, the household's economic situation significantly determines whether young men become NEETs.

Empirical studies indicate that the impact of labor market institutions on unemployment is ambiguous and not always significant. While there is evidence that stronger employment protection legislation lowers the volatility of employment growth in some countries, cases vary. There is consensus that generous unemployment benefits increase unemployment while active labor market policies (APL) decrease it. Overall, a rigid labor market reduces labor flexibility across business cycles. Although the government took several measures for targeted groups after the GFC, Turkey still has high labor costs (Telli et al., 2006). It still has a significant skills mismatch between labor supply and demand, although Turkish Employment Agency (İŞKUR) has expanded its APL programs. Furthermore, recent unemployment insurance and employment incentive packages have had limited impacts on the labor market. The low usage of temporary contracts and high severance pay for tenured workers also make Turkey's labor market more rigid. In sum, Turkey's rigid legal regulatory framework reduces labor market flexibility. On the other hand, Duman (2014) claims that the labor market is more deregulated and flexible because of the high share of informal employment, lower trade union density and less collective bargaining coverage.

Overall, Okun's coefficient for Turkey is significantly affected by factors still influencing its economic dynamics, specifically high inactivity percentage, large share of informal employment, low human capital, the transition to a non-agricultural economy and low levels of female participation.

3. Estimation

a. Data

We investigate the relationship between labor market variables and GDP growth for Turkey using employment and unemployment rate data under the MS framework.[2] Elaborating these two series enables the consistency of our findings to be checked. We report our findings separately for employment and unemployment rate; while the first section summarize growth and employment relationship, the second section employ similar models using unemployment rate.

As discussed in the previous section, sectoral shifts from agriculture to manufacturing and services is the dominant factor influencing the labor market and growth rates in Turkey. Therefore, the agriculture sector is excluded from the macroeconomic variables (labor market and GDP) to provide a clearer analysis. The source of seasonally adjusted quarterly labor market data is TurkStat's Household Labor Force Survey while GDP data are taken from TurkStat.[3]

Figure 2: Cycles of Variables for the Turkish Economy

[2] Participation rates were also analyzed within the MS framework. However, the results were inconsistent with economic theory. More specifically, there is an inverse relationship between participation rate and GDP cycles before 2000 but no statistically significant relationship after that. The correlation coefficients also confirm this outcome. The main factor explaining this result is the transformation to a non-agricultural economy that caused very low female participation rates before 2000. The subsequent rise in female participation rates, especially after the GFC, has its own dynamics and is not affected by any change in business cycle status.

[3] Both the labor market and GDP data underwent structural changes in methodology. Labor Force Surveys were conducted semi-annually between 1988 and 1999, quarterly between 2000 and 2004, and monthly after 2005. We transformed the semi-annual data of the pre-2000 period to the quarterly data using seasonal factors. In December 2016, TurkStat changed the methodology for calculating the national accounts to ESA 2010, with the base year fixed at 2009 as suggested by Eurostat. This change is reflected in the previous year's measures with the growth rates of the previously announced GDP series.

Since our main concern in this study is asymmetries across business cycle phases, most of the analysis is performed using the cyclical component of the variables. To obtain the cyclical component given in Figure 2 and determine the peak and trough dates, we follow the OECD's system of composite leading indicators.[4]

Table 2: Mean duration of cyclical phases of variables

Mean Duration (quarters)	GDP	Employment (agriculture excluded)	Unemployment Rate (agriculture excluded)
Recession	5	7	8
Expansion	13	9	12

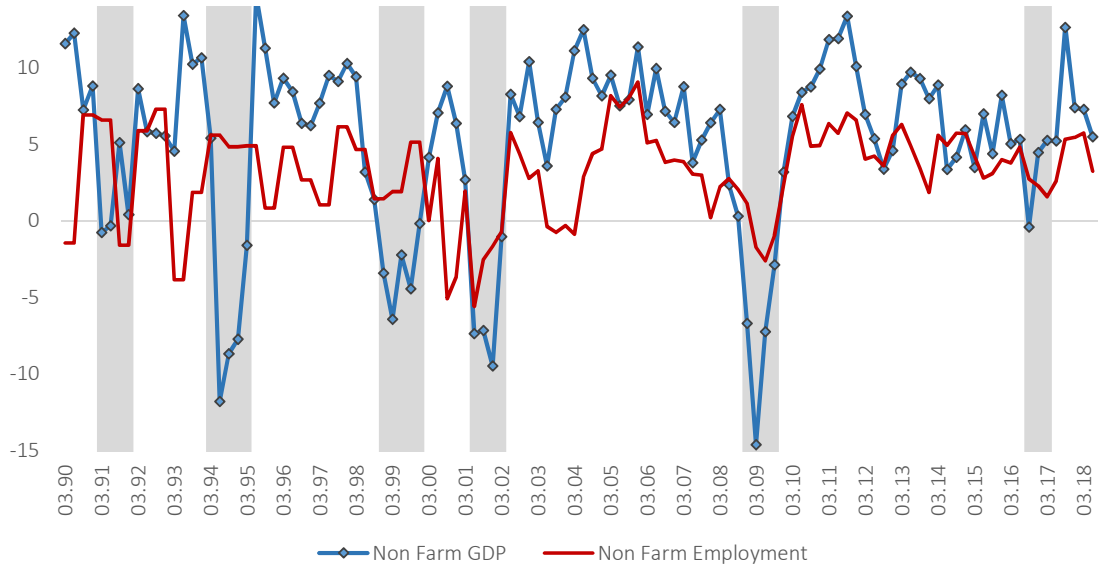
Both Figure 2 and Table 2 clearly indicate that the average duration of the business cycle phases of GDP and labor market variables are different from each other. Table 2 shows that the average duration of the GDP recession phases are shorter than those for labor market variables. In other words, it takes longer for employment and unemployment rate to switch from a recessionary to an expansionary phase. In contrast, the average duration of GDP expansionary phases last longer than those of labor market variables. These differences can be considered as a source of asymmetry.

