THE RESPONSE OF EMPLOYMENT TO GDP GROWTH IN TURKEY: AN ECONOMETRIC ESTIMATION

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Abstract

This paper aims to investigate the mechanism of adjustment in the labor market with respect to changes in GDP for the period 1988-2004. For this purpose, the response of the demand for labor to changes in GDP is modeled as an error correction model. The results of the analysis indicate that the adjustments in the labor market lagged GDP growth. Confining the analysis to the manufacturing sector provides similar results. Further analyses of variance decomposition for GDP and employment show that labor market responds to GDP changes with a delay of more than 4 periods.

JEL Classification: C22, E24, J23, J29, O53

Keywords: Turkey, labor demand, employment, error correction model, CES production function

1. Introduction

Turkish economy has experienced crises and booms in short intervals from the mid-1990s on. GDP growth rates were negative in 1994, 1999, and 2001 (see Figure 1). Attracted by such large fluctuations, some researchers (e.g. Auer and Popova, 2003) expressed explicit concern on employment since recessions are assumed to have negative impacts on employment in Turkey. Reflecting these, Figure 1 shows that the official unemployment rate which averaged 6.8 percent during 1996-98 has risen to more than 10 percent during 2002-04. A critical question is how the labor market adjusts to recessions and recoveries in the economy. Figure 1 shows no clear support for the negative impact of recessions on employment in Turkey. In those years where GDP growth rate was negative, no big jumps in unemployment rate are observed, except in 2001. The response of employment to GDP growth has recently been tested in Saget (2000) for a sample of 11 transition countries, using data for 11 years. For the two countries where there is no relation between GDP growth and employment (Bulgaria and Ukraine), Saget argues that this is due to the high share of informal economy in total output. Tan *et al*. (2002), on the other hand, found lagging response of the labor market to GDP market for Singapore for the post-1985 period. The impact of volatility in economic growth on employment growth in Turkey was investigated in a recent study by the World Bank (2006), using data from 1980 to 2002 at both aggregate and sectoral levels. However, no significant statistical relationship was found between economic volatility and employment. Simulations of the impact of monetary and fiscal policy on employment also showed that labor market adjustment takes place via wage adjustments rather than employment. Flexibility in wages was found to allow the economy to respond to changes in macroeconomic conditions. Taymaz (1998) also found using an econometric model for manufacturing industries that macroeconomic variables are important for employment generation. He argued that high real interest rates and appreciation of the real exchange rate have played a key role to attract capital inflows after the liberalization of capital accounts in the late 1980s, and

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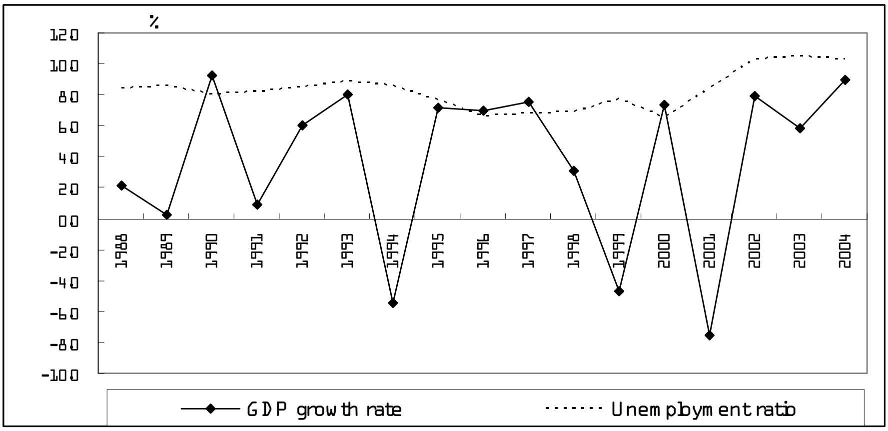
increases in real wages during the early 1990s had an important effect on employment performance of manufacturing industries

Figure 1. Real GDP growth and unemployment rates in Turkey (1988-2004)



Source of data: State Planning Office

The aim of this paper is to investigate the mechanism of adjustment in the labor market with respect to changes in GDP. The two most widely-accepted approaches in the literature are applied and time series econometric techniques are used to estimate the response of the change in labor demand to GDP growth. The analyses are performed at the aggregate economy level and for manufacturing sector separately. The organization of the paper is as follows. The second section briefly presents recent developments in Turkish labor market. The third section explains the methodology and the fourth section presents empirical results. Finally, the fifth section concludes.

