Empirical Evidence on Diverse Factor Shares across EU Countries[1]

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Abstract

The paper challenges the traditional assumption of stable factor shares introduced in the Cobb-Douglas production function. We analyse factor shares for 20 EU countries between 1995 – 2015 and find evidence for differences in labour shares across both countries and time. On the example of Slovakia, we demonstrate the impact of using different factor shares on output gap estimates quantified to reach up to 0.6 percentage points. Our research also confirms a positive correlation between the degree of economic development and relative labour shares.

Keywords: *Cobb-Douglas production function, factor shares, output gap, European Union, Slovakia*

JEL Classification: E10, E20, E27, E32

1. Introduction and Motivations

Potential output and output gap are not directly measurable indicators; thus, economists and policymakers must work using their estimates only. As estimation of the cyclical position of an economy is important for decision-making

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related to setting the direction of fiscal and monetary policies, it is crucial to select a suitable estimation method. There are several robust methods to estimate potential output and output gap. The Cobb-Douglas production function (CD PF)[2] is one of the most traditional and most frequently used. The advantages of this method are related to the simplicity of its calculation, clear interpretation of the results, and usefulness of this method in forecasting. However, its methodology has also been subject to criticism focused its quite restrictive assumptions, absence of consensus about variables that would appropriately reflect the dynamics of the production factors, and possible extension of a simple two-factor production function.

In this paper, we focus on shares of labour and capital that, within the CD PF framework, are viewed traditionally as exogenous parameters that are stable over time and across space. The practice of setting the factor shares of 2/3 to labour and 1/3 to capital has prevailed both in theory and in practical applications. However, the more recent research findings point rather to the dynamic nature of the factor shares.

The CD PF method has also been used in the regulatory framework, e.g., in the EU, the estimates of potential output and output gap are based on the use of the CD PF framework. The European Commission uses identical settings of factor shares for all countries, i.e., attributing 0.65 to labour and 0.35 to capital. Then, the estimated value of the output gap is used as an input variable to calculate the structural budget balance as one of the key indicators for assessing the progress of a country toward achievement of the country Medium Term Objective (MTO).[3]

This paper aims to look at the following issues:

- The consistency of the actual factor shares in the EU countries with the policy practice of setting identical factor shares for all EU member states;
- The stability of factor shares within individual countries over time;
- Presuming that there are substantial differences of factor shares across EU countries, it is necessary to understand whether there is any systematic pattern behind these differences and how these differences evolve over time;
- The impact of substantial differences of factor shares across EU countries on the output gap estimate of an individual country (Slovakia).

In this paper, we focus on the period 1995 – 2015 and we analyse 20 EU countries, for which the data are available in the ESA 2010 format, to assess the factor share dynamics. Two decades represent a rather short period to draw

[2] This was named after Cobb and Douglas (1928), who examined growth factors of the American economy between 1899 – 1922 and arrived at this functional relationship.

[3] The details of the CD PF specification used by the European Commission can be found, e.g., in Havik et al. (2014).

conclusions on the long-term stability of the factor shares; however, longer time series are unavailable in the ESA 2010 national accounts. In this respect, it should be noted that the last two decades has brought many changes in Europe, which might also impact on the results of our analysis. First, the integration process of post-communist countries led to sharp economic convergence and to the dynamic growth of trade.[4] Then, at the beginning of the new millennium, the single European currency was introduced. A few years later, EU countries were hit by the global financial crisis, and some of them were also hit by a severe debt crisis. Therefore, we focus not only on factor share differences across countries but also on their stability within individual countries over time. In our analysis, we rely mainly on factor share adjustments, as designed and justified by Gollin (2002). Thus, the aim of the paper is to contribute to the literature on the analysis of changes of factor shares in different countries and in different time periods. For the example of Slovakia, we also demonstrate the implications of different factor shares on the estimation of the output gap.

The rest of the paper is organised as follows. Section 2 contains a brief overview of the related literature. The empirical results, specifically, adjusted factor shares for 20 EU countries, and a brief assessment of their changes over time are presented in section 3. In section 4, we look at factor share differences across countries in more detail, examining the existence of a linear relationship between the labour share and three variables (GDP per capita, employment rate, and capital-output ratio). We use simple analytical tools with the aim of identifying the existence of any systematic patterns in the data. In section 5, we provide the estimate of the output gap for the Slovak economy using alternative settings of factor shares. We use Slovakia as a case study for countries with factor shares substantially diverging from “standard” factor shares. At the end of the paper, we formulate the conclusions and discuss the results.