b. Employment and Growth Relationship

i. Short-run and long-run dynamics

The questions arising from the arguments given above are whether there is a long-run relationship between employment and economic growth and how this relationship differs in the short-run for Turkey, as Figure 3 visualizes (Akçoraoğlu, 2010; Aydıner-Avşar and Onaran, 2010; Şahin et al., 2015).

Figure 3: Non-farm GDP and Employment (growth rate, %)



According to the Johansen system cointegration test given in Table 3, there is a cointegration relationship between employment and GDP. After detection of the long-run relationship, we estimate

[4] For details of the OECD system of composite leading indicators, see OECD (2012).

a short-run model (Equation 1) and an error correction term model (ECM) (Equation 2) to consider short-run and long-run dynamics:

$$\Delta_4 lemp_t = \alpha_0 + \sum_{i=0}^{2} \beta_i * \Delta_4 lgdp_{t-i} + \sum_{i=1}^{4} \gamma_i * \Delta_4 lemp_{t-i} + D_t + \varepsilon_t, \quad (1)$$

$$\Delta_4 lemp_t = \alpha_0 + \sum_{i=0}^{2} \beta_i * \Delta_4 lgdp_{t-i} + \delta * ECT_{t-1} + \sum_{i=1}^{4} \gamma_i * \Delta_4 lemp_{t-i} + D_t + \varepsilon_t \quad (2)$$

In Equation (1), $\Delta_4 lemp_t$ and $\Delta_4 lgdp_t$ are the fourth difference of logarithmic transformed employment and GDP, respectively. In Equation (2), ECT_{t-1} is the first lag of the error correction term and D_t denotes dummy variables.[5]

Table 3: Johansen cointegration test results

Number of cointegrating equations	Trace Statistics	P-value	Max-Eigen Statistics	P-value
None	22.02	0.14	17.89	0.08 *
At most one	4.13	0.72	4.13	0.72

(*) denotes statistical significance at 10 percent significance level. The model includes the intercept and linear trend.

The second and third columns of Table 4 refer to Equations (1) and (2), respectively. According to the estimation results, GDP and its first two lags are important determinants of employment in the short run. That is, employment adjusts slowly to the economic conjuncture as hiring and firing decisions may be costly, so firms may choose to follow a wait-and-see policy. In an expansionary business cycle phase, firms may only increase their work force after seeing a substantial rise in demand. Similarly, in a contractionary phase, instead of firing workers immediately, firms may prefer moderate labor hoarding or increased working hours. This wait-and-see policy creates a lagging structure in the employment and GDP growth relationship. The statistical significance of the lagged values of GDP growth in Table 4 proves the validity of this argument. The short-run coefficient for GDP growth is similar in both models. The coefficient of the error correction term implies that a 14 percent disequilibrium between short-run dynamics and the long-run equilibrium between employment and GDP growth is eliminated in each period. In other words, it takes almost two years to reach long-term equilibrium from the short-term disequilibrium.

[5] The dummy variables in Equations (1) and (2) show the 1994, 2001 and 2008 crises. The lag structure of the regressors in Equations (1) and (2) are determined according to their statistical significance. Since only the first two lags of GDP are statistically significant, higher lags are dropped from the model. Regarding Equations (1) and (2), different specifications of the dependent variable, such as first differencing and year-on-year growth rate, were tested. However, the fourth difference transformation of the variables is preferred because of better model diagnostics.

