Reconciliation of Economic Growth and Unemployment: Turkish Economy After 2001 Economic Crisis

by

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This is to certify that I have examined this copy of a master's thesis by

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and have found that it is complete and satisfactory in all respects,
and that any and all revisions required by the final
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To my parents

ABSTRACT

This paper considers the reasons for high unemployment rates in Turkey after the economic crisis in 2001 despite rapid GDP growth. After examining recent papers over the facts about unemployment and economic growth in the Turkish economy, it uses a Solow growth model with matching technology to analyze the problem. It is shown that higher growth rates in Total Factor Productivity (TFP) can produce a higher unemployment rate at the steady state for the Turkish economy. The transitional dynamics for unemployment rate and capital stock are also simulated. Finally, the consequences of a reduction in the payroll tax rate, which has been recently proposed by the government to decrease the unemployment rate, are analyzed.

Keywords: Economic growth, unemployment, Solow growth model, matching models

ÖZET

Bu makale, Türkiye'de 2001 yılındaki ekonomik kriz sonrası dönemde hızlı GSYİH büyümesine rağmen gerçekleşen yüksek işsizlik oranlarının nedenlerini ele almaktadır. Türkiye ekonomisindeki işsizlik ve ekonomik büyüme ile ilgili nitelikler üzerine yakın zamanda yazılmış makaleler incelendikten sonra, problemi analiz etmek için, eşleştirme teknolojisi içeren bir Solow büyüme modeli kullanılmıştır. Toplam Faktör Verimliliğindeki (TFP) daha hızlı bir büyümenin, denge durumunda daha yüksek bir işsizlik oranını oluşturabileceği Türkiye ekonomisi için gösterilmiştir. İşsizlik oranı ve sermaye stoğu için geçiş dönemi dinamiklerinin simülasyonu da yapılmıştır. Son olarak, işsizlik oranını azaltmaya yönelik hükümet tarafından yakın zamanda arz edilen sosyal sigorta işveren payındaki bir azaltmanın sonuçları analiz edilmiştir.

Anahtar Kelimeler: Ekonomik büyüme, işsizlik, Solow büyüme modeli, eşleştirme modelleri

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Chapter 1

INTRODUCTION

As Zagler (2000) mentions in his article, Okun's Law asserts that a three percent increase in the growth of output will lead to a one percent decline in the unemployment rate. Yet we observe that this long run relationship is violated in the short run, especially for developing countries. This violation is also available in the Turkish data after the economic crisis in 2001. The counter-intuitive result of this crisis is that the unemployment rate has risen while the economy has been growing at high rates during the period from 2001 to the present. Another important point is that the relationship is no longer a short run relationship, because the relationship is still observed in the data although a considerable amount of time has passed to claim that there is a long-run relationship.

In this paper, I explain the economic rationale behind this paradoxical observation by making use of a Solow growth model with matching technology. The problem at hand is important not only because it challenges one of the generally accepted laws in the economics literature, but also because explaining this particular economic event will help policy makers implement certain economic policies. When policy makers fully understand the problem and carefully examine the process, they will be able to efficiently govern the labor markets and more accurately predict the consequences of the changes in the policy instruments.

The organization of the paper is as follows. In the next chapter, I provide a careful examination of the effects of the structural changes in Turkey after the 2001 economic crisis by emphasizing the effects of European Union (EU) integration on the Turkish economy. In particular, it states the facts and objectives about the growth of economy and unemployment. A comparison of the labor markets before and after the crisis is also present in this chapter. In chapter 3, I discuss the matching models and briefly describe the model based on Erikkson (1997). In chapter 4, the model is simulated to calculate equilibrium unemployment rate after increasing the growth rate of total factor productivity (TFP). Then, transitional dynamics of unemployment and capital stock are discussed. A policy experiment is also conducted in this chapter. Chapter 5 concludes and asks further research questions.

Chapter 2

THE FACTS AND OBJECTIVES ABOUT GROWTH AND UNEMPLOYMENT

In analyzing the main question of this paper, it is crucial to consider the structural changes in Turkish economy due to increased interaction between EU and Turkey in recent years. As Tunalı *et al* (2003) points out, after the 2001 crisis, the general elections in 2002 resulted in a one-party government in the Parliament, which had been governed by coalitions for a long time. This political stability enhanced economic stability, and the overall stability caused the interaction between Turkey and the EU to accelerate. The consequences of this progress in EU integration are discussed by several researchers. Their findings are presented in this section under two subsections: Economic Growth and Unemployment.

2.1 Economic Growth in Turkey

Togan and Ersel (2005) broadly investigate the structural changes due to EU integration. Among many other economic issues, GDP growth is of their chief concern. Over the period 1950-99, the growth rate of GDP was 3.6 on average for the Turkish economy. The corresponding rates for the recent years are presented in Table 2.1. Notice that the growth rate

Years	Annual GDP Growth Rate (in %)	Years	Annual GDP Growth Rate (in %)
2000	7.36	2004	8.93
2001	-7.50	2005	7.38
2002	7.94	2006	6.10
2003	5.79	2007	4.45

Table 2.1: Annual GDP Growth in Turkey for the period between 2000-2007. Source: Turkish Republic Central Bank (TCMB) web page: `www.tcmb.gov.tr`

for 2001 plummets, but after that we observe that GDP growth rates are well above the average of past 50 years. They emphasize both the growth of productivity and the growth of employment for the growth rate of GDP. The growth of productivity can be analyzed in three categories: capital deepening, improvements in labor quality and total factor productivity (TFP). As far as the model of this paper is concerned, improvement in the total factor productivity is more important than the others because I will regard it as the source of economic growth in the long run equilibrium. This point will be clearer when I begin to discuss the model in the subsequent chapters. So, I will have a closer look at the change in the TFP.

Altuğ *et al* (2007) examine the long run TFP growth in Turkish economy. Although their analysis is much deeper than the purposes of this paper, their main findings can be summarized as follows. They define TFP as the difference between the growth of output and inputs that represents various types of increases in the productivity of factors including technological and organizational change. This will also be the same definition that I will attribute to technological progress in the model of this paper. They calculate the change in this number for different periods of Turkish economy. According to their results, contribution of total factor productivity to the output growth is increasing throughout time and it is most influential after 1980s. For these years, TFP growth rises above 1.5% for the first time. Their results are also comparable with those of Saygılı *et al* (2005). For the period between 1980 and 2000, Saygılı *et al* (2005) calculate this number as 0.44%. I will report their findings in detail when I analyze the model of this paper for the Turkish economy.

2.2 Unemployment in Turkey

A close examination of Turkish labor market is provided by Tunalı *et al* (2003). In this comprehensive study, they provide analysis about every aspect of labor markets such as employment, labor force participation, labor market institution and so on. Among those topics, I will examine unemployment closely.