2. Literature Review

The CD PF model is based on the assumption of a single-sector economy with total output determined by the quantity of production factors employed during a specific period of time. In the most traditional form of CD PF, only two production factors are considered: labour (L) and capital (K). The change of technology is reflected in the total factor productivity (A). In such a situation, the production function takes the following form:

[4] The literature confirms fast real convergence of post-communist countries over the last two decades, especially for countries that have already joined the EU (see, e.g., Grela et al., 2017; Zuk and Savelin, 2018).

$$Y = A\,L^{\alpha} K^{\beta} \tag{1}$$

where Y is total output (GDP), and α and β are parameters representing output elasticities of labour and capital. These can also be considered as shares of labour and capital in the determination of Y. Thus, in the traditional form of CD PF, the total output is determined by the combination of production factors and by A.

The belief that the factor shares are fixed goes back to Keynes (1939). However, the CD PF became an integral part of neoclassical growth theory, and, in this context, the stability of factor shares became one of the stylised facts of this theory (Solow, 1957), even though Solow himself challenged this assumption (Solow, 1958). More specifically, factor shares have been considered as not being absolutely fixed, but, rather, as oscillating around specific levels that are stable in the long-run (Mankiw, 1992, p. 55). Recently, the discussion of the stability of labour shares has experienced a revival. Mihola and Wawrosz (2014) argue in favour of the universal use of identical factor shares for every economy and point out that there is only one common level of technological progress across the world and that individual countries vary only in the degree of its actual absorption.

On the other hand, Krämer (2011) pointed to labour share decreases in G-7 countries and in continental Europe towards the end of the 20th century, even though he observed the differences in terms of the duration and depth of this decline. In his analysis of the OECD countries, Guscina (2006) pointed to the increase of labour shares from the early 60s to the late 70s and their subsequent drop towards the end of the century. This study shows that, even though there are observable differences across countries, the trend in the labour share dynamics was geared towards their increases in the 70s, followed by their decline in the 80s. Thus, the evidence indicates that, in the developed countries, the labour shares are not constant. In the group of upper middle-income transition countries, the observed decrease of labour shares has been smaller, with a reversal at the end of the 80s, which may be explained by the change of the countries' political systems and the onset of the transition process (Brada, 2013). OECD (2012) notes that, since the 90s, the labour shares of national income declined in almost all OECD member states. More precisely, the median labour share in the OECD countries declined from 66.1% in 1990 to 61.7% in 2009. Similarly, according to IMF (2007), the general decline of the labour shares in the developed economies had begun already in the early 1980s. According to the IMF (2007), prior to 2006, the most rapid decline of labour shares took place in the European countries and in Japan and reached approximately 10% of the national income, although this could be explained partially by the reversal of the strong labour share growth during the 1970s. Further evidence about a possible longer-term decline

of labour shares on national income both in developed and in most of the emerging economies was provided recently by a study of ILO and OECD (2015). Brada (2013) reviews the explanation for the decrease in the labour shares. Technological progress is considered as an explanatory factor for changes in the labour shares after World War II, when the augmentation of the labour force led initially to the rise of the labour shares and the augmentation of capital later caused an opposite change in the proportion of factor shares. However, this trend was observed both in developing and developed countries during the same time period, which decreases the credibility of this explanation. The role of globalisation has also been studied in this regard, and the underlying research points out that the decreasing labour shares are associated with larger financial openness and with the periods of crisis (e.g., Lee and Jyadev, 2005; Guscina, 2006). The last explanation for falling labour shares is based on the decreasing bargaining power of labour; e.g., Bental and Demougin (2006) use a static framework considering both moral hazard and hold-up problems and arrive at a conclusion corresponding to the recent developments in the labour share dynamics. Brada (2013) provides an alternative explanation, which links the movement of oil prices to changes in labour shares by including the energy in the production function. We may conclude that, even though the decline of labour shares has been accepted generally, consensus on the reasons behind this decline has not yet been reached.

3. Factor Shares in the EU Countries

In this section, we examine the developments of factor shares in 20 EU member countries between 1995 – 2015.[5] We use ESA 2010 data from the Eurostat database (2016) to enable necessary adjustments to the nominal calculation of labour and capital shares. Below, labour share adjustments no. 1 and no. 2 are calculated using ESA 2010 data exclusively.[6] Labour market data necessary to calculate labour share adjustment no. 3 were taken from the European Commission AMECO database (2016). For a part of the period examined (2002 – 2015), the data are consolidated at the aggregate EU and Euro area levels.

To analyse factor shares in the EU countries, we use four indicators inspired by Gollin (2002). These can be perceived as estimators of the output elasticities in the CD PF derived from national accounts. We explicitly calculate labour share (α). Assuming constant returns to scale, the share of capital (β) is derived

[5] Longer time series data for EU member states were unavailable in the required format at the time of writing this paper.