Table 4: Short-run model and ECM estimation results
Dependent variable: Employment

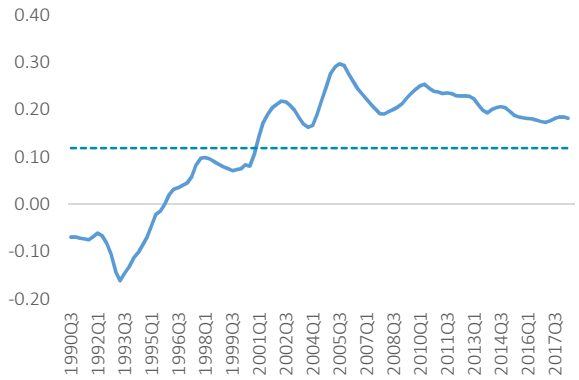
Explanatory variables	Equation (1)	Equation (2)
constant	0.02***	0.01**
	(0.00)	*(0.00)*
$\Delta_4 lgdp_t$	0.17***	0.20***
	(0.05)	*(0.06)*
$\Delta_4 lgdp_{t-1}$	-0.11**	-0.01
	(0.06)	*(0.09)*
$\Delta_4 lgdp_{t-2}$	0.08*	0.08
	(0.04)	*(0.06)*
ECT_{t-1}	-	-0.14**
		(0.05)
$\Delta_4 lemp_{t-1}$	0.71***	0.00
	(0.06)	*(0.10)*
$\Delta_4 lemp_{t-2}$	-0.28***	-0.08
	(0.08)	*(0.12)*
$\Delta_4 lemp_{t-3}$	0.17**	0.10*
	(0.06)	*(0.06)*
$\Delta_4 lemp_{t-4}$	-0.28***	-0.28**
	(0.05)	*(0.11)*
Adj. R-square	0.69	0.44

Note: According to the Breusch-Godfrey serial correlation LM test, there is no serial correlation in the residuals up to lag order 12. The ARCH LM test indicates that there is no autoregressive conditional heteroscedasticity in the residuals. According to the White Heteroscedasticity test, the null hypothesis of no heteroscedasticity in the residuals is accepted up to lag order 12. And the Jarque-Bera test indicates normal residuals. (*), (**) and (***) denote statistical significance at 10, 5 and 1 percent, respectively. The lags of the variables are selected according to their statistical and economic significance, and the model diagnostics.

To evaluate the changing dynamics of the employment-GDP growth relationship, we estimate the short run model in Equation (1) without the lags of employment, in a time varying fashion. Figure 4 presents the coefficient estimate of GDP using a time varying parameter (TVP) model.[6] The parameter estimates show a decreasing trend until the 1994 economic crisis. They then increase up to 2006 before slightly falling again.

[6] To facilitate interpretation, Figure 4 presents only the coefficient estimates for GDP while disregarding its lags. We estimate the TVP model using the Kalman Filter. We would like to thank Fethi Öğünç for sharing his code.

Figure 4: TVP parameter estimates (Employment and GDP)



One reason for the recent decline in the growth and employment relationship in Turkey may be the extensive methodological revision to the GDP data. At the end of 2016, TURKSTAT published a comprehensive update on the national income in which it changed the base year from 1998 to 2009. The main change in national income calculations was to use firm-based administrative records. The newly updated data significantly increased the national income level and average growth rate during 2012-2015, leading to a weaker outlook in the employment-growth relationship compared to previous periods.

ii. Asymmetric effects on the phase of business cycle (MS Model)

The asymmetric relationship between employment and GDP growth entails that absolute increases and decreases in output growth lead to different responses in employment growth. To investigate this asymmetry, we estimate a two-state MS model to find state-dependent growth elasticities.

Following Holmes and Silverstone (2006), we estimate a MS model that includes both the expansionary and recessionary phases of GDP and employment. In the two-state MS model, a random variable S_t, which takes values of 0 and 1, shows the state of the economy at time t. In this study, it is assumed that 0 and 1 denote expansionary and recessionary phases, respectively. The estimated model is as follows:

$$E(emp_t^c|S_t) = [(1-S_t)\mu_0 + S_t\mu_1] + (1-S_t)\beta_0^+ gdp_t^{c+} + (1-S_t)\beta_0^- gdp_t^{c-} + S_t\beta_1^+ gdp_t^{c+} +$$

$$S_t\beta_1^- gdp_t^{c-} + (1-S_t)\sum_{i=1}^{l}\delta_i\, emp_{t-i}^c + S_t\sum_{i=1}^{l}\alpha_i\, emp_{t-i}^c + \varepsilon_t, \qquad (3)$$

where $\varepsilon_t \sim i.i.d.N.(0,\sigma_\varepsilon^2)$ and the unobserved indicator variable S_t evolves according to the following first order MS process:[7]

$$P(S_t = 0|S_{t-1} = 0) = p$$

$$P(S_t = 1|S_{t-1} = 0) = 1-p$$

$$P(S_t = 1|S_{t-1} = 1) = q$$

$$P(S_t = 0|S_{t-1} = 1) = 1-q$$

$$0 < p, q < 1$$

[7] For the model, see Hamilton (1989).

where p and q are the fixed transition probabilities of being in state 0 or 1, respectively. In Equation (3), emp_t^c denotes the cyclical component of logarithmic transformed employment; μ indicates the state-dependent constant term; gdp_t^{c+} and gdp_t^{c-} represent expansionary and recessionary phases of the cyclical component of logarithmic transformed GDP, respectively.[8] Thus, in contrast to a conventional two-state MS model, Holmes and Silverstone (2006) also consider the cyclical phase of the independent variable, namely GDP.