Unemployment rates for Turkey from 1988 to 2006 can be seen in Table 2.2. As Tunalı *et al* (2003) argue, there had been several economic crisis in the past twenty years and the eco-

Years	Unemployment Rate (in %)	Years	Unemployment Rate (in %)
1988	8.4	1998	6.9
1989	8.6	1999	7.2
1990	8.0	2000	6.5
1991	8.2	2001	8.4
1992	8.5	2002	10.3
1993	8.9	2003	10.5
1994	8.5	2004	10.3
1995	7.6	2005	10.3
1996	6.6	2006	9.9
1997	6.8	2007	9.9

Table 2.2: Annual Unemployment Rates in Turkey for the period between 1988-2007. Source: Turkish Statistical Institute (TÜİK) web page: `www.tuik.gov.tr`

nomic crisis in 2001 was the severest one since 1950s. When we look at the quarterly data, we observe that unemployment rate generally oscillates around 10.3%. For some quarters it was even well above 12%. Tunalı *et al* (2003) also reports that the number of unemployed people exceeded 2.8 million at the beginning of 2003. Moreover, this crisis affected almost every sector of the economy with public sector taking the lead. It is possible to extend the analysis to include the effects of the crisis on different groups in the population. This analysis is actually performed by Tunalı *et al* (2003). However, I will not report them here because I will not distinguish among households in my model.

Another examination is provided by Taymaz and Özler (2005). They examine the current labor market flexibility of Turkish economy after new Labor Law No: 4857 was enacted in 2003 by comparing it with the previous one. They also compare it with other countries. EPL indices, which assign a score of 0-5 to each indicator determined by regular and temporary employment contracts, show that Turkey had a more stringent labor market, but it has relaxed its labor market structure substantially after the confirmation of the new law on labor markets that is in line with the EU integration. Because the new law mainly regulates the flaws in the previous law concerning short term issues for employers, Taymaz and Özler (2005) argue that it is possible for firms to hire unproductive workers. This may lead to an increase in the short run unemployment. The structure of unemployment will also change by increasing flows from and to unemployment.

These changes in the new labor law are qualitative and they mostly aim at improving and clarifying the definitions that constitute basis for the wage contracts. Therefore, it is hard to incorporate them into the model of this paper. As a quantitative analysis, however, I will calculate the effects of a reduction in the payroll tax rate on unemployment in chapter 4.

Chapter 3

MATCHING MODELS AND EQUILIBRIUM UNEMPLOYMENT THEORY

3.1 A Comparison of Matching Models With Other Traditional Models

Modeling economic growth with unemployment is a very hard task. Zagler (2000) clearly identifies the difficulty of the problem in his article. In exogenous growth models, such as Solow's (1956) growth model, the unemployment is exogenously given. In the steady state, the level of unemployment is independent of capital per worker. Any change in the unemployment rate will not affect the growth rate of output. The endogenous growth models, on the other hand, can generate a structural relationship between the growth and the unemployment rate. Yet the relationship in these models is consistent with Okun's law and cannot explain the Turkish crisis in 2001.

Since Mortensen and Pissarides (1994) published their seminal paper, matching models has become very popular in economics literature especially in explaining unemployment related issues in equilibrium. The central idea of these type of models is that finding a job or employing a worker is an uncoordinated, time-consuming and costly activity for both workers and firms in the labor market. The modeling device is the matching function that gives the number of jobs formed at any moment in time as a function of the unemployed workers and vacancies. It is a useful device, because it summarizes the trading technology in the labor market between firms and workers, like other macroeconomic tools such as production function that summarizes the relationship between physical capital and labor. Both of them achieve this without the need to state explicitly the heterogeneity among workers or firms.

Before going on describing the matching technology, I want to clarify the distinction between matching models and Walrasian and traditional Keynesian models. In an environment where the transition into or out of unemployment is *not* a trading process, it is possible to ignore unemployed workers that are between jobs and compose unemployment as cyclical, frictional, voluntary and involuntary. Pissarides (2000) asserts that this view, summarized in Keynes' famous statement, is misleading because unemployed workers, with the exception of some discouraged workers, are always between jobs or between some other state and a job. With this in mind, matching models can be viewed as models that perceive agents as rational in job creation and job destruction. The rational behavior of agents in the presence of aggregate constraints determines the unemployment rate.

In the next section, a brief description of the model of this paper is presented. The complete model and its implications can be found in Pissarides (2000). The summary of the model will still be helpful for the reader to follow the discussion of the present paper. I want to warn the reader before proceeding. Remember that I have previously mentioned the paper by Mortensen and Pissarides (1994) in which both job creation and job destruction are endogenous. However, capital decision of the firms is also considered in this paper and to avoid complexity the job destruction is assumed to be exogenous.

3.2 The Matching Technology and Finding Equilibrium

A firm may have some jobs filled and some others are vacant. Filled jobs continue production until an exogenous technological shock arrives. Only vacant jobs involve in matching process. Similarly, only unemployed workers are allowed to search for jobs. Therefore, there is no on-the-job search[1]. One important note about the process is that unemployment persists in the steady state, because some existing jobs break up due to firm specific shocks, i.e. job destruction.

Let us begin with the formalization of the equilibrium. Suppose there are L workers in the labor force and u is the unemployment rate. Let also v be the vacancy rate so that uL is the number of unemployed workers and vL is the number of vacant jobs. The number of

[1] One of the extension deals with this problem, but it is stated by Pissarides (2000) that this does not alter the basic results significantly. See Pissarides (2000) for the discussion.

matching jobs is given by the following technology:

$$mL = m(uL, vL) \tag{3.1}$$

,which is assumed to be increasing in both of the arguments, concave and homogeneous of degree 1. In empirical analysis, it is taken to be in Cobb- Douglas form. Notice that vacant jobs are filled according to Poisson process with rate $m(uL, vL)/vL$. Similarly, unemployed workers find a job with rate $m(uL, vL)/uL$. Now, define θ as vacancy-unemployment ratio. This is referred to as market tightness in the literature. Therefore, matching function can be written as:

$$q(\theta) \equiv m(u/v, 1) \tag{3.2}$$

Notice that mean duration of unemployment is $1/\theta q(\theta)$. This implication of the model will become even more important when we are calibrating the parameters of the model.

Flow into unemployment or job destruction, on the other hand, is assumed to be a Poisson process at rate λ. Without growth or turnover in the labor force change in the unemployment rate is given by the following equation:

$$\dot{u} = \lambda(1-u) - \theta q(\theta)u \tag{3.3}$$

In steady state unemployment is constant, so:

$$\lambda(1-u) = \theta q(\theta)u \tag{3.4}$$

or by rearranging:

$$u = \frac{\lambda}{\lambda + \theta q(\theta)} \tag{3.5}$$

This is the first key equation of the model. It is known as Beveridge curve and it is downward sloping and convex to the origin. It shows the relation between market tightness and unemployment rate. However, θ is unknown and must be determined.

So far, we have described the matching technology. In order to derive the equilibrium conditions, we have to analyze the behavior of the economic agents, namely firms and workers. In summary, both firms and workers regard a vacant job and income streams from being unemployed or employed, respectively, as their assets. Therefore, equilibrium conditions are derived by value maximization. With perfect market for capital, an infinite horizon and when no dynamic changes in parameters are expected, all of the value functions satisfy the Bellman equation. After solving value function equations by imposing some equilibrium conditions for the steady state, we can derive the job creation condition. Note that it can be written as a function relating wage to market tightness.

