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Relationship between wages, labour productivity and unemployment rate in new EU member countries

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Abstract. The main aim of this article is to find out the extent to which relative labour productivity and relative unemployment rate changes determine relative wage changes. We use average annual macro-data for the period 2002-2013 for Poland and other 5 new EU members: Estonia, Hungary, Slovak, Czech Republic and Slovenia. Using Poland as benchmark, first we examine the correlation between wage, productivity and unemployment rate changes in countries in question. Then, using panel data model we assess the elasticities of the relative wage changes with regard to relative productivity and unemployment changes. We found out that the trajectory of wage, productivity and unemployment rate development in new EU member countries is diversified. We confirmed a strong relationship between wage and productivity ratio changes in Poland related to Czech Republic, Estonia and Hungary. Moreover, an increase of productivity in Poland in comparison to Czech Republic is greater than an increase of wages in Poland in comparison to Czech Republic. The same relation occurs in Slovak and Slovak Republic. At the same time the productivity in Poland in relation to Hungary and Estonia has been growing slower than the wages in Poland in comparison to Hungary and Estonia. The correlations between wage and unemployment rate ratios are of smaller significance.

Keywords: real wages, labour productivity, unemployment rate, wage determination, wage-setting mechanism, new EU member countries

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INTRODUCTION

Wage-setting mechanism is closely connected both with labour market and consumer goods market thereat plays the major role in the entire economy. In neoclassical approach higher labour productivity is reflected fully in higher wages. By reviewing relevant literature it can be noticed that a major part of wage determination analysis are based on *the Philips curve* (Phillips, 1958) or *the wage curve* (Blachflower & Oswald, 1994). Hence, in most studies on macro level wages are explained by unemployment.

In this article we propose quite modified approach: using aggregate macro-level data, we attempt to determine the relations between ratios of wages, labour productivity (hereafter, productivity refers to labour productivity) and unemployment rate. Thus, *the wage ratio* is defined as a ratio of wage level in Poland

to wage level in other country, *productivity ratio* means a ratio of labour productivity in Poland to labour productivity in other country and *unemployment ratio* denotes a ratio of unemployment rate in Poland to unemployment rate in other country.

The article is a continuation of previous own research on the wage determination in Poland and in Germany in the years 1997-2012 (Nikulin, 2013). The analysis concerned two countries with different rates of technological development. Estimation results indicated that an increase in *productivity ratio* by 1% (the ratio of productivity in Poland to productivity in Germany rose by 1%) caused a grow in *wage ratio* by 0,8% (the ratio of wages in Poland to wages in Germany rose by 0,8%), by other variables unchanged. Now, we try to examine the relations in countries which entered the European Union at the same time (in 2004) to point out a trajectory of some labour market indicators development. Thus, the main aim of this article is to look into the relations between wage, productivity and unemployment ratio in countries under consideration and to find out the extent to which relative productivity and relative unemployment rate changes determine relative wage changes. We conduct an analysis for 6 new EU member countries: Estonia, Hungary, Slovak, Czech Republic, Slovenia and Poland, for the years 2002-2013.

The structure of the article is as follows. Section 2 discusses previous empirical research on wage curves. In section 3 we present our data and methodology. Section 4 provides an empirical analysis of wage, productivity and unemployment rate in Poland in relation to other countries. We conduct a development of *wage, productivity* and *unemployment ratio* co-relation, then we use the Spearman's rank correlation coefficient to assess the correlation and finally we estimate an econometric model to explain the *wage ratio* variability. Section 5 concludes.

LITERATURE REVIEW

In the literature there is some debate about wage curves. Most of the considerations are based on conception provided first by Phillips (Phillips, 1958) and their extensions (Samuelson & Solow, 1960) and (Tobin, 1972). The wage model (1) used by Welfe (Welfe, 1997) is in the line with the wage curve proposed by Phillips:

$$\frac{\Delta w_t}{w_{t-1}} = \alpha_0 + \alpha_1 \frac{\Delta p_t}{p_{t-1}} + \alpha_2 \frac{\Delta z_t}{z_{t-1}} + \alpha_3 ur_t + \delta_t \tag{1}$$