Table 5: Interpretation of coefficients

	Expansion in GDP gdp_t^{c+}	Recession in GDP gdp_t^{c-}
State 0: Expansionary phase Employment is in expansionary phase	β_0^+	β_0^-
State 1: Recessionary phase Employment is in recessionary phase	β_1^+	β_1^-

The coefficients β_0^+, β_0^-, β_1^+ and β_1^- show the elasticity of employment to GDP in different phases. A priori, they are expected to take a positive value. Table 5 clarifies the interpretation of the coefficients. Since employment is the dependent variable, phases denote the expansionary and recessionary phases of the employment cycle. In the table, β_0^+ and β_1^+ represent the response of employment to the expansionary phase of GDP while β_0^- and β_1^- denote the response of employment to recessionary phase of GDP, respectively.

Table 6: MS model estimation results
Dependent variable: Employment

State 0 = Expansionary phase (increase in employment)				
Explanatory variables	Coefficient	Estimate	Std. Error	Z-stat.
constant	μ_0	0.00	0.00	-0.70
gdp_t^{c+}	β_0^+	0.05	0.06	0.79
gdp_t^{c-}	β_0^-	0.02	0.07	0.27
emp_{t-1}^c	δ_0	0.85	0.07	11.44***

State 1 = Recessionary phase (decrease in employment)				
Explanatory variables	Coefficient	Estimate	Std. Error	Z-stat.
constant	μ_1	0.00	0.00	0.01
gdp_t^{c+}	β_1^+	0.47	0.12	3.84***
gdp_t^{c-}	β_1^-	0.37	0.09	3.98***
emp_{t-1}^c	α_1	-0.13	0.13	-0.96

Notes: The residual diagnostics related with autocorrelation and normality are passed.
(***) denote statistical significance at 1 percent.

[8] As is obvious from Table 4, as well as the contemporaneous value of GDP, its first two legs are also significant in the employment-GDP relationship. However, including two many lags in Equation (3) precludes the calculation of the log-likelihood function. Therefore, a moving average transformation is applied to gdp_t^{c+} and gdp_t^{c-} and used in Equation (3).

As can be seen from Table 6, there is a positive relationship between employment and GDP, as expected.[9] However, the link between employment and output also weakens in the expansion phase, when there is no statistically significant relationship. That is, if employment is in an expansionary phase, cyclical changes in GDP are not very decisive. Conversely, the recessionary phases of employment are strongly affected by the business cycle. In short, the recessionary phases of employment are much more responsive than the expansionary phases.[10]

Table 7: Parameter tests for within and between state asymmetries

Null and alternative hypotheses	Type of asymmetry	Wald test F(1,102)
$H_0^1: \beta_0^+ = \beta_0^-$ $H_A^1: \beta_0^+ \neq \beta_0^-$	within	0.54
$H_0^2: \beta_1^+ = \beta_1^-$ $H_A^2: \beta_1^+ \neq \beta_1^-$	within	0.37
$H_0^3: \beta_0^+ = \beta_1^+$ $H_A^3: \beta_0^+ \neq \beta_1^+$	between	12.10***
$H_0^4: \beta_0^- = \beta_1^-$ $H_A^4: \beta_0^- \neq \beta_1^-$	between	7.88**

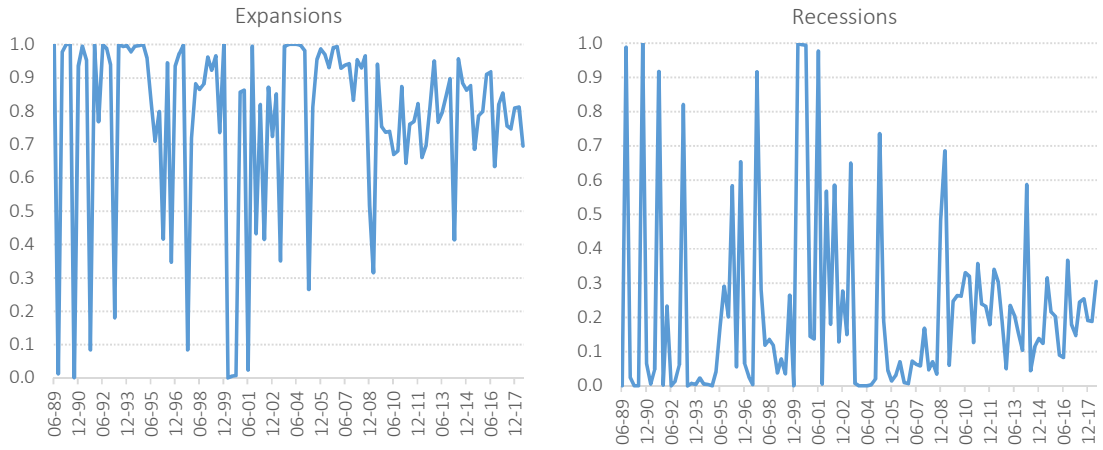
(**) and (***) denote statistical significance at 5 and 1 percent, respectively.