Another way to derive the job creation condition is to maximize firm's profit. First order conditions imply exactly the same equation for the job creation equation. Following this way is advantageous, because capital decision of the firm is already incorporated into the model. This property is essential for the analysis, because economic growth can be explained by capital accumulation. Note that real interest rate, r, is given by the marginal product of capital per effective labor less depreciation, δ, as in Walrasian models.

$$f'(k) = r + \delta \tag{3.6}$$

,where f is Cobb-Douglas production function.

I will not repeat the derivation of the job creation condition, but I will write the resulting equation later for illustration purposes. Moreover, this equation will be used while I am simulating the model.

The counter part of the job creation condition is the wage curve, which is the modified labor supply of Walrasian models. Finding the wage curve is more rigorous and the derivation has the following rationale. As the model implies, a surplus is created when a worker and a firm is matched and the job is created. This surplus is shared according to a Nash solution to a bargaining problem. Resulting equation is again a function relating wage rate to market tightness.

Job creation equation and the wage curve can be drawn on a (θ, w) space. Job creation curve is downward sloping, whereas the wage curve is upward sloping. Therefore, there exists a unique solution for wages, w^*, and market tightness, θ^*, by implicit function theorem. The equilibrium unemployment rate is, then, obtained by using Beveridge curve equation,

equation 3.5.

Before going further, I want to note that capital decision of the firm is trivial so far, because capital was not allowed to accumulate or there is not any equation showing the path of capital. (w^*, θ^*) is obtained for given capital. However, this will not be the case when we deal with the growth of the economy. In fact, the capital accumulation equation will be similar to that of Solow growth model. By doing so, we will be able to get rid of wage equation to find the steady state solutions. Instead of finding a (w^*, θ^*) pair, we will find (k^*, θ^*) pair. Still, it is possible to find w^* by using the wage equation. In the next section, I will discuss the implications of the model in the short run and in the long run. I will introduce the equations of the model after considering long run economic growth, i.e. growth in the technological parameter, p, so that I can clearly and completely discuss the model.

3.3 Short Run vs. Long Run and Technological Progress

In Chapter 1, I have stated that the relationship between unemployment and GDP growth in Turkey can be said to hold even in the long run. Our modeling framework may imply different results for the equilibria in the short run and in the long run depending our assumptions about the relationship among the model parameters. The most important assumption is about the relation between value of leisure and productivity level[2]. The short run model, described in the previous section, assumes that unemployment income is independent of the productivity level of workers. However, this is not the case when we consider long run equilibrium. Generally speaking, unemployment income is consisted of actual income and the imputed value of leisure. It is natural to assume that actual income is proportional to average wages or wealth. Furthermore, the value of leisure is proportional to wealth if we

[2]Let me inform you that the model assumes that recruitment cost of the firms is proportional to general productivity level, pc. It is claimed by Pissarides (2000) that this is a reasonable assumption since it is more costly to hire more productive workers. However, any alteration about this relationship does not change implications for the short run and long run. Therefore, let me suppress the discussion about this relationship.

regard leisure as a consumption good[3]. Therefore, I assume that unemployment income is proportional to wealth of the worker and this is given by ζ. This implies that wage rate is also proportional to productivity level. This leaves the job creation condition independent of productivity level.

In empirical analysis, it is very common to equate the value of leisure to zero for countries which do not have a well established unemployment insurance system[4]. Since Turkey is one of those countries, I will assume that ζ, hence the value of leisure, is zero through the rest of this paper. However, I will keep it in the equations of the model for convenience.

Although equilibrium unemployment rate is independent of general productivity level, the growth rate of productivity influences the equilibrium rate of unemployment. Since I will also analyze the consequences of the economic growth in my model, I will let the productivity grow over time and investigate its effects on equilibrium unemployment rate. As in Solow model, I will assume that productivity grows at rate g so that the level of productivity at time t can be written as:

$$p(t) = e^{gt} p_0 \tag{3.7}$$

,where $p_0 > 0$ given initially.

3.4 Closed Form Equations of the Model at the Steady State

Now I am ready to write down the closed form equations of the full model. In the model, there are two dynamic equations. One of them is for capital accumulation and the other one is for unemployment. The latter one is given by 3.3. The former one can be written as follows:

$$\dot{k} = sf(k) - \left(\delta + g - \frac{\dot{u}}{1-u}\right) k - c\theta \frac{u}{1-u} \tag{3.8}$$

[3]Wealth is composed of human wealth and nonhuman wealth. Value of leisure is always proportional to total wealth. However, this not sufficient for wages to be proportional to productivity, because there is always a non proportional part due to nonhuman wealth. On the other hand, value of nonhuman wealth adjusts market outcomes in the long run so that wage rate is proportional to productivity. See Pissarides (2000) for discussion.

[4]See, for example, Malherbet and Ulus (2003) for Turkey and Saini (2007) for India.

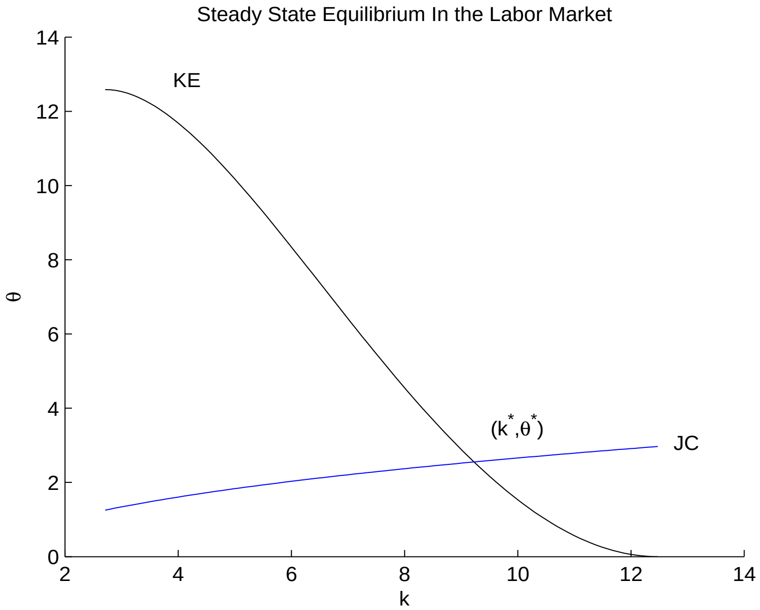

Figure 3.1: Steady State Equilibrium in the Labor Market. Equilibrium θ and k is determined by the intersection of JC and KE curve in the labor market. Equilibrium u is, then, calculated by using the Beveridge curve.

,where s is the exogenously given saving rate and c is the constant hiring cost for the firm. Notice that there are additional terms that make the capital accumulation equation different from the one for Solow model. These additional terms are due to cost of opening up new vacancies. Notice further that allowing unemployment to be determined endogenously in the model causes itself and its time derivative to appear in the capital accumulation equation.