[6] Labour share adjustments are described in more detail below.

as a residual value, as the assumption of constant returns to scale[7] implies that the sum of output elasticities equals one, i.e.,

$$\alpha + \beta = 1 \tag{2}$$

Labour share indicators are calculated as follows:

$$\text{naive } \alpha = \frac{compensation\ of\ employees}{GDP} \tag{3}$$

The first indicator is calculated as the trivial ratio of compensation of corporate employees to GDP. We consider naive α as a "starting point" of our calculations, with solely informational value, for two major reasons. First, the calculation of naive α does not take into account compensations of workers who have other than corporate employment status – for example, self-employed persons. Therefore, the labour share estimated by naive α is underestimated. Another drawback of naive α is that, in its original form presented by Gollin (2002), the denominator is not adjusted for indirect taxes. Thus, if β were calculated analogically to (3), the equation (2) would not be valid.[8]

The drawbacks of naive α can be eliminated by applying several adjustments, resulting in the following indicators:

$$\alpha_{adj1} = \frac{compensation\ of\ employees + GOSH}{GDP - indirect\ taxes} \tag{4}$$

$$\alpha_{adj2} = \frac{compensation\ of\ employees}{GDP - indirect\ taxes - GOSH} \tag{5}$$

$$\alpha_{adj3} = \frac{(compensation\ of\ employees / \ number\ of\ employees) \times total\ workforce}{GDP - indirect\ taxes} \tag{6}$$

GOSH in equations (4) and (5) represents the flow of Gross Operating Surplus to Households. In Gollin's analysis, GOSH represents the approximation of Operating Surplus to Private Unincorporated Enterprises (hereinafter, OSPUE), and we make an effort to specify its closest approximation in the ESA 2010 methodology. It is reasonable to assume that the income of the prevailing majority of workers, except for corporate employees, will be reflected in GOSH.[9] In the ESA 2010 framework, indirect taxes are defined specifically as "taxes less subsidies on the product".

[7] We stick to this traditional assumption, as it was proven to be valid by Douglas (1948) using the example of the US economy. More recently, Burnside, Eichenbaum and Rebelo (1995) did not find any evidence that would undermine the validity of this assumption, despite the ongoing discussions about its validity.

[8] The income approach to GDP accounting specifies GDP as the sum of compensations of employees, gross operating surplus, and indirect taxes.

Three adjusted indicators of the labour share eliminate the main drawback of naive α, i.e., the underestimation of the labour share due to neglecting a substantial part of the labour income. On the other hand, $\alpha_{adj\,1}$ attributes the whole value of GOSH to labour; i.e., it assumes that households (or, more specifically, the private unincorporated enterprises) do not use capital in their business activities. This is quite an obvious drawback of $\alpha_{adj\,1}$, as this indicator has a built-in tendency to overestimate the labour share. In contrast, $\alpha_{adj\,2}$ assumes the distribution of GOSH between labour and capital in the same proportion as in the rest of the economy. As this assumption seems to be better aligned with the economic reality, $\alpha_{adj\,2}$ should provide a more accurate estimate of the labour share compared to both naive α and $\alpha_{adj\,1}$.

The estimation of the labour share using $\alpha_{adj\,3}$ is based on the assumption that the employed and those without a formal employment contract earn the same average compensation. Thus, average compensation of employees is assumed to be paid to all individuals in the work force, which allows estimation of the total labour income. Then, the adequacy of $\alpha_{adj\,3}$ as an estimator of α, depends on the rate of divergence between the average compensation of employees and the average compensation of others in the work force. In this regard, Gollin (2002) points to one advantage of $\alpha_{adj\,3}$, which is linked to the fact that it is not needed to make assumptions about the distribution of OSPUE (or GOSH, in our case) between labour and capital. To calculate $\alpha_{adj\,3}$ from the available data, we must begin with the following equation:

$$\textit{Total work force} = \textit{number of employees} + \textit{number of self} - \textit{employed} \qquad (7)$$

The AMECO database is used to derive the time series on total employment (representing the total workforce) and number of self-employed. Following Bernanke and Gűrkanyak (2002), the calculation of $\alpha_{adj\,3}$ takes into account the adjustment for indirect taxes.

In our analysis, we calculate four indicators: naive α, $\alpha_{adj\,1}$, $\alpha_{adj\,2}$, and $\alpha_{adj\,3}$ for each year and for each country where there was data availability, as well as for the aggregated EU and the Euro area. Subsequently, the average value

[9] We considered whether to use either GOSH or the net operating surplus (i.e., GOSH adjusted for estimated depreciation). There are several reasons in favour of the use of GOSH: labour income included in "compensation of employees" is, analogically to GOSH, defined either as gross income or total labour cost to an employer (including employer's social contribution payments). Similarly, "compensation of employees" does not account explicitly for possible appreciation of the human capital that could alter future incomes of employees. Thus, GOSH appears to be fundamentally more consistent with "compensation of employees".

of each indicator for each country was calculated. The results are presented in Table 1. The descriptive statistics were not calculated for the aggregated EU and the Euro area.

