TÜRKİYE CUMHURİYET
MERKEZ BANKASI

RESEARCH NOTES IN ECONOMICS

Decomposition of Real Wage Growth in Turkey[1]

Altan Aldan, H. Burcu Gürcihan Yüncüler

Özet: Ücretlerdeki artış oranı politika yapıcılar ve makro iktisatçılar için en önemli değişkenlerden birisidir. Ücretlerde artış ekonomik büyüme ve enflasyonist baskılar konusunda bir gösterge olarak kullanılabilir. Ancak, ortalama ücret artışı verisi işgücü piyasasındaki kompozisyon değişimlerini de içerdiğinden hatalı yorumlara yol açabilir. Bu çalışmada, 2005-2016 dönemi için, Oaxaca-Blinder ayrıştırma yöntemi kullanılarak söz konusu kompozisyon değişimlerinden arındırılmış ücret artış verisi elde edilmiştir. Çalışmanın bulguları, ekonomik yapıdaki ve işgücündeki dönüşüm sürecinin bu dönemde ücretler üstünde artırıcı bir etkisinin olduğuna işaret etmektedir. Ayrıca, söz konusu kompozisyon etkisinin boyutu yıllar içinde farklılık gösterebilmektedir. Bu nedenle, ortalama ücret artışları kullanılarak yapılacak yorumlarda temkinli olunmalıdır.

Abstract: Wage rate is one of the most important variables for policy makers and macro economists. It can be used as an indicator of economic growth and inflationary pressures. However, the average wage growth could also lead to misinterpretations as it involves composition changes in the labor market. In this study, we use Oaxaca-Blinder decomposition technique to filter out the effects of these composition changes on wage growth for the period of 2005-2016. Our results suggest that transformation of the economic structure and the labor force composition increased wages in this period. Besides, the magnitude of this composition effect is not homogeneous across years. Hence, conclusions based on aggregate wage data should be drawn carefully.

[1] The authors would like to thank to Murat Üngör for his valuable suggestions.

1. Introduction

Wage rate is one of the key labor market indicators used to assess the level of the economic activity and inflationary pressures. However, most of the time, wage related timely data that can be used for this purpose are aggregate variables that are subject to composition bias. At the aggregate level, wage rate is simply the aggregate compensation divided by total hours worked. Due to trends and cyclical variation in the labor market through time, this measure is biased and it does not always comply with state of economic activity. In this case, it is not possible to associate wage movements with productivity and demand conditions.

Data contaminated by compositional shifts can be misleading. For instance, different groups within the data set might be showing similar responses to a shock; however change in the weights of groups might imply a different response on average. Considering wage movements, observed wage inflation might be high not because of demand pressures but due to enhancing skill quality of labor (composition of labor changing at firm level or shift in economic activity towards high skilled industries/occupations). This type of bias poses a challenge not only for policy makers who react to economic conditions but also for macro theorist who try to match results of the models that postulate homogenous labor to stylized facts from aggregate data.

As documented in the literature, skill quality of labor increases during recessions introducing countercyclical composition bias that could obscure the cyclicality of real wages ((Solon et al. (1994) Keane and Prasad (1993)). Composition bias has been shown to exist in Turkey as well. Aldan and Yüncüler (2016) shows that ignoring unobserved heterogeneity result with misleading evidence about the cyclicality of real wages. In addition, gradual transformations in the structure of the economy and the composition of labor force can produce secular trends in real wages. This may be important for developing economies whose economic and demographic structures are converging to developed ones. Turkey is a typical example of a developing country in a catch up process. Compared with the developed countries, Turkey is characterized by low education level, high informality, low female employment rate, young population and high agricultural share in employment. However, there has been a significant convergence to the developed countries in terms of labor force structure and labor market conditions in the last decade.