In the steady state both $\dot{k}$ and $\dot{u}$ are zero. Thus, equations 3.3 and 3.8 imply

$$sf(k) - (g+\delta)k = \frac{\lambda c}{q(\theta)} = \frac{u}{1-u}c\theta \tag{3.9}$$

Let us call this as capital equation, KE. Once we know the steady state values of capital per effective labor, k^*, and market tightness, θ^*, we can find the equilibrium unemployment rate at the steady state, u^*. However, equation 3.9 has two unknowns, k and θ and we need one more equation to find the unique solutions for the unknowns. To do so, we will make use of the job creation equation that we discussed in Section 3.2. By making use of the wage equation, which is not repeated in this paper but can be found in Pissarides (2000), and equation 3.6 we can write the job creation condition, JC, as follows:

$$(1-\beta)[f(k)-kf'(k)] - \frac{1}{1-\zeta}\beta c\theta - \frac{f'(k)-\delta+\lambda-g}{q(\theta)}c \tag{3.10}$$

,where β is the bargaining power of workers and $q(\theta) = \theta^{-\eta}$. Notice that equation 3.9 is decreasing and equation 3.10 is increasing in k when θ is written as a function of k in both of the equations. Therefore, equilibrium values for capital per effective labor and market tightness, k^* and θ^*, is determined uniquely, as in Figure 3.1. I defer the discussion and the analysis of the dynamics of the model to the next chapter.

Chapter 4

ANALYSIS FOR THE TURKISH ECONOMY

Although my current model allows me to resolve the paradox in the Turkish economy, as it will be apparent in the subsequent sections, there are other possible alternative explanations. In fact, I tried to test the accuracy of some of them before analyzing the long run equilibrium. However, they all resulted in failure either due to data constraints or unrealistic assumptions of those models. In the next section, I briefly discuss two of them.

4.1 Alternative Explanations

In 1970s and 1980s, European countries experienced high unemployment rates, whereas unemployment rates for the U.S. economy were at reasonable levels although both European and the U.S. economies are exposed to similar shocks. The reasons for the difference have been much debated and the conclusion is that the increase is in the natural rate of unemployment (NARU). Mortensen and Pissarides (1999) also analyze this problem in their article. Their model is convenient to be used in analyzing the problem of this paper. Among several other findings, the most useful one for this paper is that skill-biased technological shocks, in which there is an increase in the relative productivity of high skilled workers, increase equilibrium unemployment rate in an economy with segmented labor markets if unemployment-skill relation is convex.

I intended to apply their model to a particular data set extracted from Turkish Household Budget Surveys provided by TÜİK. In this data set, education levels are divided into 11 groups. Total wage earnings and total number of individuals in each group are available. The group means and the overall mean of wage earnings for those groups are also calculated. In Table 4.1, relative group wage earnings and annual unemployment rates for the period are displayed. The standard deviations among the relative group wage earnings for each year are calculated after dividing all the group means to the overall mean. By doing so, I

	2002	2003	2004	2005
Illiterate	0.25	0.27	0.26	0.29
Non-graduate	0.17	0.14	0.13	0.14
Primary School	1.13	1.13	1.16	1.24
Primary Education	0.04	0.06	0.07	0.12
Secondary	1.45	1.62	1.68	1.77
Secondary Equivalent Vocational	1.78	1.72	1.85	2.12
High School	1.52	1.44	1.43	1.43
High School Equivalent Vocational	2.35	2.09	2.05	2.18
University (2 years)	2.55	2.62	2.85	2.50
University (4 years)	5.39	4.80	4.51	4.23
High Education	7.72	10.58	8.48	7.65
Standard Deviation	2.36	3.02	2.45	2.19
Unemployment Rate (in %)	10.3	10.5	10.3	10.3

Table 4.1: Relative Wage Earnings for educational groups for the period 2002-2005. Source: Turkish Statistical Institute (TÜIK).

first calculated the relative wage earnings, setting the average wage earning productivity to 1, so that the numbers are comparable. Then, since the model implies a linear relationship between the wage earnings and productivity levels, I could check whether there is a skilled-biased shock in productivities.

However, there two problems in using this model to explain the Turkish case. First one is that the data set for the wage earnings is available for the period between 2002 and 2005. Thus, it is impossible to sketch the exact distribution of wage earnings before the 2001 economic crisis. In fact, we see in Table 4.1 that unemployment increases, though slightly, when the standard deviation increases. The second one is a conflict between the data and the model. The model implies that as skill level increases, the unemployment rate in that skill group decreases. However, we observe in Table 4.2 that unemployment rate among university graduates is higher than the unemployment rate among workers with high school diploma. Therefore, their model does not help unless serious modifications are made.

One way to overcome the data constraint is to use a similar model in which the segmentation is with respect to sectors instead of education level of individuals. I used the data set provided by Saygılı *et al* (2005) and their analysis to portray the movement of TFP, or p in our model, for agriculture, manufacturing and services for the period from 1972 through 2003. By doing so, I aimed at extending the horizon of the data set beyond the

	2002	2003	2004	2005
Illiterate	4.6	7.0	3.7	4.5
Less than High School	9.6	10.2	9.1	9.6
High and Vocational High	14.7	12.8	15.1	13.6
Higher Education	11.1	11.1	12.4	10.2

Table 4.2: Annual unemployment rates for educational groups in Turkey for the period between 2002-2005. Source: Turkish Statistical Institute (TÜİK) web page: `www.tuik.gov.tr`

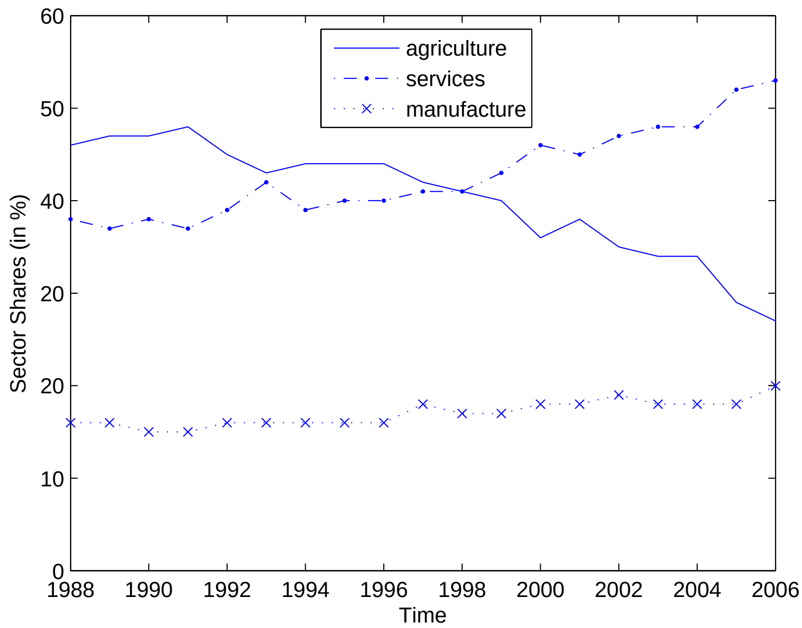

Figure 4.1: Sectoral annual employment shares in Turkey for the period 1988-2006.

crisis. When I calculated the unemployment rates of the model, I realized that equilibrium unemployment rate declines whenever productivities get closer for the groups. Hence, the model can be said to be quite satisfactory in explaining the relation between unemployment and economic growth for the period before the crisis. Yet, it is equally unsatisfactory for the period after the crisis. This result is not surprising to me, because the model proves that rational individuals search for jobs that require exactly the same skill level that they possess. However, this is an unrealistic assumption when markets are segmented with respect to sectors since workers move from one sector to another in Turkey. This can be justified by Figure 4.1 when we observe the dramatic decline in percentage of agricultural workers in the Turkish labor force since 1988.