We conduct Wald coefficient equality tests to analyze the asymmetry within and between the expansionary and recessionary phases. These are given in Table 7. The first two hypotheses argue no asymmetry between the expansionary and recessionary phases of GDP in states 0 and 1, respectively. Since the null hypotheses could not be rejected, we can say that the effects of expansionary and recessionary phases of GDP on employment are not statistically different from each other in every state. In other words, the response of employment to the expansionary and recessionary phases of GDP is the same in both state 0 and in state 1. Regarding the third and fourth hypotheses, there is evidence of asymmetry between the states. Similarly, the effect of expansionary phase of GDP in state 0 is statistically different from the effect of expansionary phase of GDP in state 1. The same is true for the recessionary phase of GDP. These results can also be seen in Table 6, which shows that the expansionary and recessionary phases of GDP only have significant effects in the recessionary phase of employment.

[9] In the MS model, we estimate two models with different state probability regressors. In the first model, the unconditional state probabilities are assumed to be time invariant whereas, in the second model, the first lag of the GDP cycle is used as a probability regressor. That is, we allow for time-varying transition probabilities determined using the first lag of cycle of GDP. The coefficient estimates do not differ significantly between these models. Besides, the log-likelihood test favors the use of time-invariant probabilities. We therefore report estimates based on time-invariant probabilities in Table 6.

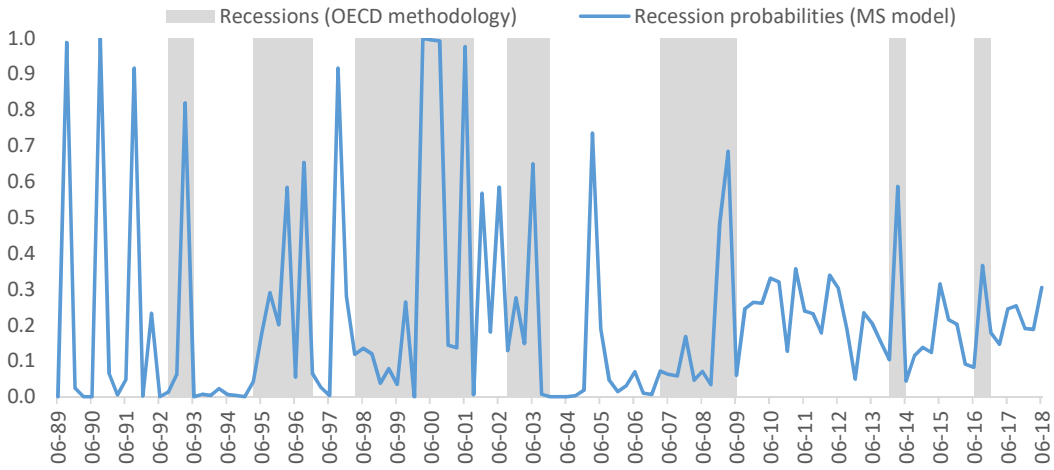
[10] As a robustness check, we estimated the MS model only considering the expansionary and recessionary phases of employment. That is, the independent variable in the model is the cyclical component of GDP, gdp_t^c, alone not the expansionary and recessionary phases separately. The estimation results show that the business cycle (cyclical component of GDP) is statistically significant in the recessionary phases of employment but not in the expansionary one.

Figure 5: MS smoothed state probabilities (Employment and GDP)



In this study, we assume that states follow each other uninterruptedly. That is, state 1 begins at the end of state 0. The smoothed probabilities given in Figure 5 show the calculated expansion and recession state probabilities for the employment cycle. As Figure 5 shows, expansions occur more often with an unconditional probability of 77 percent. In contrast, recessions are observed rarely as expected, with an unconditional probability of 23 percent. The average duration of the expansion state is longer than the recession one.