As discussed above, labor market trends are highly dominant in the Turkish case. What is the impact of these trends on wage inflation? How has hourly wage behaved over time

once changes in the labor composition are accounted for? In this study, our motivation is to measure the composition bias inherent in average real wage growth for the 2005-2016 period. To do so, we use Oaxaca-Blinder decomposition method developed by Oaxaca (1973) and Blinder (1973). The method is originally developed for measuring the gender wage gap and is extensively used in the discrimination literature. In most of the applications, the method is used to decompose the differences in mean values between two groups in a given year.[3] On the other hand, we use Oaxaca-Blinder decomposition to analyse mean wages in two different years, rather than comparing two groups in a given year.[4] We decompose the change in average real wage into "explained" and "unexplained" parts, where the "explained part" reflects the impact coming from compositional changes and "unexplained" part can be considered as a measure of wage movements independent of compositional changes. Our results show that around a quarter of real wage growth between 2005 and 2016 is due to change in the composition of labor market. In addition, we find that compositional effects can vary significantly across years. Therefore, it might be misleading to draw conclusions based on the growth rate of average raw wage for policy makers.

2. Methodology

We use the standard Oaxaca-Blinder wage decomposition to disentangle wage changes into its explained and unexplained parts for the period 2005-2016 and for each consecutive year of the period. Starting point is a standard Mincerian wage regression of the form

$$w_{it} = X'_{it}\widehat{\beta}_t + \varepsilon_{it} \qquad (1)$$

where w_{it} is the logarithm of wage of an individual i at time t, X_{it} is the vector of covariates and ε_{it} is the error term. $\widehat{\beta}_t$ contains the slope parameters and the intercept. Mean log wage difference can be expressed as the difference in the linear prediction at the year-specific means of the regressors. That is:

$$E(w_{it}) - E(w_{it-1}) = E(X'_{it}\widehat{\beta}_t) - E(X'_{it-1}\widehat{\beta}_{t-1}) \qquad (2)$$

where $E(\varepsilon_{it}) = E(\varepsilon_{it-1}) = 0$. Under the assumption that residual mean is zero conditional on covariates, the equality $E(X'_{it}\widehat{\beta}_t) = E(X'_{it})\widehat{\beta}_t$ holds. Adding and subtracting the expression $E(X'_{it})\widehat{\beta}_{t-1}$, average counter-factual wage that workers in year t would have earned under the wage structure of year t-1; and replacing expectations with sample averages, the annual change in log hourly wage of an employee can be written as follows:

[3] Some examples of Oaxaca-Blinder methodology implementation include wage differences between different racial groups (Reimers, 1983), between public and private sectors (San and Polat, 2012) finance and non-finance sectors (Capuano etal, 2014).
[4] Similar to our utilization of Oaxaca-Blinder methodology, Babcock and Marks (2011) decompose the decline in academic time use of college students in US between 1961 and 2003.

$$\bar{w}_t - \bar{w}_{t-1} = \bar{X}_t'\hat{\beta}_t - \bar{X}_{t-1}'\hat{\beta}_{t-1} = \underbrace{(\bar{X}_t' - \bar{X}_{t-1}')\hat{\beta}_{t-1}}_{\text{Explained}} - \underbrace{\bar{X}_t'(\hat{\beta}_t - \hat{\beta}_{t-1})}_{\text{Unexplained}} \quad (3)$$

where $\hat{\beta}_t$ and $\hat{\beta}_{t-1}$ are the estimated coefficients from the wage regressions. The explained term is part of the difference that is due to differences in workers' characteristics and industry/occupation structure across years. It measures how much higher the employee sample of year t would have earned if they had been working in year t-1. The unexplained term measures the difference in wages across one year that is due to change in the wage structure. It can be interpreted as difference due economic conditions such as phase of the business cycle or to firm related factors such as productivity levels.