Another solution can be based on the model of Mortensen and Pissarides (1994). A *mean-preserving* shock to the productivity distribution can generate high unemployment rates although the economy grows at high rates by increasing the endogenous job destruction rate. However, this analysis requires a more detailed data set. So, I never followed that path to solve the problem[1].

Our assumption on productivity is much simpler than that of the models mentioned in the preceding paragraphs. All the employed workers choose either the high value of productivity or the low value of productivity. These *idiosyncratic* shocks move the productivity from high level to low level at rate λ. If it is high, he continues production with productivity level p. Otherwise, the job is destroyed and the worker is unemployed.

4.2 Steady State Analysis

The parameter values I used in my analysis are presented in Table 4.3. In fact, many of the parameters are calibrated in these type of models because it is usually impossible to apply econometric techniques to obtain estimates of these parameters. The way I chose the parameters of the model is described in the following paragraphs.

[1] The common property of the alternative explanations is that they focus on the changes in the structure of the economy. However, the analysis of the next section views the problem at hand from a macroeconomic perspective and explains the effects of the growth in the TFP on the labor and capital markets.

Parameter	Value
η	0.50
λ	0.13
c	0.51
β	0.50
α	0.40
δ	0.05
s	0.25
ζ	0.00
avg	0.85

Table 4.3: Parameter Values for the Model

The most important parameter of the model is the elasticity of the matching function, η. As Pissarides (2000) argues, the estimate is between 0.4 and 0.7, which are the estimates provided by Blanchard and Diamond (1989) and Pissarides (1986), respectively. However, it is taken to be 0.5 in calibration exercises and it is shown that results are robust when the number is slightly changed. In their analysis for Turkey, Malherbet and Ulus (2003) also assume that η is 0.5 and I will follow their way by setting η to 0.5.

The rate at which the idiosyncratic shocks arrive, λ, is calibrated so that average duration of unemployment and the average unemployment rate for the period after the crisis is matched. Notice that average duration for an unemployed worker is given by $avg = 1/\theta q(\theta)$. By rearranging equation 3.9, we obtain;

$$\lambda = \frac{u}{(1-u)avg} \tag{4.1}$$

The data set for duration of unemployment is constructed as follows. In the Household Labor Force Surveys, the unemployed workers are asked how long they are searching for a job. Based on their answers, they are grouped in the 7 intervals: 1-2, 3-5, 6-8, 9-11, 12-23, 24-35 and 36 and more. The thresholds are measured in months. Following Tunalı *et al* (2004) and Tansel and Taşçı (2007), group means are set at the following values, respec-

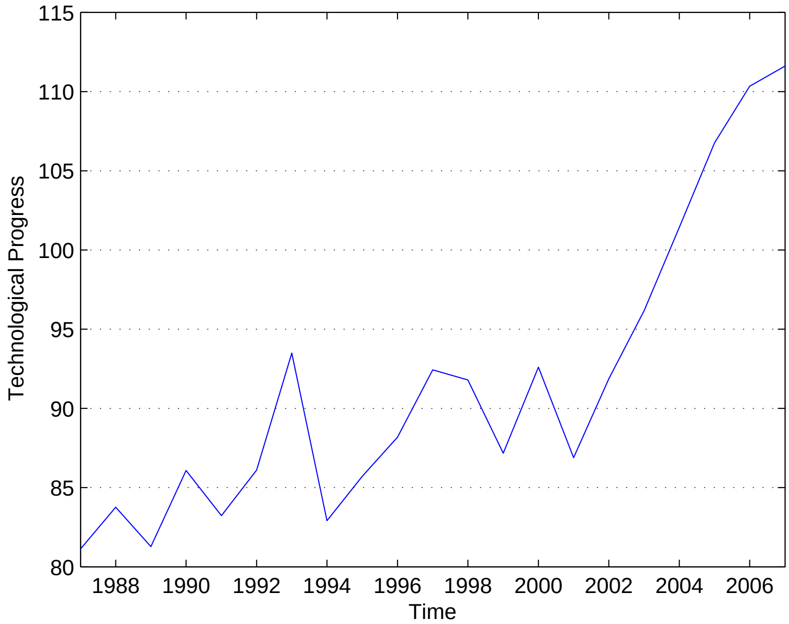

Figure 4.2: TFP for the period between 1987 and 2007. The series obtained in a similar fashion with Saygılı *et al* (2005). Source: Saygılı and Cihan (2008)

tively: 1.5, 4, 7, 10, 14, 25 and 52. The average duration of unemployment for the period between 2001 and 2005 is calculated as 10.22 months.

However, I have to consider the mechanism behind the matching process before calibrating the parameters according to this number. Notice that the sampling scheme is *stock* sampling and the calculated number does not correspond to the completed spell of those unemployed workers. Lancaster (1990) closely investigates the consequences of stock sampling in transition data analysis. The striking result is that the completed duration of the *new* entrants and the elapsed duration of the workers in the unemployment pool are the same when the process is Poisson. Since the matching in the labor market follows a Poisson process, average duration of unemployment is set to be equal to the mean of the sample.

Setting the values for the other parameters is more straightforward. The cost of holding a vacant job, c, is calibrated so that average unemployment rate for the period before the crisis is matched. The saving rate, s, is taken to be the average of gross capital formation

	θ^*	k^*	w^*/p	u^*
$g_1 = 0.49\%$	2.36	9.25	1.33	7.78%
$g_2 = 4.17\%$	1.47	3.76	0.88	9.66%

Table 4.4: Equilibrium values of the variables of the model for the periods before and after 2001.

to GDP ratio for the whole period[2]. As discussed in the previous chapter in detail, ζ is taken to be zero. Due to lack of better information, I follow Malherbet and Ulus (2003) and equate β to 0.5. As in other conventional macroeconomic models, the depreciation rate is set to be 0.05. The capital share in income, α, is calculated as 0.4 by Saygılı *et al* (2005). This number is also used by Altuğ *et al* (2007).

Estimation for the technological improvement, or change in TFP, for the period between 1972 and 2003 can also be obtained from Saygılı *et al* (2005). However, I used a similar data set provided by Saygılı and Cihan (2008), in which capital stock estimates are given for the period between 1979 and 2007. Therefore, I could extend the estimation for TFP as much as possible. The series for TFP is drawn in Figure 4.2. The levels for TFP for the period between 1987 and 2007 are calculated in a similar fashion with Saygılı *et al* (2005). The horizon is divided into two periods: from 1987 up to 2001 and 2001 and afterward. I restricted the period so that it is consistent with the horizon of annual unemployment rate series except for the year 1987. I also included the year 1987 since the economy booms in 1988 and using TFP level of this year underestimates the growth rate of TFP of the first period. Although TFP goes up and down throughout the first period, I assumed a constant growth rate, g_1. Average growth rate for the first period is 0.49%. The average unemployment rate for Turkish economy for the period before 2001 is 7.78%. The growth rate of TFP for the second period, g_2, is calculated as 4.17%. This rate of growth implies an equilibrium unemployment rate of %9.65, which is just below the average unemployment rate for the period after 2001, 9.94%. A brief summary of the results of the simulations can be found in Table 4.4

[2]Saving rate in the model of this paper refers to the investment rate of the economy and they are used interchangeably.