2. Recent Developments in the Turkish Labor Market

A detailed overview of the trends and demographic and structural factors in Turkish labor market can be found in Auer and Popova (2003), Tunali (2003), and World Bank (2006: 1-14). The main findings of these studies can be summarized as follows. The employment performance of Turkey during the last two decades has been poor. Working age population is growing rapidly and it has been difficult to absorb large numbers of young workers into productive employment. Net migration into Turkey in the past two decades has further increased the labor supply. However, both overall labor force participation rate and female labor force participation rate are still low. During the course of structural changes in the economy, the share of the labor-intensive agricultural sector in total employment has fallen while that of industry and services has improved. However, this increase in industry and services was not sufficient to generate strong employment growth. World Bank (2006) also investigated whether employment fell strongly during and after the crisis years, but no conclusions could be drawn from the analysis. Because of lagged responses, output shocks were reflected in the labor market the next year. For instance, the labor market responded to the 1994 crisis in 1995.[1] There is little to suggest that employers have restructured and laid-off workers during crises. World Bank (2006)

[1] There are also institutional factors that determine the response of employment to macroeconomic volatility. For instance, during economic downturns, large-scale layoffs do not occur due to strong employment protection legislation in Turkey (World Bank, 2006). However, such institutional factors are out of the scope of this study.

argues that the increase in employment during the crisis year of 1994 where GNP fell by 6.1 percent can be best explained by the tendency for agriculture to act as a social safety net, as indicated by a sharp increase in agricultural employment.

3. Methodology

The macroeconomic relation between economic growth and employment has been a major concern for economists for a long time. The famous Okun's Law, for instance, related positive GDP growth with decline in unemployment rate. However, recent works on the relation between economic growth and employment emphasize structural factors that determine the demand for labor and unemployment. In this paper, rather than examining the structural determinants of employment demand, two approaches that have been developed to examine the relationship between output and employment will be tested. In the demand-side Keynesian approach the relation between GDP, wage level, and labor demand is examined while taking into consideration the substitution effect arising from the substitutability of capital and labor (see Cellini *et al*., 2001, for an application of this approach to European Union countries and the US). In the neoclassical approach, on the other hand, the determinants of labor demand are investigated through a specified production function such as a constant elasticity of substitution (CES) production function (see Tan *et. al*., 2002, for an application of this approach to Singapore). In addition to these two approaches, there are other econometric studies that examine the relation between labor demand and other variables such as openness, education, etc. Guisan (2005) warns that a disequilibrium approach is the most appropriate one to examine the relation between labor demand and its determinants. She proposes a realistic view where not only demand and supply of primary inputs are taken into account but also domestic and foreign intermediate inputs, human capital, and social capital. Finally, some cross-country studies have investigated the elasticity of employment to GDP growth in a variety of OECD and European countries as well as the USA (see for instance, Boltho and Glyn, 1995; Padalino and Vivarelli, 1997; and Seyfried, 2005)

3.1. Neoclassical Approach. Employers in a perfectly competitive market maximize profits by equating the marginal product of each production factor (capital and labor) to the value of the marginal product of that factor, wage in the case of labor. Real wage series can be obtained from official statistics. Marginal product of labor, on the other hand, can be derived from a production function such as constant elasticity of substitution (CES) production function. CES production function is originally introduced by Arrow *et al.* (1961) and is defined as follows:

$$Q = f(K, L) = \theta\left[\beta L^{-\rho} + (1-\beta)K^{-\rho}\right]^{-\frac{s}{\rho}} \qquad (1)$$

where Q, K, and L denote value-added, capital, and labor, respectively. β is the distribution parameter that determines the distribution of income among factor inputs ($0<\beta<1$); θ is the scale parameter determining technological progress; s is a parameter that determines the degree of the returns to scale; and ρ is the substitution parameter which determines the elasticity of substitution between factor inputs ($\rho>0$). The marginal product of labor can be derived using the profit maximization principle. Profit maximization requires that marginal products of capital and labor be equal to their respective payments:

$$\frac{\partial Q}{\partial K} = f_K = r \quad (2) \qquad\qquad \frac{\partial Q}{\partial L} = f_L = w \quad (3)$$

where w is real wage and r is the real rate of return to capital. Marginal product of labor in equation (3) can be explicitly written as follows:

$$\frac{\partial Q}{\partial L} = s\theta^{-\rho/s}(1-\beta)Q^{1+\rho/s}L^{-1-\rho} = w \tag{4}$$

Finally, taking natural logarithms of both sides, equation (4) can be rearranged into the following form:

$$\ln L = c + \alpha_1 \ln Q + \alpha_2 \ln w \tag{5}$$

where the terms c, α_1, and α_2 are short representations of the following terms: $c = \frac{1}{1+\rho}\ln\left(s(1-\beta)\right) - \frac{\rho}{1+s}\ln\theta$, $\alpha_1 = \frac{1+\rho/s}{1/(1+\rho)}$, and $\alpha_2 = -\frac{1}{1/(1+\rho)}$. Equation (5) is the equation to be estimated for the neoclassical approach. This model is named Model 1 below. Since the parameters in α coefficient terms can take only positive values, the coefficient of ln$Q$ is expected to be positive and that of ln$w$ is expected to be negative.

3.2. Extended Model. The long run relation between labor demand (L) and its components (X) can be expressed as $L_t = f(X_t)$, where the subscript t represents time. The short-run relation, on the other hand, can be best explained as $\Delta L_t = f(\Delta X_t)$. The error correction model (ECM) is a combination of these two:

$$\Delta L_t = \alpha + \beta X_{t-1} + \gamma L_{t-1} + \mu \Delta X_t + \varepsilon_t \tag{6}$$

In the error correction model, the determinants of labor demand in the long-run (X) are selected on the basis of economic theory. Therefore, additional to the determinants in the CES production function approach, the following variables are added to the regression equation in the Keynesian approach: real GDP (Y), real wage rate (w), real user cost of capital (r), and linear time trend. The error-correction term (γ) can be interpreted as the speed of adjustment between two periods, which can also be viewed as the degree of flexibility in labor demand. The implied long-run relation is therefore of the following form:

$$L_t = \alpha + \beta_1 Y_t + \beta_2 w_t + \beta_3 r_t + \varepsilon_t \tag{7}$$

This model is named Model 2 below. The main difference between Model 1 and Model 2 is that Model 2 includes the variable r in addition to the list of variables in Model 1. Ex ante, real GDP is expected to have a positive long-run effect on labor demand and real wage level to have a negative impact on labor demand. Inclusion of the real user cost of capital is important for theoretical reasons. A positive value for r means that the substitution effect (i.e. substitution of labor for capital by producers) is stronger than the income effect.

3.3. Data Construction and Sources. Data are obtained from the Central Bank of Turkey Electronic Data Dissemination Service. All series are collected for the period 1988-2004. The real GDP series are at 1987 prices. Employment series are available biannually until the end of 1999 and quarterly thereafter. Thus, the frequencies of the employment data are different before and after 2000. Wage data obtained are normalized using the consumer price index series. Finally, real user cost of capital (r) is calculated using the following formula:

$$r = p_I\left(\pi_I - \delta + i\right) \tag{8}$$

where p_I, Π_I, δ, and i refer to the price deflator for fixed capital formation relative to the GDP deflator, inflation rate for investment good prices (calculated as the changes in the price deflator for fixed capital formation), depreciation rate (set as 0.05), and interest rate.

For *i*, the rate of interest for Treasury bonds with one-year maturity is used as a proxy.

4. Empirical Results

4.1. Unit Root and Cointegration Tests The series are first checked for unit roots and stationarity. The results of tests of stationarity are presented in Table 1. Stationarity of the series are checked for levels and differences using the Augmented Dickey-Fuller (ADF) test. Of the six series used in the analysis, only employment and real wage series for manufacturing are stationary and the rest are nonstationary. Furthermore, nonstationary series become stationary in the first differences, therefore they are integrated of order one, i.e. I (1).