Figure 6: Recession probabilities of employment

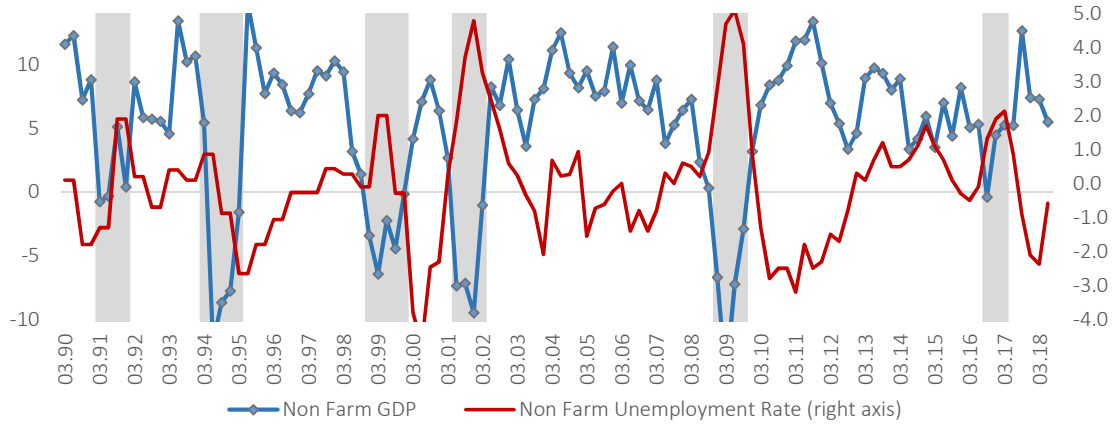


The shaded areas in Figure 6 show the recession phases of the employment cycle obtained by following the OECD system of composite leading indicators. The blue line shows the recession probabilities obtained from the MS model. The figure clearly indicates that the recession probabilities obtained from the MS model successfully identify most of the actual recession phases.

c. Unemployment Rate and Growth Relationship

Complimentary to the previous section, we repeat the same analysis using the non-farm unemployment rate, as shown in Figure 7. Under Okun's law, unemployment rate dynamics include participation dynamics, which is one of the important factors for Turkey's labor market structure, as highlighted in the second section (Tatoğlu, 2011).

Figure 7: Non-farm GDP (growth rate, %) and unemployment rate (Y-o-Y difference)



i. Short-run dynamics

There are several approaches for estimating Okun's coefficient. Although Okun's law was originally expressed in differences, some studies use a gap version of the variables. We estimate Okun's law in both the gap versions of the series and growth rates. Since the unemployment rate is stationary, we focus on short-term dynamics to estimate the following equation:

$$\Delta_4 unemp_t = \alpha_0 + \sum_{i=0}^{2} \beta_i * \Delta_4 lgdp_{t-i} + \sum_{i=1}^{4} \gamma_i * \Delta_4 unemp_{t-i} + D_t + \varepsilon_t \quad (4)$$

where $\Delta_4 unemp_t$ is the fourth difference of the unemployment rate and $\Delta_4 lgdp_t$ is the fourth difference of the logarithmic transformed GDP data.

Table 8: Okun's law estimation results using linear models

Transformation: gap of the series		Transformation: log fourth difference of the series	
Explanatory variables	Coefficient estimate	Explanatory variables	Coefficient estimate
constant	-0.02 *(0.04)*	constant	0.18 *(0.13)*
gdp_t^c	-0.08*** *(0.02)*	$\Delta_4 lgdp_t$	-0.09*** *(0.02)*
gdp_{t-1}^c	0.07** *(0.03)*	$\Delta_4 lgdp_{t-1}$	0.07** *(0.03)*
gdp_{t-2}^c	-0.03 *(0.03)*	$\Delta_4 lgdp_{t-2}$	-0.03 *(0.02)*
$unemp_{t-1}^c$	0.99*** *(0.07)*	$\Delta_4 unemp_{t-1}$	0.87*** *(0.09)*
$unemp_{t-2}^c$	-0.03 *(0.10)*	$\Delta_4 unemp_{t-2}$	0.04 *(0.12)*
$unemp_{t-3}^c$	-0.16 *(0.10)*	$\Delta_4 unemp_{t-3}$	-0.19 *(0.12)*
$unemp_{t-4}^c$	-0.11* *(0.06)*	$\Delta_4 unemp_{t-4}$	-0.14 *(0.09)*
Adj. R-square	0.84	Adj. R-square	0.78

Note: According to the Breusch-Godfrey serial correlation LM test, there is no serial correlation in the residuals up to lag order 12. The ARCH LM test indicates that there is no autoregressive conditional heteroscedasticity in the residuals. According to the White Heteroscedasticity test, the null hypothesis of no heteroscedasticity in the residuals is accepted up to lag order 12. The Jarque-Bera test indicates normal residuals. (*), (**) and (***) denote statistical significance at 10, 5 and 1 percent, respectively. The lags of the variables are selected according to their statistical and economic significance, and the model diagnostics.

Table 8 presents the OLS estimation results of Okun's law. The results indicate that, irrespective of the transformation methodology, Okun's coefficient is statistically significant with the expected negative sign. The linear model estimation results show that statistically significant GDP coefficients sum to about -0.02. There are slight differences in the parameter estimates between Tables 8 and 4. Overall, the unemployment rate has a weaker relationship with GDP than employment. This may be because, in addition to employment developments, unemployment rate is also affected by changes in LFP. LFP can be considered a structural variable because it is affected by many economic variables like demographic developments, institutional settings, pension schemes, etc. (see Duval et al., 2011). None of these variables are expected to change significantly in the short term. Because of this, LFP and hence the unemployment rate may be less responsive to GDP in the short term.

ii. Asymmetric effects on the phase of the business cycle (MS Model)