Considering the discussion above, it is not surprising that the results leading to the lowest average labour share are those based on naive α and that the values of $\alpha_{adj\,1}$ lead to the highest labour share estimate. In the case of $\alpha_{adj\,2}$ and $\alpha_{adj\,3}$, both the average value for the EU and the median for 20 EU member countries are close to the labour share of 0.65. Thus, the EU average and median for $\alpha_{adj\,2}$ and $\alpha_{adj\,3}$ indicate that "standard" factor shares of 0.65 for labour and 0.35 for capital might be appropriate for EU countries as a whole. However, if we focus on individual countries, substantial differences across them become obvious. The average estimates of labour shares using naive α, $\alpha_{adj\,1}$, $\alpha_{adj\,2}$, and $\alpha_{adj\,3}$ fall into the interval, with a width of 18.9 percentage points or more.

T a b l e 1

Alternative Estimates of Labour Shares in 20 EU Countries
(Arithmetic mean for 1995 – 2015 or a shorter period)

	Period	naive α	$\alpha_{adj\,1}$	$\alpha_{adj\,2}$	$\alpha_{adj\,3}$
Euro area	2002 – 2015	0.474	0.703	0.640	0.621
EU	2002 – 2015	0.477	0.706	0.644	0.632
Belgium	1995 – 2014	0.503	0.715	0.663	0.673
Czech Republic	1995 – 2014	0.398	0.637	0.547	0.515
Denmark	1995 – 2014	0.515	0.705	0.670	0.648
Germany	1995 – 2014	0.509	0.710	0.660	0.631
Greece	1995 – 2014	0.326	0.750	0.593	0.570
Spain	1995 – 2014	0.484	0.732	0.665	0.629
France	1995 – 2014	0.512	0.733	0.681	0.629
Croatia	2002 – 2014	0.481	0.747	0.692	0.723
Italy	1995 – 2015	0.387	0.696	0.585	0.590
Cyprus	1995 – 2014	0.429	0.671	0.594	0.593
Latvia	1995 – 2014	0.415	0.612	0.546	0.535
Lithuania	2004 – 2014	0.411	0.576	0.518	0.527
Hungary	1995 – 2014	0.434	0.696	0.627	0.597
Netherlands	1995 – 2015	0.495	0.669	0.626	0.659
Austria	1995 – 2014	0.478	0.680	0.626	0.622
Portugal	1995 – 2015	0.468	0.743	0.675	0.657
Slovenia	1995 – 2014	0.507	0.767	0.715	0.712
Slovakia	1995 – 2014	0.382	0.670	0.561	0.479
Finland	1995 – 2015	0.479	0.682	0.634	0.626
UK	1995 – 2015	0.498	0.729	0.672	0.625
MIN		0.326	0.576	0.518	0.479
MAX		0.515	0.767	0.715	0.723
Range		0.189	0.191	0.196	0.244
Median		0.478	0.701	0.630	0.625
STDEV		0.053	0.047	0.054	0.062
CV		0.116	0.068	0.086	0.101

Note: Shading highlights minimum (MIN) and maximum (MAX) values of each indicator within the set of countries considered. Descriptive statistics at the bottom exclude aggregated data for the EU and the Euro area. STDEV denotes standard deviation; CV denotes the coefficient of variation.

Source: Authors' calculations based on the Eurostat data (2016).

Labour share estimates obtained using naive α show the lowest rate of dispersion across countries, as measured by the standard deviation. This is somewhat contrary to Gollin (2002), who, using the same measure of dispersion, concluded that all suggested adjustments ($\alpha_{adj\,1}$, $\alpha_{adj\,2}$, and $\alpha_{adj\,3}$) led to lower variability of factor shares across countries.[10] However, if different mean values of the four indicators are taken into account using the coefficient of variation, then our results are consistent with Gollin (i.e., $\alpha_{adj\,1}$, $\alpha_{adj\,2}$, and $\alpha_{adj\,3}$ show lower dispersion than does naive α). However, neither adjustment reduces substantially the range, or dispersion, of $\alpha_{adj\,2}$ and $\alpha_{adj\,3}$. We consider the latter two indicators as the most favourable for two main reasons. First, their mean values are close to the benchmark value of 0.65. Second, neither of these indicators has a clear built-in tendency to either underestimate (as is the case with naive α), or overestimate (as is the case with $\alpha_{adj\,1}$) the labour share. As shown in Table 1, substantial differences in labour shares across 20 EU countries (as measured by $\alpha_{adj\,2}$ and $\alpha_{adj\,3}$) can provide support for not using identical factor shares for all countries. In other words, our analysis shows that the current policy practice in the EU of using identical factor shares for all member states might not be consistent with the reality.