Because of the additive linearity in the equations, it is easy to compute detailed decomposition of the explained and unexplained parts. These parts can be written in terms of sums over the explanatory variables:

$$(\bar{X}_t' - \bar{X}_{t-1}')\hat{\beta}_{t-1} = \sum_k (\bar{X}_{t,k} - \bar{X}_{t-1,k})\hat{\beta}_{t-1,k} \quad (4)$$

$$\bar{X}_t'(\hat{\beta}_t - \hat{\beta}_{t-1}) = (\hat{\beta}_{t,0} - \hat{\beta}_{t-1,0}) + \sum_k \bar{X}_{t,k}(\hat{\beta}_{t,k} - \hat{\beta}_{t-1,k}) \quad (5)$$

Each element of the explained part is the respective contribution of the k^{th} covariate to the composition effect. Each component of the unexplained part is the contribution to the total wage structure coming from variation in the returns to the k^{th} covariate.[5]

3. Data and Descriptive Analysis

In our empirical analysis, we use micro datasets from the Household Labor Force Survey conducted by Turkish Statistical Institute (Turkstat) covering the period between 2005 and 2016. This survey provides information on a set of demographic and job-related individual characteristics. Our sample is limited to regular and casual employees working in the non-agricultural sector aged 15 or above. Outcome variable is real hourly wage obtained by deflating the nominal wage by Consumer Price Index.

We use the following explanatory variables in estimations: set of individuals' observed characteristics including age, age squared, gender, marital status, years of education, enrollment in school, years of tenure at the firm, tenure squared, labor market status in the previous year (employed or not), industry of employment according to the NACE Rev. 2 classification, permanency of the job and part-time work.[6] We also include four skill categories related with occupations using International Labor Organization classification

[5] Details of Oaxaca-Blinder decomposition and the Stata command "oaxaca" used in this paper can be found in Jann (2008).
[6] As an alternative, we also included the square of years of education. The results are roughly the same.

(ILO, 2012). Finally, we include regional dummies for 26 NUTS2 regions. In all regressions, we use the population weights provided by Turkstat.

Table 1 reports the means of the variables used in the analysis, for the years 2005 and 2016. The differences of the means are also given. The table shows that real wages are around 42 percent higher on average in 2016 compared to 2005. In 2016, there are more female and less married workers and workforce on average is older and more educated. In this period, share of workers without social security has declined significantly. Moreover among the workers; share of those enrolled in education has increased, years of tenure at the same job has declined. Finally, the share of occupations requiring the highest level of skill (skill level 4) has increased while the share occupations requiring skill levels 2 and 3 declined.

Table 1. Descriptive Statistics

	Whole Sample	2005	2016	Difference
Real Hourly Wage (Log)	0.944	0.685	1.110	0.424
Age	34.622	33.278	35.483	2.205
Female	0.258	0.209	0.289	0.080
Married	0.673	0.688	0.663	-0.025
Years of Education	9.651	8.913	10.131	1.218
Enrolled in Education	0.102	0.055	0.131	0.076
Informal	0.195	0.286	0.137	-0.150
Years of Tenure	6.228	6.876	5.812	-1.065
Temporary Work	0.083	0.083	0.082	-0.001
Part-time	0.032	0.021	0.038	0.017
Employed Last Year	0.869	0.866	0.871	0.005
Skill Level 1	0.133	0.133	0.133	-0.001
Skill Level 2	0.605	0.616	0.598	-0.018
Skill Level 3	0.093	0.105	0.085	-0.020
Skill Level 4	0.170	0.146	0.185	0.039
Number of Observations	165550	70443	93922	

Notes: All differences are significant at 1 percent except for temporary work and skill level 1 dummies. Skill levels 1 and 4 correspond to occupations with least and most skill requirements, respectively. Real hourly wages are calculated at 2005 prices.