To estimate state dependent Okun's coefficients we estimate the following MS model:

$$E(unemp_t^c|S_t) = [(1-S_t)\mu_0 + S_t\mu_1] + (1-S_t)\beta_0^+ gdp_t^{c+} + (1-S_t)\beta_0^- gdp_t^{c-} + S_t\beta_1^+ gdp_t^{c+} +$$

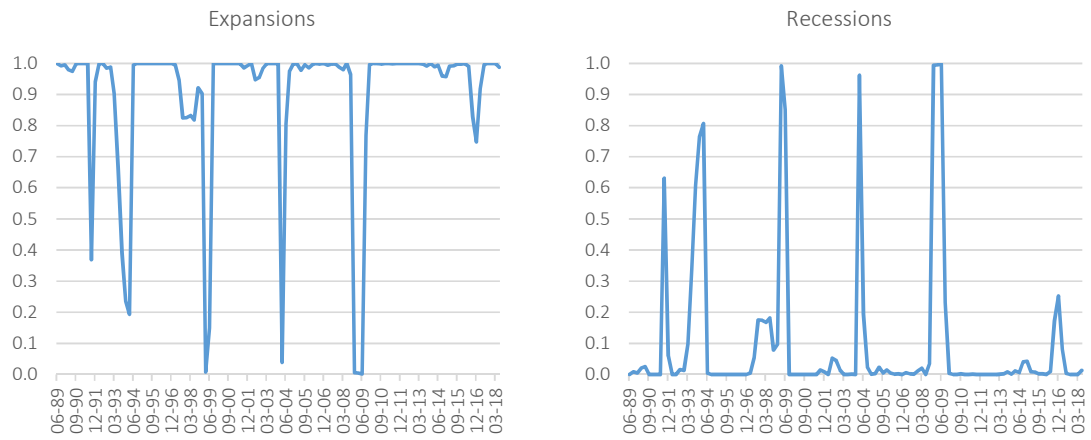
$$S_t\beta_1^- gdp_t^{c-} + (1-S_t)\sum_{i=1}^{l}\delta_i\, unemp_{t-i}^c + S_t\sum_{i=1}^{l}\alpha_i\, unemp_{t-i}^c + \varepsilon_t. \quad (5)$$

The details of the model are similar to those given in Equation (3).[11] Figure 8 presents the smoothed expansion and recession probabilities for unemployment. Expansions occur frequently, with an

[11] As in the model given in Equation (3), the moving average transformation is applied to gdp_t^{c+} and gdp_t^{c-}. This form is used in Equation (5).

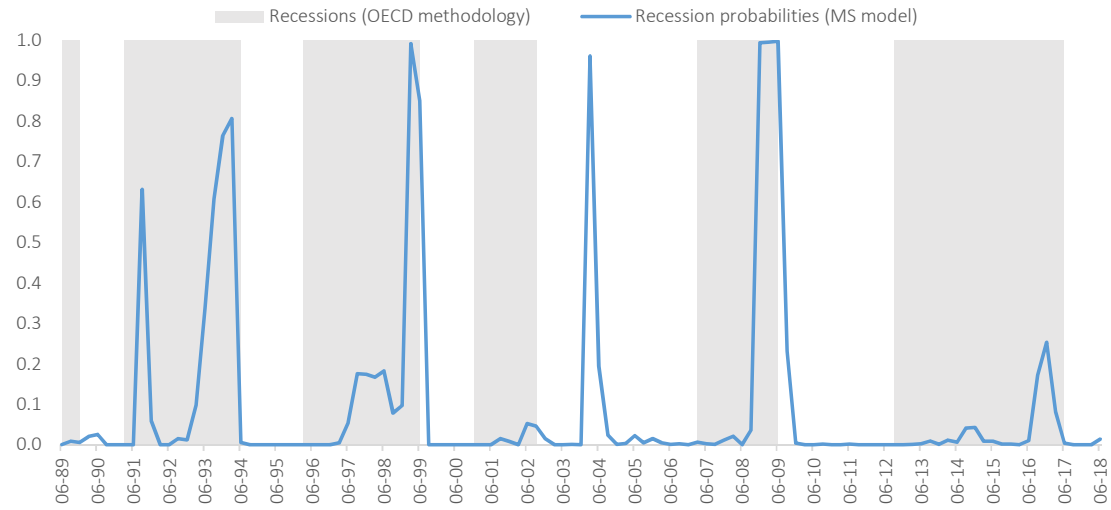
unconditional probability of 90 percent whereas recessions are observed more rarely, as expected, with an unconditional probability of 10 percent. The average duration of expansions is higher than the average duration of recessions.