In addition, the stability of factor shares over time should also be considered. To do so, we consider only the changes of $\alpha_{adj\,2}$ and $\alpha_{adj\,3}$; i.e., we use the most relevant indicators considering the discussion above. However, it is important to note that all four indicators show strong consistent dynamics for most countries, as can be seen from the diagrams in Appendix 1. An overview of the developments of $\alpha_{adj\,2}$ and $\alpha_{adj\,3}$ for a set of countries is provided in Table 2. If looking at the aggregated EU and Euro area, the labour share appears to be quite stable. However, we must recall that, in these cases, the data are available only for a shorter time period. On the other hand, when looking at 20 EU countries individually, only 6 countries have stable labour shares using $\alpha_{adj\,2}$ and $\alpha_{adj\,3}$ estimates.

Hungary provides an example of a country in which the development of labour shares is characterised by a trend in terms of $\alpha_{adj\,2}$ and $\alpha_{adj\,3}$. Between 1995 – 2014, both indicators declined by at least 0.1 (i.e., 10 percentage points). During the same period, the labour share in Spain declined by half of this value. Slovenia, Germany, Lithuania, Portugal, Greece, and Cyprus, i.e., the countries' most hit by the debt crisis, experienced very similar developments of their labour shares. On the other hand, Finland, the UK, and Germany experienced periods of notable growth of their labour shares.

[10] Gollin's conclusions were based on the analysis of a different set of countries and a different time period.

Table 2

$\alpha_{adj\,2}$ and $\alpha_{adj\,3}$ in the EU Countries

	Period	Interval $\alpha_{adj\,2}$	Interval $\alpha_{adj\,3}$	Assessment
Euro area	2002 – 2015	[0.625, 0.648]	[0.605, 0.631]	Stable over time
EU	2002 – 2015	[0.634, 0.653]	[0.620, 0.641]	Stable over time
Belgium	1995 – 2014	[0.644, 0.679]	[0.652, 0.687]	Stable over time
Czech Rep.	1995 – 2014	[0.533, 0.566]	[0.489, 0.545]	Stable over time
Denmark	1995 – 2014	[0.648, 0.704]	[0.627, 0.689]	Stable over time
Germany	1995 – 2014	[0.616, 0.702]	[0.596, 0.654]	Declining trend before 2007, soft growth afterwards
Greece	1995 – 2014	[0.553, 0.639]	[0.532, 0.615]	Growing trend 2010, sharp decline afterwards
Spain	1995 – 2014	[0.628, 0.683]	[0.600, 0.650]	Declining trend
France	1995 – 2014	[0.671, 0.697]	[0.615, 0.654]	Soft growth after 2008
Croatia	2002 – 2014	[0.664, 0.733]	[0.674, 0.767]	Sustained decline of $\alpha_{adj\,3}$
Italy	1995 – 2015	[0.559, 0.611]	[0.573, 0.604]	Stable over time
Cyprus	1995 – 2014	[0.534, 0.674]	[0.565, 0.623]	Strong growth before 2009, later sharp decline – namely $\alpha_{adj\,2}$
Latvia	1995 – 2014	[0.486, 0.661]	[0.489, 0.589]	Stable within wide range
Lithuania	2004 – 2014	[0.483, 0.558]	[0.484, 0.569]	Strong decline after 2009
Hungary	1995 – 2014	[0.583, 0.698]	[0.549, 0.649]	Sustained strong decline
Netherlands	1995 – 2015	[0.604, 0.649]	[0.630, 0.682]	Declining trend of $\alpha_{adj\,2}$
Austria	1995 – 2014	[0.591, 0.669]	[0.592, 0.658]	Decline before 2007, growth later
Portugal	1995 – 2015	[0.629, 0.696]	[0.589, 0.688]	Rapid decline after 2003
Slovenia	1995 – 2014	[0.680, 0.794]	[0.673, 0.787]	Rapid decline before 2007
Slovakia	1995 – 2014	[0.533, 0.593]	[0.452, 0.509]	Stable over time
Finland	1995 – 2015	[0.603, 0.677]	[0.595, 0.661]	Jump up after 2007
UK	1995 – 2015	[0.619, 0.699]	[0.567, 0.657]	Growing trend before 2010

Note: For more details see Appendix 1.
Source: Authors' calculations based on the Eurostat data (2016).