Table 1. Unit root tests

Variable	Number of lags	t-statistic	Probability
Employment (aggregate)	4	-1.677	0.741
GDP (aggregate)	2	-1.962	0.603
Real wage (aggregate)	5	-2.934	0.164
Employment (manufacturing)	0	-4.298	0.007
GDP (manufacturing)	2	-1.291	0.624
Real wage (manufacturing)	1	-3.739	0.006
User cost of capital	0	-2.797	0.206

Table 2. Cointegration tests for the aggregate economy variables

Hypothesized number of cointegration equations	Eigenvalue	Trace test statistic	Critical values	
			5 percent	1 percent
Variables: employment, output, and wage (Model 1)				
None **	0.496	39.729	29.68	35.65
At most 1	0.295	13.679	15.41	20.04
At most 2	0.009	0.363	3.76	6.65
Variables: employment, output, wage, real user cost of capital (Model 2)				
None**	0.673	70.356	47.21	54.46
At most 1	0.456	27.813	29.68	35.65
At most 2	0.113	4.674	15.41	20.04
At most 3	0.002	0.099	3.76	6.65

Note: ** rejection of null hypothesis (no cointegration) at 5 percent level.

The requirement for non-stationary variables to reflect a long-run relationship is that they be cointegrated. If a linear combination of two I (1) series are stationary, then it is likely that they are cointegrated. For this purpose, there is a need to check for cointegration between the nonstationary variables to be used in regressions. The results of the cointegration tests based on the Johansen trace test for the aggregate economy is presented in Table 2.

4.2. Error Correction Model. Having established the existence of cointegration relations for the variables in the estimation equation for the aggregate economy, the relations between employment, GDP, and real wage level at the whole economy and manufacturing sector levels are estimated using error correction models (ECM). An ECM establishes a link between the long-run equilibrium and the short-run dynamics. The deviation from the long-run equilibrium is adjusted by short-sun adjustments. Employment is, then, a function of change in real GDP and real wage in the long-run. In addition, quarterly seasonal dummy variables and four dummies that represent years of economic crises (1994, 1999, 2001, and 2002) are also used in the estimations. The results of two ECM estimations for the aggregate economy (Models 1 and 2) are presented in Table 3. The implied ECM equation for the aggregate economy in Model 2 is as follows:

Employment = *Cons* + 0.731*GDP* – 0.290*Wage*

(5.265) (-2.295) *Adjusted* R^2= 0.872

where *Cons* refers to a constant and R-squared with a bar refers to the adjusted R-squared. The implied ECM equation for Model 2 is as follows:

Employment = *Cons* + 0.293*GDP* – 0.012*Wage + 0.145R*

(6.290) (-0.310) (5.492) *Adj.* R^2= 0.945

Table 3. Results of the ECM estimation for the aggregate economy

	Model 1		Model 2	
	Coefficient	(t-statistic)	Coefficient	(t-statistic)
Cointegration equation	-0.341	-2.635 **	-0.323	-0.666
D(Employment(-1))	0.124	0.696	0.264	0.636
D(Employment(-2))	-0.312	-1.273 *	-0.264	-0.699
D(Employment(-3))	0.258	1.280 *	0.296	0.747
D(Employment(-4))	-0.539	-2.087**	-0.345	-0.952
D(GDP(-1))	-0.494	-1.006	-0.435	-0.616
D(GDP(-2))	0.306	0.462	0.541	0.540
D(GDP(-3))	-0.490	-0.875	-0.420	-0.464
D(GDP(-4))	-0.012	-0.031	0.125	0.237
D(Wage(-1))	0.034	0.514	-0.015	-0.151
D(Wage(-2))	0.098	1.560*	0.095	1.206
D(Wage(-3))	-0.037	-0.486	-0.144	-1.514
D(Wage(-4))	0.018	0.234	0.038	0.406
D(r(-1))	-0.036	-2.307**	-0.096	-1.4420*
D(r(-2))	-	-	0.000	-0.002
D(r(-3))	-	-	-0.069	-1.127
D(r(-4))	-	-	-0.059	-0.844
Constant	-	-	-0.002	-0.070
Seasonal dummy 1	-0.075	-2.353**	-0.086	-1.4127*
Seasonal dummy 2	0.147	4.421***	0.125	2.812***
Seasonal dummy 3	0.077	2.649**	0.016	0.378
Seasonal dummy 4	-0.020	-0.722	-0.028	-0.597
Crisis 2000	0.050	1.700**	0.009	0.164
Crisis 2001	-0.059	-1.766**	-0.019	-0.252
Crisis 1994	0.054	1.416*	0.035	0.887
Crisis 1999	0.046	1.281*	-0.061	-1.5428*
R-squared	0.944		0.946	
Adjusted R-squared	0.872		0.832	
F-statistic	13.024		8.334	