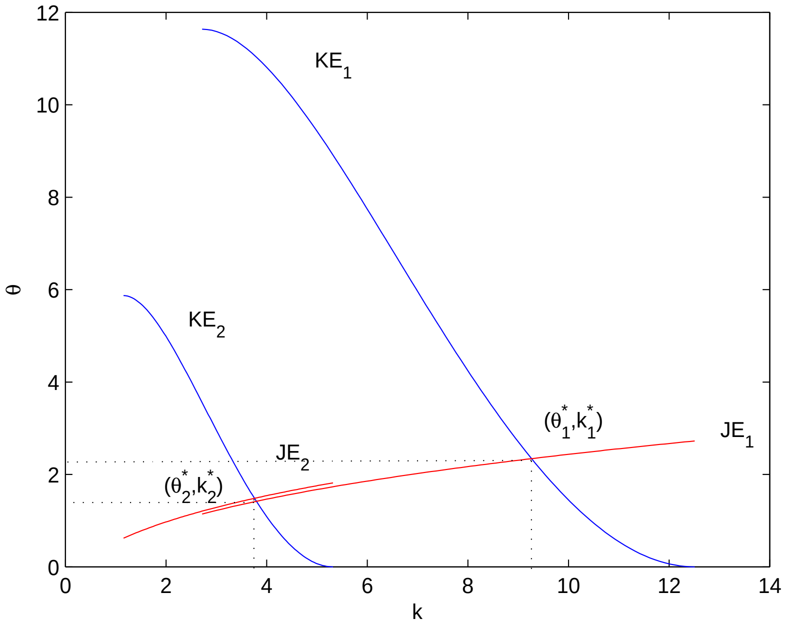

Figure 4.3: The effects of an increase in g on equilibrium θ and k

Although the TFP growth, hence the GDP growth, is quite high, the equilibrium unemployment is also high for this economy. As in Figure 4.3, both JC and KE curves shift such that θ decreases in response to an increase in g, although the effect is ambiguous in general. The intuition beyond this analysis can be summarized as follows. With constant saving rates, technological improvement is so high that steady state level of capital per effective labor declines. This implies that marginal product of capital goes up. The increase in the marginal product of capital deteriorates job creation leading to a decline in equilibrium market tightness and an increase in equilibrium unemployment rate.

Our analysis assumes a constant saving rate for both of the periods. However, as shown in Figure 4.4, investment to GDP ratios are usually lower for the after crisis period. One would expect that the decline in the saving rate will lower the steady state capital per effective labor and this will increase equilibrium unemployment rate. The results are summarized in Table 4.5. When the saving rates are set to the respective period averages, the equilibrium

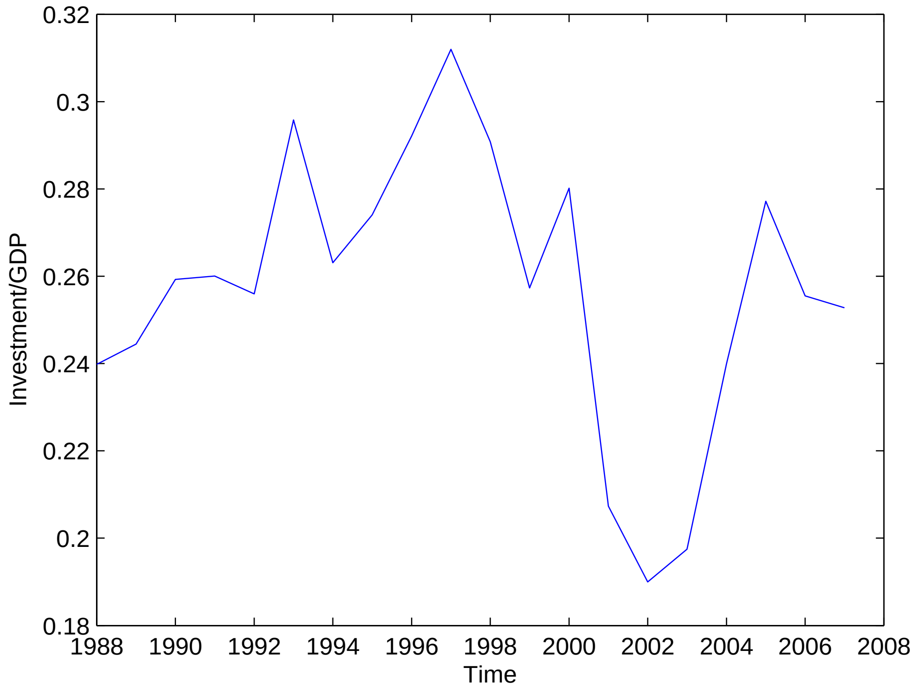

Figure 4.4: Investment to GDP ratios for the period between 1988 and 2007. Source: Turkish Statistical Institute (TÜİK) web page: `www.tuik.gov.tr`

unemployment rate is well above 10%.

4.3 Dynamics of the Model

In analyzing such a dynamic model, it is natural to ask how the dynamics of this economy look like. In this section, I will figure out the paths that unemployment and capital per effective labor follow in a transition economy. Consider equations 3.3 and 3.8. These are the dynamic equations, or equations of motion, of the model for u and k respectively. Since the equilibrium conditions are too complicated, it is impossible to explicitly write

	c	θ^*	k^*	w^*/p	u^*
$s_1 = 27.1\%$	0.54	2.39	10.80	1.43	7.78%
$s_2 = 23.2\%$	-	1.22	3.13	0.81	10.42%

Table 4.5: Equilibrium values of the variables of the model for different saving rates

down those equations only in terms of u and k. However, it is still possible to describe the movement of those variables in the dynamic equations given the values of model parameters.

Out-of-steady-state dynamics of a similar model is described by Pissarides (2000). Although the analysis is not a full model of business cycles, its assumptions are still valid for the model of this paper. In summary, it can be shown under reasonable assumptions that out-of-steady-state wage and market tightness are also given by job creation and wage equation conditions, given the level of capital stock. Whenever there is an exogenous shock to the model, vacancies and wages instantaneously adjust to clear the market. Another important result is that unemployment rate should be initialized. This fact will be discernible when I plot the phase diagram. Therefore, given initial values of unemployment and capital per effective labor, market tightness can be found by equation 3.10. Change in unemployment and capital per effective labor, then, can be calculated by making use of equations of motion. In the second period, market tightness can again be found by using equation 3.10. The process goes on like this until the change in both the unemployment rate and the capital per effective labor is zero.