Despite the tendencies observed, it should be noted that two decades represent too short a period to draw a conclusion on the long-term stability of factor shares. It is possible that some deviations observed will revert towards the long--term mean in the upcoming years. Therefore, we examine only the space dimension

of factor share dynamics below. However, it is worth noting that, with the exception of Portugal and "stable labour share" countries, all major labour share changes and shifts in the trend can be observed between 2007 – 2010, i.e. the period of the most severe turbulences brought by the global financial crisis and the subsequent debt crisis in Europe. It is yet to be seen whether these changes are of a structural character, and there is need for further research into the factor share stability over time.

4. Labour Share Differences across Countries and their Dynamics over Time

We have shown above that the labour shares differ substantially across 20 EU countries. Thus, the reasons behind these differences should be explored. The variation of labour shares across countries was attributed traditionally to different levels of their economic development. In the past, several studies have confirmed a positive correlation between the level of economic development of a particular country and its labour share.[11] However, Gollin (2002) challenges this traditional view. Overall, the literature provides a more complex explanation of factor share differences across countries. Rodrik (1999) focused on the role of institutional factors and of the democratic institutions specifically. Decreuse and Maarek (2008) examined the relationship between the labour shares and the stock of foreign direct investment in developing economies, and they found a U-shaped relationship between these variables. Bentolila and Saint-Paul (2003) pointed to possible effects of such factors as capital-output ratio, labour adjustment costs, and union bargaining power.

We examine the existence of a linear relationship between the estimated labour shares (represented by $\alpha_{adj\,2}$ and $\alpha_{adj\,3}$) and the following variables: GDP per capita (GDPpc), employment rate (ER), and capital-output ratio (CR). For this purpose, we calculate the correlation coefficients between the values of $\alpha_{adj\,2}$ and $\alpha_{adj\,3}$ from Table 1 and the mean values of GDPpc, ER, and CR for individual countries based on the AMECO database data. In the case of labour share and GDPpc, we expect a positive correlation, which is in line with the traditional approach. Such correlation could be explained by several factors: higher labour productivity, higher investment in human capital, and higher relative valuation of individual free time by individuals in developed countries.

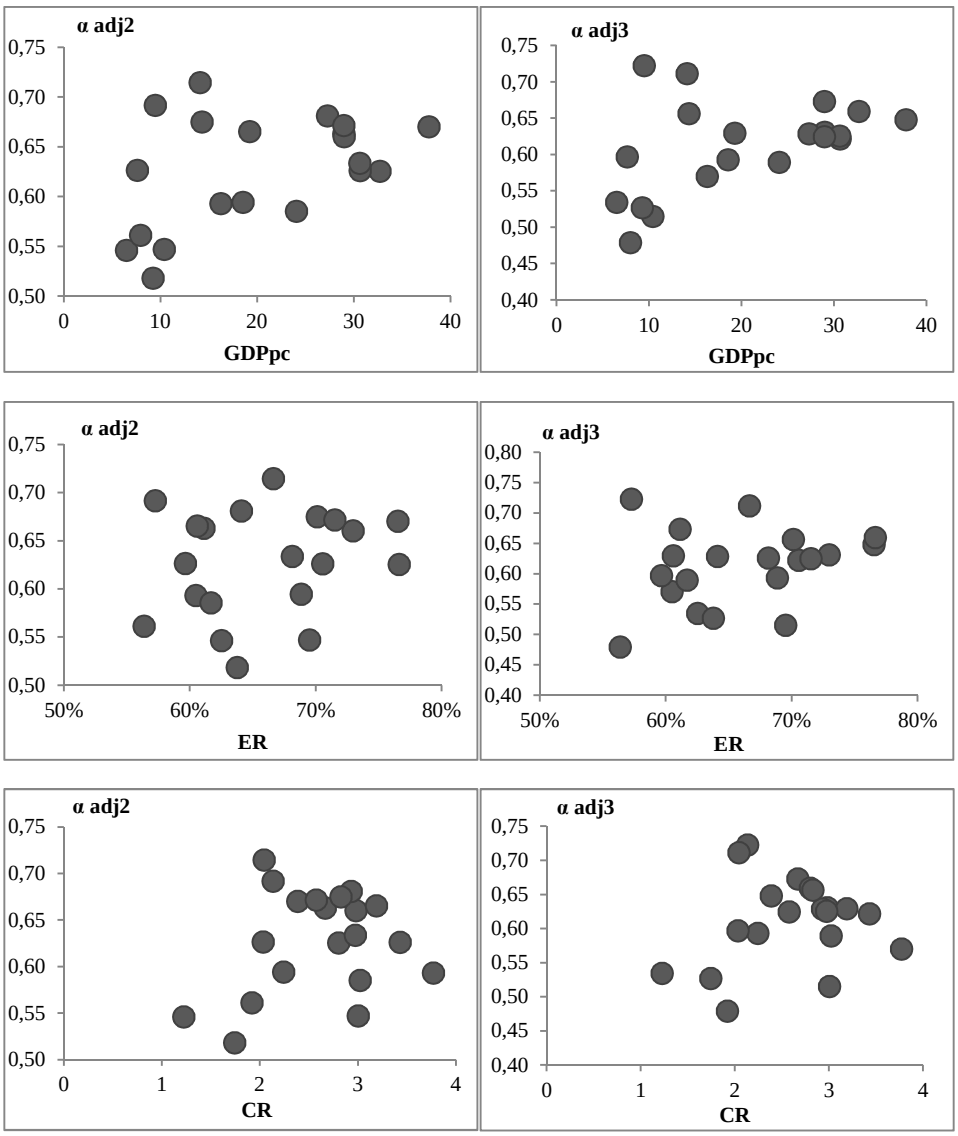
We also expect positive correlation between labour shares and corresponding ER and CR. In the case of ER, this intuition is based on the interaction between