4. Results

We start with presenting the results of Mincerian wage equations for the years 2005 and 2016 in Table 2.[7] Coefficients of age and tenure are positive and age and tenure squared are negative as expected. Being a women and working informally are associated with lower wages and wages are positively correlated with years of education as documented in the

[7] Regression results for all years in the sample are available upon request.

literature. Rather surprisingly, there is a large premium of working part time once other characteristics are controlled. This might be a reason of lower declared working hours than actual working hours for part time workers. On the other hand, Booth and Wood (2008) find a part-time wage premium for Australia and develop some hypotheses on this result.[8]

Table 2. Determinants of Wages		
	2005	**2016**
Age	0.051	0.038
Age squared	-0.001	0.000
Female	-0.052	-0.088
Married	0.070	0.061
Years of Education	0.043	0.039
Enrolled	0.033	-0.005
Informal	-0.277	-0.329
Tenure	0.021	0.012
Tenure squared	0.000	0.000
Skill level 2	0.042	-0.013
Skill level 3	0.212	0.177
Skill level 4	0.426	0.507
Temporary work	-0.138	-0.128
Part-time work	0.393	0.211
Employed Last Year	0.078	0.084
Notes: Dependent variable is the logarithm of hourly wage. All coefficients are significant at 1%. Coefficients of occupational skills are relative to occupations requiring least skill (skill level 1). Both regressions include industry and region dummies.		

In the second step, we decompose real wage growth into explained and unexplained parts for the period of 2005-2016 and calculate the contribution of wage determinants on explained wage growth. As presented in Table 3, total real wage growth is 43.4 percent if we do not take the compositional changes into account. On the other hand, if the structure of labor market remained constant at 2005 levels, wage growth would be 32.7 percent. Real wages further increased by 10.8 percent due to compositional changes in the labor market. In other words, there is around 1 percent rise in real wages annually due to structural transformation of the economy and population.

Next we turn to the contribution of covariates to wage growth. We see that highest (positive) contributions to wage growth come from increase in educational attainment of wage earners and decline in informality. Average wages are around 10 percent higher in 2016 compared to 2005 due to rise in educational attainment and declining informality.

[8] One of the possible reasons for part-time wage premium is that part-time workers might be less likely to work extra-hours which will reduce hourly wages of full-time workers (Booth and Wood, 2008). In 2005, on average, part-time workers in Turkey declared around 20.3 hours per week compared to 54.7 hours per week for full-time workers.

Change in the occupational composition towards more skilled jobs and aging population have also significant effect on real wage growth. On the other hand, decline in the average tenure in the firm reduces wage growth considerably. Increasing female employment rate has a negative but smaller effect on wage growth.

Table 3. Decomposition of Real Wage Growth (2005-2016, %)

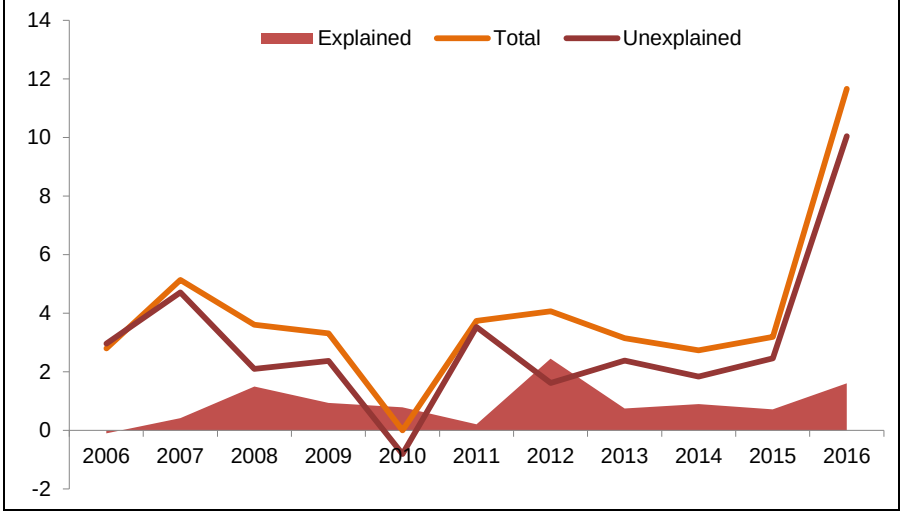
Wage Growth	Unexplained	Explained
43.4	32.7	10.8
Contribution of Covariates to Explained Growth(2015-2016,%)		