I plotted a phase diagram, as in Figure 4.5, in which we have k on the horizontal axis and u on the vertical axis. I also defined an interval for k[3]. In order to draw the locus of $\dot{k} = 0$ and $\dot{u} = 0$, I first obtained values for θ using the JC curve equation, equation 3.10. By doing so, I was able to replace the value of θ in equation 3.8 so that it is expressed in terms of u and k only. By setting equation 3.8 to zero and solving for u I could find the locus of $\dot{k} = 0$. In a similar fashion, it is possible to replace θ in equation 3.3 and find the locus of $\dot{u} = 0$ by solving for u. Notice that I implement the condition that wage rate and market tightness immediately adjust so that the economy is always on the JC curve.

In Figure 4.5, we observe that $\dot{k} = 0$ curve is steeper than $\dot{u} = 0$. Next, I investigated how u and k evolves over time, given that economy starts from an initial point. The curves divide the diagram into four parts and the arrows show whether u and k are increasing or

[3]The model predicts that the steady state values for k should be in the range that is determined by model parameters. Specifically, lower and upper bounds are given by solutions to the equations $sf'(k) = g + \delta$ and $sf(k) = (g + \delta)k$, respectively. See Pissarides (2000) for discussion.

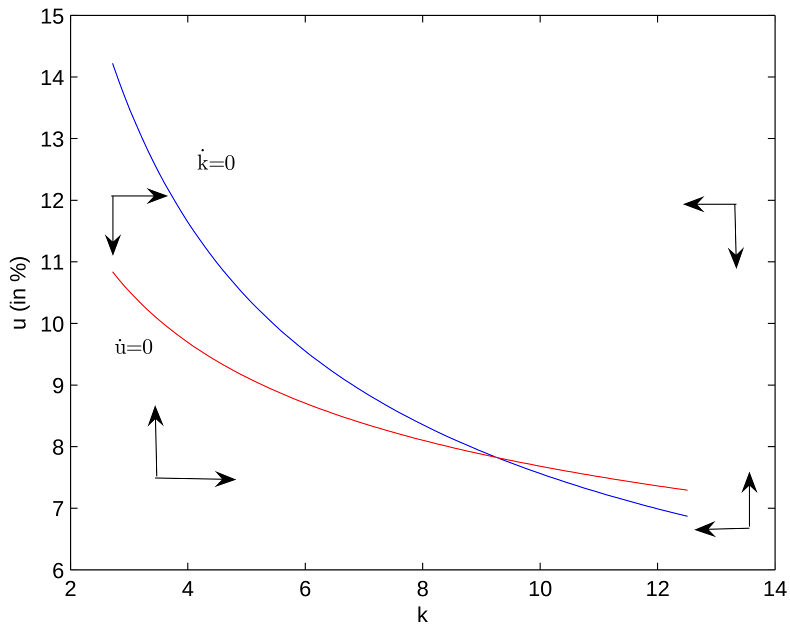

Figure 4.5: Phase Diagram for the Adjustment of u and k for $g = 0.49\%$.

decreasing. Figure 4.5 is analogous to phase diagram of Ramsey's optimizing agents model. The only difference is that we do not have a stable saddle path. Instead, u is initialized like k and there is a unique path that makes the economy reach the steady state.

Suppose that the economy is at its initial steady state before the crisis and the growth rate of the technology parameter exogenously increases so that the economy starts moving to its new steady state. I plotted the adjustment of u and k in Figures 4.6 and 4.7, respectively. When technology starts to improve at a higher rate, unemployment first declines slightly until the negative effect of increasing marginal product of capital is in action. After few periods pass, it starts moving steadily to its steady state level. When we update growth rate of the variables within a 0.1 unit time interval, u takes the half way between the two steady state levels after 220 iterations. The corresponding number for k, on the other hand, is a smaller one, 110, because initial capital per effective labor is further away from its steady state level.

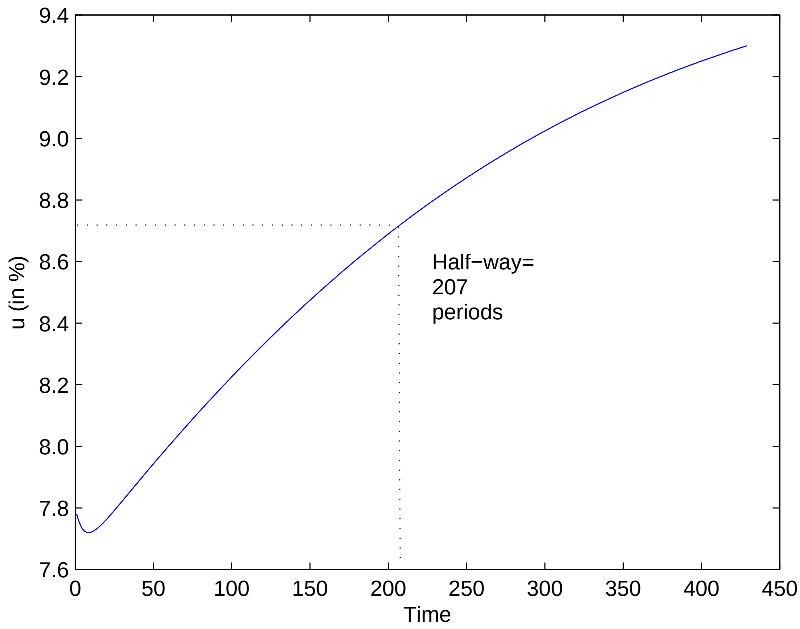

Figure 4.6: Adjustment of unemployment when g increases from 0.49% to 4.17%. Growth rates are adjusted in 0.1 time intervals.

4.4 Payroll Tax in the Model

The high unemployment rates in Turkey at the beginning of the new millennium has become a hot political issue. Nowadays, the government is planning to decrease the payroll tax rate by 5% to improve job creation by lessening the recruitment cost of firms. Table 4.6 presents the payroll tax rates that employers and employees are obliged to pay. Next, I consider the effects of a reduction in the payroll tax rate within the framework of the model described in the previous chapter. A complete derivation can be found in Appendix. Note that I follow value maximization approach described in chapter 3 in constructing the model. In a similar fashion, same conclusions can be reached by profit maximization approach.

The result is not surprising and analogous to the conclusions of conventional long-run equilibrium models. The change in the government taxation policy does not change any real outcome except for the distribution of the income. In summary, any increase in the tax rate is attributed to the workers by the firms so that the real cost of the wages for the firms

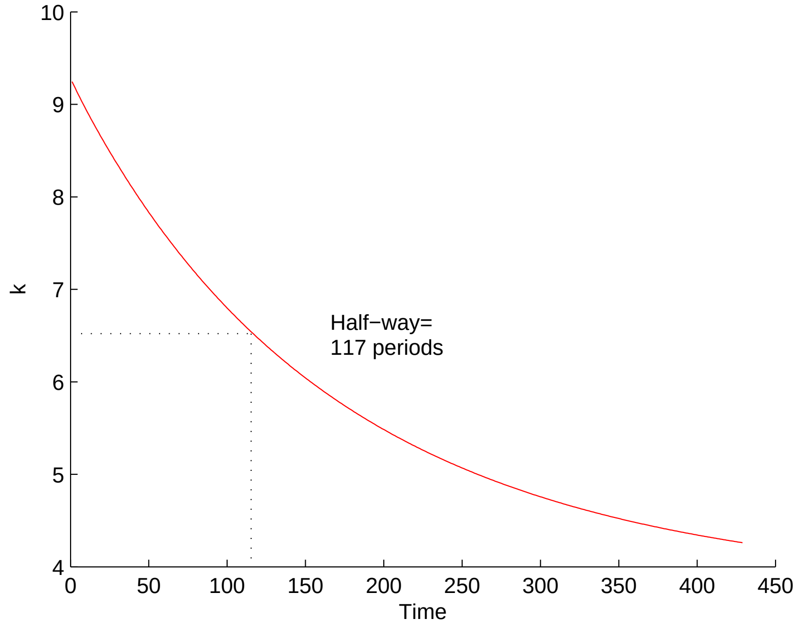

Figure 4.7: Adjustment of capital per effective labor when g increases from 0.49% to 4.17%. Growth rates are adjusted in 0.1 time intervals.

does not change. Therefore, I end up with equations 3.9 and 3.10 again and equilibrium market tightness and unemployment rate are unaltered.