[11] See, e.g., Elías (1992), Ortega and Rodríguez (2006). The latter authors examine the data for the corporate manufacturing sector.

the supply and the demand. A high employment rate should indicate a tight labour market with a relative lack of disposable labour force. Labour compensation should be relatively higher, and, hence, it would have a higher share of the total income compared to countries with low ER and a high stock of disposable labour force.

F i g u r e 1

Scatter Plots Relating Labour Shares to Average Values of GDPpc, ER, and CR in EU Countries (averages for 1995 – 2015, or shorter periods)



Source: Authors' calculations.

The theory provides two arguments to suggest a positive linear relationship between the labour share and the CR. The first one is based on the complementary nature of the production factors within the CD PF framework.[12] Thus, higher capital intensity of production should lead to the increasing labour share of total income. The second argument is related closely to the first one: a high value of CR would indicate relative abundance of K and increase the value of its complement, i.e., L. Thus, unrestricted global supply of capital would be confronted by a limited labour supply in an individual country.

The average values (arithmetic mean) of GDPpc, ER, and CR used in the correlation analysis were computed for the same period as the period for deriving the values of $\alpha_{adj\,2}$ and $\alpha_{adj\,3}$. GDPpc is a mean value of annual GDP at current prices per capita in thousands EUR.[13] ER is computed as the ratio of total employment to the total economically active population. In the correlation analysis, we use average values of the annual data on GDPpc, ER, CR, and labour shares. CR represents the average value of net capital stock per unit of GDP in constant prices in a particular country.

Only in the case of GDPpc do the scatter plots relating labour shares to average values of GDPpc, ER, and CR (Figure 1 in the Appendix) indicate a possible linear relationship. This is confirmed by the values of the correlation coefficients between labour shares and ER and CR, which come out as statistically insignificant. The correlation coefficient of GDPpc has a positive value of 0.43 for both $\alpha_{adj\,2}$ and $\alpha_{adj\,3}$.[14]

T a b l e 3

Correlation Coefficients between Labour Shares and GDPpc, ER, and CR
(Correlation of average values over 1995 – 2015 or shorter periods, 20 EU countries)

		GDPpc	ER	CR
$\alpha_{adj\,2}$	Correlation coefficient*	0.43	0.20	0.23
	p-value**	0.055	0.39	0.33
$\alpha_{adj\,3}$	Correlation coefficient*	0.43	0.24	0.18
	p-value**	0.057	0.30	0.45

Note: * Pearson correlation coefficient, 20 observations. ** Two-tailed test.
Source: Authors' calculations.

The positive correlation between average GDPpc and average values of $\alpha_{adj\,2}$ and $\alpha_{adj\,3}$ shows that more developed economies tend to reach a higher labour

[12] For more details see, e.g., Bentolila and Saint-Paul (2003).

[13] We used nominal GDPpc intentionally, as it can capture structural currency appreciation over time, since real convergence of a country should be accompanied by its currency appreciation against the basket of currencies of reference countries.

[14] We consider this to be statistically significant, even if the p-value indicates that its significance is slightly weaker than the 5% level.

share at the expense of capital. If factor shares are interpreted as elasticities, then cyclical labour market fluctuations should have a relatively higher impact on the output gap in more developed countries. The existence of the positive correlation between GDPpc and the labour share might appear to contradict the conclusions of Gollin (2002), who, after proposed adjustments to naive α, did not find any systematic relationship between the factor shares and GDPpc. Also, in our analysis, the correlation coefficient between naive α and GDPpc is significantly higher (0.59, significant at 5% level) compared to the correlation between the adjusted measures of labour share and GDP (Table 3).