where w_t denotes average nominal wage, p_t denotes average price level calculated with the use of consumer price index, z_t – labour productivity, ur_t – unemployment rate, δ_t - random coefficient. Model (1) was used to estimate the wage rate in Poland in the period 1960-1993 (Welfe, 1997). Note, that there is a several other attempts to assess the determinants of wage level or wage rate in Poland, see e.g. (Welfe, 1996), (Welfe, 2000), (Osiewalski & Welfe, 1998), (Kwiatkowski et al., 1999), (Welfe, Kelm, & Majsterek, 2002), (Ossowski, 2013), (Nikulin, 2013). Proposed empirical models enable measuring the elasticity of wages with respect to price level, labour productivity and unemployment rate. Moreover, some researchers provided empirical wage models using real wage level, e.g. (Welfe, Karp, & Kębłowski, 2006). Blanchard and Katz (Blanchard & Katz, 1999) estimated the real wage as the function of unemployment, given the reservation wage and labour productivity. They considered the *wage curve* proposed by Blanchflower and Oswald (Blachflower & Oswald, 1994) and examined some OECD counties and US economy.

Moreover, there is also a wide range of analysis of the wage determination in new EU member countries. D'Adamo (D'Adamo, 2014) examined wages in the public sector and the private traded and non-traded sector in ten transition countries which are members of the European Union. Rusinova et al. (Rusinova,

Lipatov, & Heinz, 2015) found the evidence for a reaction of wage growth to unemployment and productivity growth in 19 EU countries. Wage-setting analysis for Poland, Hungary, Czech Republic, Slovakia were provided e.g. by Basu et al. (Basu, Estrin, & Svejnar, 2004) and (Estrin, Svejnar, & Basu, 1997). They obtained a negative coefficient of unemployment in the wage equation. However, other authors also suggest the negative unemployment elasticity of pay. Iara and Traistaru (Iara & Traistaru, 2003) estimated wage curve for Poland, Hungary, Romania and Bulgaria using regional data from 1991-1999. They retrieved that average wages were negatively associated with regional unemployment rate in Poland (the unemployment elasticity of pay was around -0,06). Similar results received Duffy and Walsh (Duffy & Walsh, 2001). Blanchflower (Blanchflower, 2001) examined the wage curve for 23 transitions countries (i.a. Poland, Slovakia, Hungary, Czech Republic, Estonia, Slovenia). He found the wage elasticity with respect to unemployment rate from -0,3 to -0,1.

Also note that our empirical wage equations are only partially in line with the mentioned real wage models. We contribute to the literature on labour market in European countries by applying ratios of wage, productivity and unemployment rate in Poland to other countries instead of using their levels. We believe that our approach allow to observe the changes in wages, productivity and unemployment rate in Poland in comparison to changes in the other countries, which entered the European Union at the same time. The main result of our study is a comparison of productivity and wage changes in Poland in relation to analogous changes in other new EU member countries.

DATA AND METHODOLOGY

All data were collected from OECD statistics (data.oecd.org). According to the OECD methodology the *average wage* is obtained by dividing the national-accounts-based total wage bill by the average number of employees in the total economy, which is then multiplied by the ratio of the average usual weekly hours per full-time employee to the average usually weekly hours for all employees. This indicator is measured in USD constant prices using 2012 base year and Purchasing Power Parities (PPPs) for private consumption of the same year, what enables an international comparison (OECD, 2015a). The *average labour productivity* instead is calculated on dividing the level of GDP by hour worked. The indicator is measured in USD constant prices (using 2005 as base year) and PPP of 2005 (for more information about the measure of labour input see e.g. (OECD, 2001)). Following the OECD methodology (OECD, 2015b), we use the *harmonised unemployment rate (HUR)*, to calculate the extent of unemployment.

We use quantitative methods. First, we observe the development of wage and productivity ratio in the analysed period. Then we assess the correlation between relative wages, productivity and unemployment rate in Poland in relation to other countries using Spearman's rank correlation coefficient. Finally, we examine the elasticities of *wage ratio* with respect to *productivity ratio* and *unemployment ratio* in all counties in question. We apply the random coefficient model for panel data.