Note: *, **, ***: significant at 10, 5, and 1 percent. D refers to first differences.

The values of t statistics are presented below relevant variables in parentheses. The explanatory power of the cointegration equations is good in both models as it is able to explain 87 and 94 per cent of the change in employment. The values of the coefficients can be interpreted as the elasticities of labor demand with respect to the corresponding variables. The t statistic values indicate that the variables are significant at least at 5 percent level, except wage in Model 2. The results of the ECM in Model 1 can be interpreted as follows: a percentage increase in GDP raises employment by 0.73 percent and a percentage increase in the real wage level reduces employment by 0.29 percent. In terms of Model 2, the coefficient of real wage is insignificant therefore the model's interpretation is as follows: a percentage increase in GDP raises employment by 0.29 percent and a percentage increase in the user cost of capital increases employment by 0.14 percentage points. The positive sign of the user cost of capital means that substitution effect is stronger than income effect. The magnitude of this effect (0.14) is, however, modest by any standard. Error correction factors can be viewed as an indicator of the speed of adjustment in disequilibrium in the labor market. To put differently, it can be interpreted as a measure of labor market flexibility. Error correction factors are found to be 34.1 percent in Model 1 and 32.3 percent in Model 2 (Table 3). The disequilibrium in the labor market is adjusted by about one-third in each period. Cellini *et. al*. (2001) reports the values of adjustment factors for European Union countries and the USA ranging between 0.4 and 0.8. Compared with such figures, the Turkish figure of 0.3 can be considered as a low one.

4.3. The Results for the Manufacturing Sector. The results of the estimation for the manufacturing sector using Models 1 and 2 are presented in Table 4.

Table 4. Results of the regression for the manufacturing sector

	Model 1			Model 2		
Variable	Coef.	t-stat.	Prob.	Coef.	t-stat.	Prob.
Constant	-8.181	-4.427	0.000	-6.355	-3.352	0.002
GDP	0.539	8.574	0.000	0.476	7.341	0.000
Wage	-0.050	-0.978	0.335	-0.025	-0.512	0.612
Cost of capital	-	-	-	0.125	2.351	0.025
Seasonal dummy 1	-0.083	-2.967	0.006	-0.136	-3.938	0.000
Seasonal dummy 2	-0.055	-1.896	0.067	-0.078	-2.703	0.011
Seasonal dummy 3	-0.041	-1.385	0.176	-0.075	-2.392	0.023
Seasonal dummy 4	-0.059	-2.118	0.042	-0.097	-3.159	0.004
Crisis 1994	0.035	0.688	0.496	0.004	0.075	0.941
Crisis 1999	0.119	2.268	0.030	0.145	2.879	0.007
Crisis 2000	-0.014	-0.264	0.794	0.003	0.056	0.956
Crisis 2001	0.037	0.673	0.506	0.044	0.846	0.404
R^2		0.903			0.918	
Adjusted R^2		0.873			0.888	
DW statistic		1.680			1.958	
Jarque-Bera test		0.717			0.871	
F stat. (prob.)		0.000			0.000	