Informality**	5.17	Tenure**	-1.20
Years of Education**	4.74	Female Share**	-0.60
Skill Composition**	1.80	Industry Composition**	-0.30
Age**	1.20	Married**	-0.10
Part Time**	0.35	Regional Composition**	-0.10
Employed Last Year	0.04	Enrolled in Education	-0.00

Notes: Wage growth is calculated as the difference of average of logarithm of wages. All effects are significant at 1%. The effects of age and tenure are combined effects of these variables and their square. The composition effects are the combined effects of categorical variables. ** denotes significance at 5 %.

The results in Table 3 indicate that change in labor market structure and worker characteristics explain around 25 percent of wage growth between 2005 and 2016. In order to see whether this effect is homogenous within the period, we redo the Oaxaca-Blinder decomposition for every annual wage change between 2005 and 2016. By doing so, we obtain two series of wage growth; raw wage growth and unexplained or compositionally adjusted wage growth. Figure 1 shows that although two series are highly correlated, considering only raw wage growth can sometimes be misleading. For example, raw wage growth in 2012 was higher than 2011 pointing out to increasing inflationary pressure whereas compositionally adjusted wage growth rate declined. In summary, our results reveal that the effects of compositional changes are not homogenous across years. Cyclical effects or policies might have caused variation in the magnitude of composition effects. For example, the (positive) contribution of skill composition of occupations increased in the years of slowdown, namely 2009, 2012 and 2016 (See Table A1 in the appendix). This is in line with the earlier literature suggesting that firms keep mostly skilled jobs in the periods of economic downturn.

Figure 1. Total, Explained and Unexplained Wage Growth (%)



4. Results

Wage rate is one of the critical indicators followed by policy makers. Besides, it is of academic interest since it is included in most of the macroeconomic models. On the other hand, wage movements include the effects of the changes in the labor force (such as age, gender composition or educational attainment) or structural transformation (such as decline in informality or shifts in industrial composition). Therefore, analysis based on average wage rate in a developing country like Turkey can be misleading.

In this note, we examine whether worker characteristics and/or labor market structure have a significant role in average wage movements. We show that around a quarter of real wage growth between 2005 and 2016 can be explained by observed factors. Moreover, this explained part of wage growth is not uniform among years. Hence, movements of raw wage and composition adjusted wage, which can be considered to be more related to macroeconomic factors, can sometimes be quite different.

Our results have important implications. First, changes in labor market conditions have a tendency to increase wages mainly due to increasing educational attainment of the workforce and declining informality. Policy makers should consider that, real wages increase around 1 percent on average due to changes in labor market every year. Second, policy recommendations or macroeconomic models that ignore compositional changes may cause misleading results.

References

Aldan, A., & Yunculer, H. B. G. (2016). Real wages and the business cycle in Turkey. Central Bank of the Republic of Turkey, Working Paper No. 1625.

Babcock, P., & Marks, M. (2011). The falling time cost of college: Evidence from half a century of time use data. *Review of Economics and Statistics*, *93*(2), 468-478.

Blinder, A. S. (1973). Wage discrimination: Reduced form and structural estimates. *Journal of Human Resources*, 8(4), 436-455.

Booth, A. L., & Wood, M. (2008). Back-to-front down under? Part-time/full-time wage differentials in Australia. *Industrial Relations: A Journal of Economy and Society*, *47*(1), 114-135.

Jann, B. (2008). The Blinder-Oaxaca decomposition for linear regression models. *The Stata Journal*, *8*(4), 453-479.

Capuano, S., Lai, T. K., & Schmerer, H. J. (2014). The US finance wage premium before and after the financial crisis: a decomposition exercise. *Applied Economics Letters*, *21*(16), 1144-1147.