EMPIRICAL ANALYSIS

Development of the wage-productivity co-relation

This part of the article we start with the explanation of tree types of ratios we've built. The first one, called *wage(earnings) ratio(E_t)*, means the ratio of average annual wage in Poland in time *t* to average annual wage in country *i,* at the same time *t*:

$$E_t = \frac{AWP_t}{AWC_{it}} \tag{2}$$

where: AWP_t denotes average annual wage in Poland in time *t,* AWC_{it} denotes average annual wage in other country *i* at the same time *t*.

Then, we can describe the *productivity ratio (LP_t)* and *unemployment ratio (UR_t)* in the same way:

$$LP_t = \frac{ALPP_t}{ALPC_{it}} \tag{3}$$

where: $ALPP_t$ denotes average labour productivity in Poland in the time *t*, $ALPC_{it}$ denotes average labour productivity in other country *i* in the time *t*.

$$UR_t = \frac{URP_t}{URC_{it}} \tag{4}$$

where: URP_t denotes unemployment rate in Poland in the time *t*, URC_{it} denotes unemployment rate in other country *i* in the time *t*.

The Figure 1 presents *wage* (E) and *productivity* (LP) *ratios* development in the time 2002-2013 in 5 countries (Czech Republic, Estonia, Hungary, Slovak Republic and Slovenia). Within the Figures 1a-1e is contained that the differences in wage level between Poland and other countries are larger than the differences in labour productivity. In particular, in 2002 average wage in Poland amounted to 123% of average wage in Czech Republic. Simultaneously, the ratio of productivity in Poland to productivity in Czech Republic valued at 0,74, what indicate, that the productivity in Poland equalled 74% the productivity in Czech Republic. In 2013 the wage level in Poland is 111% the wage level in Czech Republic and the productivity in Poland amounted to 79% of productivity in Czech Republic We can conclude, that predominantly wages in Poland between 2002-2013 have been rising slower than in Czech Republic, whereas the productivity in Poland have been increasing faster than in Czech Republic.

Comparing the *wage* and *productivity ratio* related to Poland and Estonia, we can observe that the ratio altered significantly in the years 2002-2013. In 2002 wages in Poland were 167% of wages in Estonia, whereas in 2013 only 120%. Whereas, the ratio of productivity in Poland and productivity in Estonia showed minimal fluctuation. In 2002 productivity in Poland is 106% of productivity in Estonia, while in 2013 - 101%. It is important to note that the gap between *wage ratio* (E) and *productivity ratio* (LP) decreased significantly in the analysed period, what results mainly from the continually growth of the wage level in Estonia.

As can be seen from the Figure 1C the *wage ratio* as well as the *productivity ratio* were volatile in the analysed period. From 2002 to 2007 both ratios have been falling, what indicate, that both the wages and productivity have been rising faster in Hungary than in Poland. On the contrary, after 2007 an upward trend may be observed, what mean that both the wages and productivity have increased rapidly in Poland than in Hungary. Comparing year 2002 with 2013 we can observe that the *wage ratio* grew from 1,05 to 1,08. Thus,

despite of significant fluctuations in analysed period, the final level of wage ratio was nearing to the initial one. However, the growth of productivity in Poland was more significant than in Hungary at the same time.