Note: coef: coefficient, stat: statistic, prob: probability, DW: Durbin-Watson

The equations fit well with an explanatory power of 0.90-0.91. Durbin-Watson statistics imply no serious autocorrelation and the Jarque-Bera test statistics do not reject the null hypothesis of normality, i.e. the residuals are normally distributed. The results of regressions obtained from Model 1 suggest that the growth of manufacturing GDP (i.e. real manufacturing value-added) by one percent raises employment by about 0.54 percent and a rise in real wages by 1 percent decreases employment by a mere 0.05 percent. However, the coefficient for wage is not statistically significant as in the case of the aggregate economy above. With the inclusion of the cost of capital in Model 2, the results change slightly but the wage coefficient is still insignificant. In Model 2, one percent GDP growth in the manufacturing sector increases labor demand by 0.476 percent (smaller than the one in Model 2) and an increase in the real user cost of capital increases labor demand by 0.12 percent. The impact of the real user of capital on labor demand is almost same in both the aggregate economy and the manufacturing sector. An increase in the real cost of capital stimulates the use of more labor in place of capital (substitution effect) and this effect is larger than the income effect in which producers reduce their demands for both production factors.

4.4. Variance Decomposition and Impact Analysis. In this section, an unrestricted vector autoregression (VAR) model for the aggregate economy is constructed and variance decomposition of employment is performed. It is important to note that due to the existence of serious multicollinearity in a VAR model, the coefficients of the variables are not of interest. The relations among the variables can be extracted from Granger causality tests or from the decomposition of the variance of the error in the VAR model. Cholesky factorization is preferred in removing the contemporaneous correlation between a given innovation and the variables. In constructing the VAR model, it is also important to determine the Cholesky ordering of the variables since the variable that is placed later in ordering will be assigned a small share of decomposition. The ordering of the variables in VAR models is based on the underlying economic theory of this study and the sequence is as employment-GDP-wage in Model 1 and employment-GDP-wage-rental rate of capital in Model 2. Finally, in specifying the VAR model, optimal lags are selected according to Akaike Schwarz selection criteria and the model favors four lags. Variance decomposition exercise is performed for 20 periods. The results, which are presented in Figures 1 and 2, show that after, 20 periods, GDP accounts for about half of the variance of employment whereas real wage level and user cost of capital account for a very small amount of the variance in employment, amounting to less than 20 percent. About 20 (Model 1) or 40 percent (Model 2) of the variance of employment is accounted for by itself.

Figure 1. Variance decomposition of employment (Model 1)

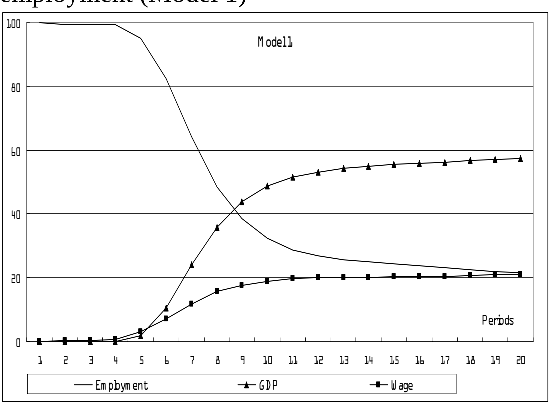
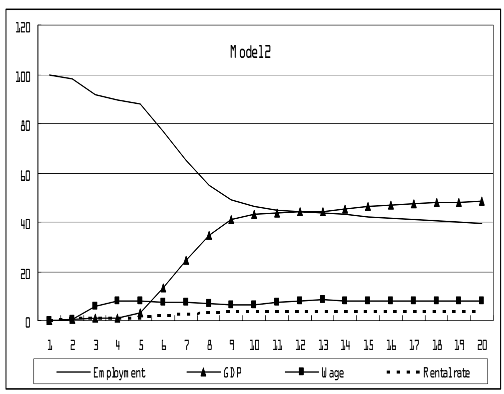


Figure 2. Variance decomposition of employment (Model 2)



4.5. Impulse Responses. Finally, impulse response functions for the aggregate economy are presented in Figures 3 and 4 for Models 1 and 2, respectively. An impulse response function measures the dynamic effects of a unitary shock on the variables under consideration, employment in this case. A shock to a given variable has an impact not only on itself but also on the current and future values of other endogenous variables in the VAR model due to the lag structure of the model. Impulse responses are derived by applying a specific Cholesky factor in the amount of one standard deviation of the innovation.