Figure 8: MS smoothed state probabilities (Unemployment rate and GDP)



The shaded areas in Figure 9 show the recession phases of the unemployment cycle obtained following the OECD system of composite leading indicators. The line shows the recession probabilities from the MS model. The graph clearly shows that the recession probabilities from the MS model successfully identify most of the actual recession phases. The average durations of the expansion phases are longer than those of the recession phases.[12]

Figure 9: Recession probabilities of unemployment rate



The MS model estimation results given in Table 9 reveal an asymmetric relationship between the unemployment rate and GDP that depends on the state of the business cycle. Similar to the MS estimation results reported in the previous section for the employment, the relationship between the unemployment rate and GDP growth weakens during expansion phases. During the expansionary

[12] The estimated durations of states obtained from the MS model are approximately two quarters for recession and twenty quarters for expansion.

state of unemployment rate, only the recessionary phase of the GDP cycle (β_0^-) is significant, with a coefficient similar to that using the OLS model. In other words, in state 0, the unemployment rate does not respond to an expansion in GDP. Instead, as expected, it responds to a deceleration in GDP by rising. On the other hand, recessionary state of unemployment rate (which denotes an increase in unemployment rate) both the expansionary and recessionary phases of GDP have a statistically significant relationship to it. The estimated Okun's coefficient for the recessionary phase is in interval [-0.11;-0.22] and larger than the linearly estimated Okun's coefficient in absolute terms. This clearly shows the asymmetry in the sense that the unemployment rate is more responsive to GDP during recessions than expansions.

Table 9: MS model estimation results
Dependent variable: Cycle of unemployment rate

State 0 = Expansionary phase (decrease in unemployment rate)

Variable	Coefficient	Estimate	Std. error	Z-stat.
constant	μ_0	-0.15	0.06	-2.50**
gdp_t^{c+}	β_0^+	-0.01	0.03	-0.59
gdp_t^{c-}	β_0^-	-0.08	0.03	-2.74**
emp_{t-1}^c	δ_0	0.76	0.06	13.67***

State 1 = Recessionary phase (increase in unemployment rate)

Variable	Coefficient	Estimate	Std. error	Z-stat.
constant	μ_1	1.16	0.26	4.43***
gdp_t^{c+}	β_1^+	-0.22	0.09	-2.50**
gdp_t^{c-}	β_1^-	-0.11	0.05	-2.45**
emp_{t-1}^c	α_1	0.40	0.24	1.69*

Notes: The residual diagnostics related with autocorrelation and normality are passed. (*), (**) and (***) denote statistical significance at 10, 5 and 1 percent, respectively.

Another interesting point is that in state 1, the coefficient of the expansionary phase of GDP is greater than its recessionary equivalent in absolute terms. That means that when unemployment rate is rising, it reacts more strongly to increases than decreases in GDP. To summarize, when the unemployment rate is not rising, it is unaffected by the expansion phase of the economy, but it does start to rise during the contraction phase. On the other hand, when unemployment rate is rising, it responds both to the expansionary and recessionary phases of GDP, with the former having a larger effect in absolute terms.

Table 10: Okun's coefficient parameter tests for within and between state asymmetries

Null and alternative hypotheses	Type of asymmetry	Wald test F(1,102)
$H_0^1: \beta_0^+ = \beta_0^-$ $H_A^1: \beta_0^+ \neq \beta_0^-$	within	1.25
$H_0^2: \beta_1^+ = \beta_1^-$ $H_A^2: \beta_1^+ \neq \beta_1^-$	within	2.87*
$H_0^3: \beta_0^+ = \beta_1^+$ $H_A^3: \beta_0^+ \neq \beta_1^+$	between	5.02**
$H_0^4: \beta_0^- = \beta_1^-$ $H_A^4: \beta_0^- \neq \beta_1^-$	between	0.32

(*) and (**) denote statistical significance at 10 and 5 percent, respectively.

The Wald coefficient test results presented in Table 10 support these findings in that both the within and between-state asymmetries are significant. The rejection of the second hypothesis implies that the unemployment rate responds significantly differently to the expansionary and recessionary phases of GDP in state 1. The rejection of the third hypothesis signals asymmetry between the states in that the unemployment rate responds differently to the expansionary phase of GDP in states 0 and 1.

4. Conclusion

Okun's law is one of the fundamental rule of thumbs in the economic literature. However, recent studies suggest that the relationships between employment, unemployment and GDP have changed over time and differ between the expansion and recession phases. The results of this study provide statistically significant empirical evidence that both employment and unemployment rate are more responsive to negative economic growth shocks in Turkey. For this analysis, we use quarterly data for labor market variables and GDP for 1989 to 2018 and apply MS models. This study makes several contributions. Taking this asymmetric behavior into consideration can improve forecasting of Turkey's unemployment rate and enable to build more efficient economic policies. Finally, our study indicates that ignoring these asymmetries may result in misinterpretation of the long-term relationship between employment and GDP in Turkey. However, while the theoretical case for asymmetry is quite solid, explaining the structural problems that might cause this in Turkey is beyond the scope of this paper.

Future research could focus on sources of upward trends in unemployment rate across labor force groups. Determining the cyclical asymmetry of unemployment rate among young, female or low-educated workers may be crucial for understanding the overall dynamics of the Turkish labor market. Besides, it is important to determine the asymmetric effects of sub-groups, especially after economic crises, to implement effective active labor market policies.

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