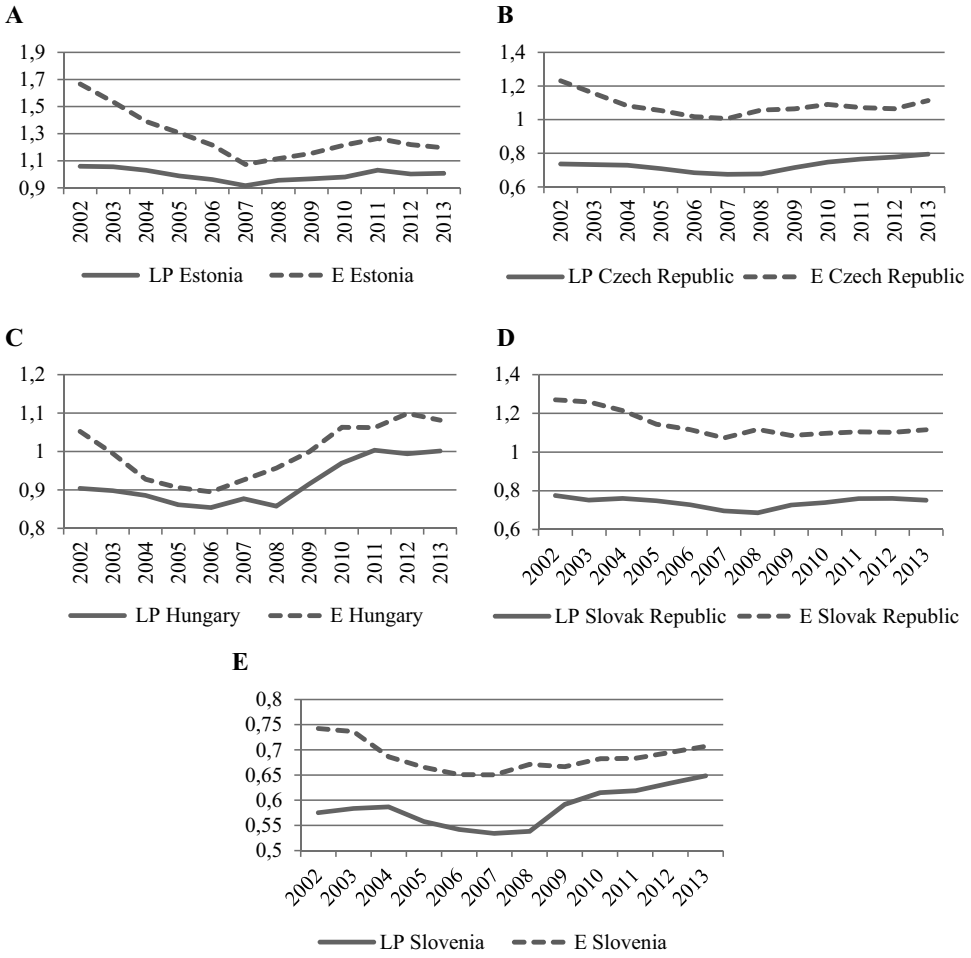

Figure 1. The wage (E) and productivity (LP) ratios in the years 2002-2013.
Source: own elaboration using the OECD databases OECD (2015), Average wages (indicator). doi: 10.1787/cc3e1387-en (Accessed on 05 February 2015), and Level of GDP per capita and productivity: http://stats.oecd.org/Index.aspx?DataSetCode=PDBI_I4

Figure 1D shows that the *productivity ratio* in Poland to Slovak Republic was unchanged in the years 2002-2013. In particular, in 2002 the productivity in Poland constituted 78% of the productivity in Slovak Republic, whereas in 2013 the ratio was 75%. On the contrary, the *wage ratio* showed a slightly downward trend, particularly from 2002-2007, when the ratio fell from 1,27 in 2002 to 1,07 in 2007 (wages in Poland in 2007 constituted 107% of wages in Slovak Republic). After 2007 the relation between productivity level

in these two countries was rather stable. On the other hand, for the whole period 2002-2013 the wages in Slovak Republic have been increasing faster than in Poland, therefore the gap between wages in these two countries has decreased.

Within the Figure 1E is contained that the *wage ratio* between Poland and Slovenia maintained the steady rate. In 2002 the average wage level in Poland constituted 74% of average wage level in Slovenia, whereas in 2013 it was 71%. Moreover, the fluctuations of *productivity ratio* were also slight in the whole period. In 2013 in comparison to 2002 the *productivity ratio* was greater only by 7 pp. Therefore, in 2013 productivity in Poland constituted 65% of productivity in Slovenia.

Correlation between wages, labour productivity and unemployment rate

In previous step we have examined the developing of wage and productivity ratio in 5 countries in the years 2002-2013.

Table 1

Correlation between *wage* and *productivity ratio* ($r_{E, LP}$) and between *wage* and *unemployment ratio* ($r_{E, UR}$) in new EU member counties in the years 2002-2013.

	($R_{E, LP}$)	($R_{E, UR}$)
Czech Republic	0,720 p=0,008	-0,042 p=0,897
Estonia	0,874 p=0,000	-0,259 p=0,417
Hungary	0,902 p=0,000	-0,608 p=0,036
Slovak Republic	0,483 p=0,112	0,545 p=0,067
Slovenia	0,552 p=0,06	-0,028 p=0,931

Source: own elaboration.