Figure 3. Impulse response functions of employment (Model 1)

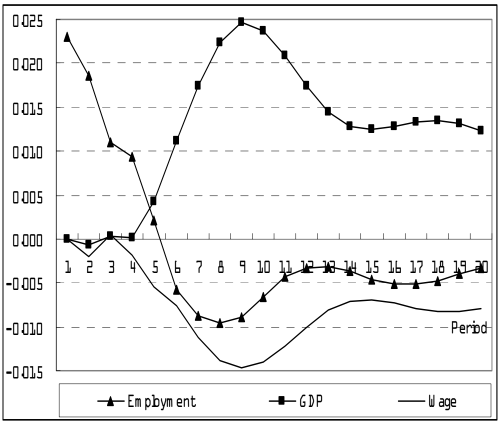
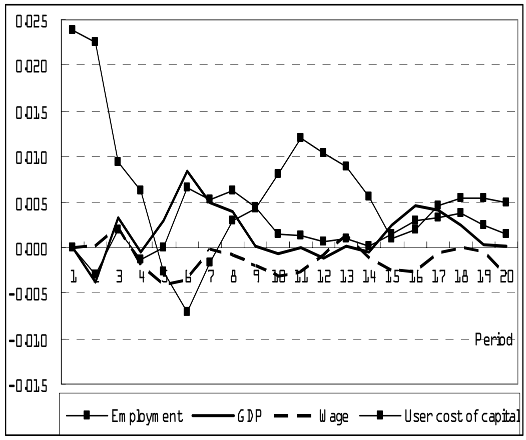


Figure 4. Impulse response functions of employment (Model 1)



In Model 1, the impulse response functions imply that the response of employment to GDP and wage shocks is negligible until the fifth period. From then on, labor demand responds to such shocks and the long-run path is achieved after 15 periods where the impacts of the shocks exhaust and remain stable. The effect of GDP shock is remarkable after the fifth period. In Model 2, the response of employment to GDP, wage level, and user cost of capital is very small until the fifth period. From fifth period on, the amplitude of the responses is large but they die out in the 13th period. In both models, the persistence of employment growth seems to be an important factor for employment growth. The impulse responses in this section point out an important finding emphasized in World Bank (2006). Output and wage shocks (and cost of capital shocks as a special case) are reflected in the labor market with a delay of more than four periods.

5. Conclusion

In this study, the relationship between employment, GDP, real wages, and the user cost of capital in Turkey is examined. The elasticity of employment with respect to real GDP was estimated to be 0.7 (or 0.3 percent when the user cost of capital is included) at the level of aggregate economy and 0.5 in the manufacturing sector. These results are similar to those found by Boltho and Glyn (1995) for OECD countries (within the range of 0.5-0.6 in general). In addition to these findings, it was found based on variance decomposition analysis that GDP accounts for about half of the variance in aggregate employment. The findings of the paper indicate that output shocks are reflected with a delay of four periods in the labor market. After four periods, GDP growth has an immediate and large effect on employment which lasts for about ten periods. Although economic growth provides a stimulus for employment, employment responds to growth with a delay. This may partially explain why unemployment rates have not increased much during serious recessions, as happened in 1994 and 1999. Similarly, during periods of high growth, unemployment rates have not declined much.

The conclusion of the analyses in this paper is thus that economic growth precedes employment growth and impacts significantly on adjustments in the labor market with a four-period delay. After this delay, GDP growth and persistence of employment growth lead to further increases in labor demand. This paper did not aim at exploring the structural factors that also have an important role in the changes in labor demand or labor supply, such as demographic and population dynamics, institutional factors in wage determination, and the government's employment policies. This study is purely of analytic nature and seeks mainly to examine the nature of the relation between employment and GDP growth. Therefore, the results have limited policy implications and should be interpreted with caution. One of the shortcomings of this paper is the lack of quarterly or monthly data. This is serious especially for wage levels in which Turkish statistics perform extremely poorly. For the disaggregated three-digit manufacturing industries, the wage data are available only annually, which makes it impossible to perform an analysis like the present one. Long data series at higher levels of disaggregation and frequency will be necessary for future research. The future direction of this study should concentrate more on economic sectors so that sectoral behaviors can be investigated.

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