ILO (2012). International Standard Classification of Occupations: Structure, Group Definitions and Correspondence Tables, http://www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/---publ/documents/publication/wcms_172572.pdf

Keane, M., & Prasad, E. (1993). Skill levels and the cyclical variability of employment, hours, and wages. *Staff Papers (International Monetary Fund)*, *40*(4), 711-743.

Oaxaca, R. (1973). Male-female wage differentials in urban labor markets. *International Economic Review*, 14(3), 693-709.

Reimers, C. W. (1983). Labor market discrimination against Hispanic and black men. *The Review of Economics and Statistics*, 65(4), 570-579.

San, S., & Polat, Ö. (2012). Estimation of public–private wage differentials in Turkey with sample correction. *The Developing Economies*, *50*(3), 285-298.

Solon, G., Barsky, R., & Parker, J. A. (1994). Measuring the cyclicality of real wages: how important is composition bias?. *The Quarterly Journal of Economics*, *109*(1), 1-25.

Appendix:

Table A1. Contribution of Covariates to Annual Explained Real Wage Growth

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Average Wage Growth	**2.80**	**5.14**	**3.62**	**3.33**	**-0.01**	**3.74**	**4.07**	**3.15**	**2.75**	**3.19**	**11.66**
Explained Growth	**-0.16**	**0.43**	**1.51**	**0.95**	**0.79**	**0.21**	**2.45**	**0.75**	**0.91**	**0.73**	**1.61**
Age	-0.03	0.14**	0.23**	0.18**	0.15**	0.18**	0.23**	0.13**	-0.03	0.06	0.17**
Female	-0.05**	-0.02**	-0.04**	-0.06**	0.01	-0.05**	-0.11**	-0.10**	-0.03**	-0.12**	-0.09**
Married	-0.05**	0.00	0.02	0.01	-0.02	-0.06**	-0.03**	-0.01	-0.09**	-0.02	0.04**
Education	0.56**	0.40**	0.64**	0.48**	0.18**	0.35**	0.79**	0.28**	0.54**	0.55**	0.53**
Enrolled in Education	0.00	-0.01**	0.01**	0.02**	0.00	-0.01**	-0.01	-0.03**	-0.04**	-0.01*	0.00
Informal	0.25**	0.52**	0.87**	0.13**	0.22**	0.13**	0.74**	0.45**	0.45**	0.25**	0.16**
Tenure	-0.61**	-0.21**	-0.20**	0.05	-0.18**	-0.21**	-0.05	-0.13**	-0.05	-0.09**	0.16**
Skill	-0.06	-0.37**	0.01	0.42**	0.30**	-0.07	0.50**	0.26**	0.11	0.23**	0.41**
Temporary	-0.03**	0.03**	0.07**	0.07**	-0.01**	-0.02**	0.00	-0.01**	-0.01	-0.03**	0.03
Part-time	0.07**	-0.01	0.05	0.18**	0.12**	-0.01	-0.01	0.09**	0.03	0.03	0.03
Employed Last Year	0.09**	0.00	0.01	-0.04**	-0.16**	-0.01	0.08**	0.05**	0.01	-0.03*	0.08**
Industry Composition	-0.22**	0.06	-0.14*	-0.28**	0.27**	-0.01	0.27**	-0.19**	-0.23**	-0.06	0.12**
Regional Composition	-0.07	-0.08	-0.03	-0.21**	-0.08	-0.02	0.07	-0.03	0.26**	-0.05	-0.01

Notes: Wage growth is calculated as the difference of average of logarithm of wages. The effects of age and tenure are combined effects of these variables and their square. The composition effects are the combined effects of categorical variables. * and ** denote significance at 10 % and 5 %, respectively.

For questions and comments:
Editor, Research Notes in Economics
TCMB İdare Merkezi, Anafartalar Mah. İstiklal Cad, No: 10, Kat:15, 06050, Ulus Altındağ Ankara/TURKEY
E-mail: ekonomi.notlari@tcmb.gov.tr