In the next part of the article we assess the correlation between *wage ratio* and *labour productivity ratio* in countries under consideration. Moreover, we investigate also the correlation between *wages* and *unemployment rate*. Because of small dataset, we use one of the nonparametric test, Spearman's rank correlation coefficient, to indicate the relation between ratios we analyse. The results of the estimation are presented in Table 1.

It can be seen from the Table 1 that only in Hungary and Slovak Republic there is a statistically significant relation between *wage ratio* and *unemployment ratio* (we use an alpha level of 0,10 for all statistical tests). In Hungary the correlation is inverse and rather moderate what signifies that an increase in *wage ratio* corresponds to a decrease in *unemployment ratio*, and conversely. While, in Slovak Republic an increase in *wage ratio* corresponds to an increase in *unemployment ratio*. In other countries it is not possible to determine the relations between *wage* and *unemployment ratio*, because of their statistical insignificance. In case of correlation between *wage* and *productivity ratio*, the statistically significant relation occurs in all countries under consideration. In Czech Republic, Estonia and Hungary the relation is positive and strong, what implicates the fact, that changes in *wage ratio* are strongly connected with changes in *productivity ratio*. It is important

to note, that an increase in the ratio of average wage in Poland to average wage in Czech Republic corresponds closely to an increase in the ratio of productivity in Poland to productivity in Czech Republic. The same relationship emerges in Estonia and Hungary, whereas in Slovak Republic and Slovenia the strength of this relationship is weaker. On the whole, in each analysed country the changes in *wage ratio* are significant connected with changes in *productivity ratio*.

Econometric modelling

Besides the identification of correlation between analysed ratios it seemed to be recommended to use econometric wage determination models to indicate the elasticities of the *wage ratio* with regard to *productivity* and *unemployment ratio*. The analysed data are cross – sectional time series, so we've decided to use a panel data model. Given that our entitles (countries) are heterogeneous, we estimate a random coefficient regression using the generalized least squares (GLS) method. We've examined the structural differences across five countries in question using a Chow test and have rejected the H_0 hypothesis about poolability. We find it appropriate to treat the elasticities of *wage ratio* with respect to *productivity ratio* and *unemployment ratio* as random variables differing from country to country. Random coefficient regression (RCR) model treats both intercept and slope coefficients as random variables (Swamy, 1970). The model proposed by Swamy (Swamy, 1970) is as follows:

$$y_i = X_i\beta_i + \varepsilon_i \tag{5}$$

where i=1..N denotes countries, y_i is a vector of observations for *i*th country, X_i is a matrix of nonstochastic covariates, and β_i is a vector of parameters specific to country i. The error term vector ε_i is distributed with mean zero and variance σ_{ii}I. Moreover, each country – specific β_i is related to common parameter vector β:

$$\beta_i = \beta + \nu_i \tag{6}$$

where $E(\nu_i) = 0$, $E(\nu_i\nu_i') = \sum$, $E(\nu_i\nu_j') = 0$ for j≠I, and $E(\nu_i\varepsilon_j') = 0$ for all *i* and *j*.

In this case we consider the following model:

$$LE_{it} = \beta_0 + \beta_1 LLP_{it} + \beta_2 LUR_{it} + \varepsilon_{it} \tag{7}$$

where: LE_{it} - natural logarithm of *wage ratio* in time *t* and country *i*; LLP_{it} - natural logarithm of *productivity ratio* in time *t* and country *i,* LUR_{it} - natural logarithm of *unemployment ratio* in time *t* and country *i*.

After estimation of the model (6) we get country-specific best linear predictors. The elasticities of the *wage ratio* with regard to *productivity* and *unemployment ratio* are reported in Table 2

Testing the joint significance of the slope parameters with the use of the Wald chi2 test, we can state that all the coefficients in the model are statistically significant. Based on estimated model we can make the following conclusions:

– in case of Czech Republic: if the ratio of productivity in Poland to productivity in Czech Republic increases by 1 %, we can expect the ratio of wage in Poland to wage in Czech Republic to increase by an average of 0,76%. Moreover, an increase in ratio of unemployment rates in Poland and in Czech Republic by 1% causes an average increase in wage ratio by 0,11%;