Premiums	Workers' Share (as % of gross wage)	Employers' share (as % of gross wage)
Industrial Accident and Occupational Diseases Insurance*	-	1.5-7
Health Contribution**	5	6
Maternity Insurance	-	1
Disability, Old-Age and Burial Insurance Premium***	9	11

Table 4.6: Social Security Premium Rates. Source: Social Security Institution (SSK) web-page. `www.ssk.gov.tr`

* Median value, 4.25%, is assumed when calculating the share of employers.

** For students under the definition of Law No: 3308, this amount is 4% and paid by government agencies. I ignored this group.

*** For mine workers, the corresponding rate for employers is 13%. I also ignored this discrepancy.

Chapter 5

CONCLUSION

In this paper, I analyzed the relationship between unemployment rate and economic growth in the long run in a matching model framework. The model of this paper can be seen as a Solow growth model where the unemployment rate is endogenously determined. My modeling framework made it possible to increase the equilibrium unemployment rate while the output grows at a constant rate. This is the relationship between unemployment and growth that we observe in the data for Turkish economy.

The source of economic growth in the model is the exogenous increase in the growth rate of TFP. This assumption is in line with many of the recent papers dealing with long run growth in Turkish economy. It is also reasonable to assume that the growth rate of TFP has increased further after 2001 economic crisis due to structural changes during the accelerated integration of Turkey to the EU. The source of unemployment, on the other hand, is the decline in the equilibrium capital per effective labor. This decline causes the capital to be costly for firms, which, in turn, leads to a decline in job creation. When job creation declines, the labor market clears at a higher unemployment rate.

Since there are two dynamic equations in the model, it is natural to investigate the out-of-steady-state dynamics of the model. I was able to draw a phase diagram showing the adjustment of unemployment and capital per effective labor. I found out that the variable that is further away from its steady state takes the half of the distance from the initial point to the steady state in a shorter time interval.

Finally, I analyzed the long run effects of a reduction in payroll taxes. I showed that when capital is included in the model the equilibrium unemployment is independent of payroll taxes since wages adjust in the long run so that the tax rate disappears from the equations describing the equilibrium.

Although the model broadly explains the Turkish case, it is still possible to improve the analysis. For example, I might assume Ramsey type optimizing households in the model, as in the original model of Eriksson (1997). However, this would complicate our analysis for the analysis of out-of-steady-state dynamics because there would be three equations of motion in such a model. Another possible extension can be to establish an endogenous growth model by introducing human capital to the model. Laing *et al* (1995) consider the education decision of individuals before searching for a job in the labor market. Their education decisions influences economic growth through changes in the parameters of the model. It is also possible to motivate economic growth by Schumpeter's creative job destruction idea. This model assumes that the productivity of existing jobs do not grow and technological progress is achieved by job destruction and new job creation or by restructuring the existing capital. In this model, unemployment rate unambiguously increases when there is technological progress.

In this paper, I avoid taking further steps and try to keep the analysis very simple. Therefore, I make use of an exogenous growth model with a constant saving rate and a matching technology. A more detailed model might be more satisfactory for policy analysis. Yet this model adequately serves for the purposes of this paper.

Appendix A

INCORPORATING PAYROLL TAX INTO THE MODEL

Suppose that the government charges the firms to pay a payroll tax that is equal to τ percent of the wages. Let J be the present-discounted value of expected profit from an occupied job and V be that of an vacant job. Similarly, let W and U be the present-discounted value of expected income of an employed and unemployed worker, respectively. Below are the Bellman equations for the four value functions for an individual firm and worker, where $r - g$ is defined as the effective discount rate.

$$(r-g)(J_i + pk) = pf(k) - \delta pk - (1-\tau)w - \lambda J_i \tag{A.1}$$

$$(r-g)V_i = -pc + q(\theta)(J_i - V) \tag{A.2}$$

$$(r-g)U = \zeta rU + \theta q(\theta)(W_i - U) \tag{A.3}$$

$$(r-g)W = w + \lambda(U - W_i) \tag{A.4}$$

All the other variables are standard and exactly the same with our model described in the earlier chapters. Notice that there is no subscript i for U since return from searching for a job is independent of the wage of the individual job, w_i.

In equilibrium, rents from a vacant job, hence V, is equal to zero, because all profit opportunities are exploited. Therefore, equation $A.2$ implies,

$$J = \frac{pc}{q(\theta)} \tag{A.5}$$

By rearranging equation $A.1$ and using equation $A.5$ and the equilibrium condition $V = 0$, we obtain the job creation condition with payroll taxes as follows:

$$p(f(k) - (r+\delta)k) - w(1+\tau) - \frac{(r+\lambda-g)pc}{q(\theta)} \tag{A.6}$$

Notice that the only difference is that wage rate is now inflated with the tax rate. Next, we need to determine the wage rate. The first order conditions from a Nash solution to this bargaining problem implies that

$$(1-\beta)(1+\tau)(W_i - U) = \beta(J_i - V_i) \tag{A.7}$$

Now, W_i can be expressed in terms of U and w_i by using equation $A.3$. By implementing the equilibrium condition $V = 0$ and equation $A.5$, wage equation can be written as

$$(1+\tau)w_i = (1-\beta)(1+\tau)(r-g)U + \beta p(f(k) - (r+\delta)k) \tag{A.8}$$

Notice that w is the same for all the job pairs. Thus, we drop the subscript i in the sequel. Moreover, by equations $A.4$, $A.5$ and $A.7$, $(r-g)U$ is equal to;

$$(r-g)U = \frac{\beta p c \theta}{(1-\beta)(1+\tau)} \tag{A.9}$$

Finally, by writing this into the equation $A.8$, we obtain the wage equation as follows;

$$(1+\tau)w = \beta p(\frac{1}{1-\zeta}c\theta + f(k) - (r+\delta)k) \tag{A.10}$$

This implies that job creation is unaltered when we change the payroll tax rate, because the term $(1+\tau)w$ is determined solely by the parameters of the model and it disappears when we plug it into the job creation condition in equation $A.6$. Moreover, we obtain equation 3.10, the JC curve of Chapter 3.

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