– in case of Estonia: if the ratio of productivity in Poland to productivity in Estonia increases by 1 %, we can expect the ratio of wage in Poland to wage in Estonia to increase by an average of 2,67%. Moreover, an increase in ratio of unemployment rates in Poland and in Estonia by 1% causes an average increase in wage ratio by 0,07%;
– in case of Hungary: an increase in ratio of productivity in Poland and in Hungary by 1% causes an average increase in wage ratio by 1,24%. The influence of unemployment ratio on wage ratio is statistically insignificant;
– in case of Slovak Republic: if the ratio of productivity in Poland to productivity in Slovak Republic increases by 1 %, we can expect the ratio of wage in Poland to wage in Slovak Republic to increase by an average of 0,84%. Moreover, an increase in ratio of unemployment rates in Poland and in Slovak Republic by 1% causes an average increase in wage ratio by 0,14%;
– in case of Slovenia: if the ratio of productivity in Poland to productivity in Slovenia increases by 1 %, we can expect the ratio of wage in Poland to wage in Estonia to increase by an average of 0,8%. Moreover, an increase in ratio of unemployment rates in Poland and in Slovenia by 1% causes an average increase in wage ratio by 0,09%.

Table 2

The elasticities of the *wage ratio* with regard to *productivity* and *unemployment ratio* analysed countries.

Czech Republic	*Coefficient*	*Standard error*	*z*	*p>z*
LLP	0,7561739	0,2814873	2,69	0,007
LUR	0,1091288	0,0312034	3,5	0,000
Estonia				
LLP	2,667515	0,3711935	7,19	0,000
LUR	0,0732307	0,02637	2,78	0,005
Hungary				
LLP	1,242372	0,2451441	5,07	0,000
LUR	0,0231222	0,0235141	0,98	0,325
Slovak Republic				
LLP	0,8397299	0,2923148	2,87	0,004
LUR	0,1436131	0,0330616	4,34	0,000
Slovenia				
LLP	0,7982995	0,2054623	3,89	0,000
LUR	0,0857098	0,0315478	2,72	0,007
Wald chi2(2) = 17,55 Prob > chi2 = 0,0002				
Test of parameter constancy: chi2(12) = 752.04 Prob > chi2 = 0.0000				

Source: own elaboration.

CONCLUSIONS

Our analysis demonstrates that there is no correlation of statistical significance between *wage* and *unemployment ratio* in most countries in question (with an except to Hungary where there is a moderate adverse correlation). It denotes, that the ratio of wages in Poland and those of the other countries are changing differently from the ratios of unemployment rate. At the same time, the changes in ratio of wages in Poland to wages in the other countries are more connected to the changes in ratio of productivity. In the case of Czech

Republic, Estonia and Hungary we found a strong positive correlation between *wage* and *productivity ratio*, what means, that the changes in wages in Poland in comparison to wages in Estonia (and to wages in Hungary and Czech Republic) correspond to changes in productivity in these countries. In Slovak Republic and Slovenia the correlation is of smaller significance. It can be concluded that wages do not adjust thoroughly to productivity movements. Using panel data model we found that the productivity in Poland in relation to Czech Republic, Slovak Republic and Slovenia has been growing faster than the wages in Poland in comparison to given countries. It is important to note, that the level of productivity in Poland is lower than in Czech Republic, Slovak Republic and Slovenia (in 2013 average labour productivity in Poland consisted ca. 80% of average labour productivity in Czech Republic and in Slovak Republic and only 65% of average labour productivity in Slovenia), whereas the wage levels in Poland, Czech Republic and Slovak Republic are similar. The lower productivity level in Poland could be a reason for greater dynamic of productivity increase in Poland in analysed period. Conversely, in comparison to Estonia and Hungary, the productivity in Poland has been growing slower than the wages in Poland in relation to wages in Estonia and Hungary.

Summarizing we can point out that the trajectory of *wage, productivity* and *unemployment rate* in new EU member countries is diversified. Our remarks are consistent with previous research on the diversity of new EU member countries, see e.g. (Szymczak & Gawrycka, 2008). On the basis of our dataset and methodology we compared the dynamic of relations between *wages, productivity* and *unemployment rate* in Poland in comparison to other new EU members. We believe that our analysis could be an incentive to further research in wage determination on macro-level.

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