The existence of a positive linear relationship between the labour shares and average GDPpc across EU countries is important with regard to assessing the adequacy of identical factor shares for estimation of the potential output in the EU countries. In section 3, we observe substantial differences in labour shares across 20 EU countries (as measured by $\alpha_{adj\,2}$ and $\alpha_{adj\,3}$), which we consider to be a relevant argument for not using identical factor shares for all countries.

Most data confirm that, in the EU, economic convergence has taken place over a relatively long period. Therefore, if economic convergence is measured by GDPpc, and there is a positive correlation between the GDPpc and the labour share, we can expect labour shares to converge over time. If this hypothesis were confirmed, it would provide support for the use of identical factor shares for the EU countries.

To analyse this, we compare the development of the dispersion rates of GDPpc and $\alpha_{adj\,2}$, $\alpha_{adj\,3}$ for 20 EU countries between 1995 – 2014.[15] We use standard deviation as a measure of dispersion of GDPpc, $\alpha_{adj\,2}$ and $\alpha_{adj\,3}$ for each year. To calculate standard deviations, we use AMECO data on GDPpc for each country, expressed as the share of the EU average (i.e., EU-28 average = 100). The relative expression of GDPpc allows for automatic adjustment for a growing trend of the average GDPpc. Otherwise, the increasing values of nominal GDPpc would make the standard deviations incomparable over time.

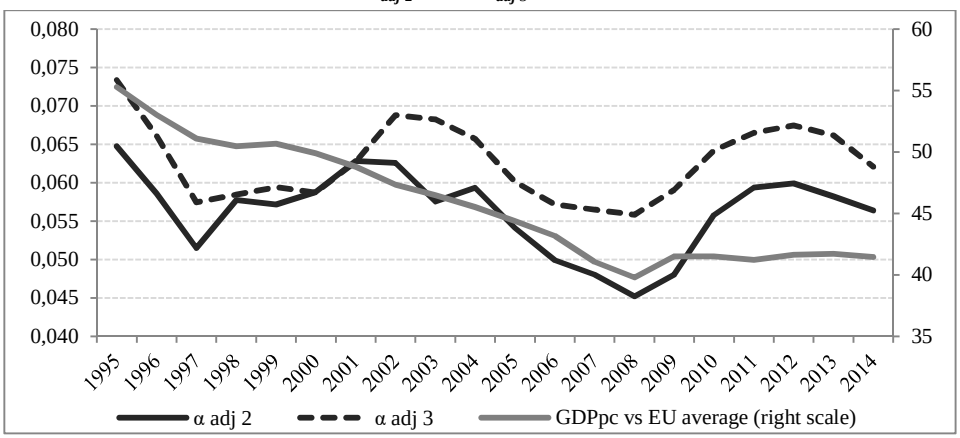
Computed standard deviations for GDPpc, $\alpha_{adj\,2}$, and $\alpha_{adj\,3}$ are shown in Figure 2. The chart indicates a positive correlation between standard deviations of GDPpc and $\alpha_{adj\,2}$, whereas the correlation between GDPpc and $\alpha_{adj\,3}$ is less clear. However, all displayed standard deviations reach their maximum value in the first observed year (1995), minimum values are reached in 2008 and, consequently, they increase. It remains to be seen whether this development coinciding with the global financial crisis is either only temporary or represents a new long-term trend.

[15] Year 2015 is excluded due to the lack of observations needed to calculate $\alpha_{adj\,2}$ and $\alpha_{adj\,3}$.

If we look at the long-term development solely based on the comparison of initial and final values of standard deviations, then we can conclude that, between 1995 – 2014, the dispersion of considered variables in the EU countries declined. Specifically, the standard deviation of GDPpc declined by one quarter, the standard deviation of $\alpha_{adj\,2}$ declined by half of that rate, and the standard deviation of $\alpha_{adj\,3}$ declined by slightly more than 1/7.

Thus, our analysis suggests that, during the past two decades, the convergence process of labour shares in the EU was slower than the was overall economic convergence, as measured by GDPpc. In addition, both processes seem to have stopped after 2008.

F i g u r e 2
Standard Deviation of GDPpc, $\alpha_{adj\,2}$ and $\alpha_{adj\,3}$ (20 EU countries)



Source: Authors' calculations.

5. Output Gap Estimation of the Slovak Economy with Alternative Factor Shares

In section 3, we identified substantial differences in labour shares across 20 EU countries. In this section, for the example of Slovakia, we demonstrate how different settings of factor shares would be translated in the estimation of the output gap. We compare two alternatives: (i) using a unified factor share setting, as used by the European Commission, i.e., α = 0.65, and (ii) using an adjusted estimate of factor share for Slovakia, as calculated in Table 1, i.e., α_{adj3} = 0.48. It should be noted that setting the labour share at α_{adj3} = 0.48 represents a most distant alternative from the unified factor share α = 0.65. Thus, the difference between the two output gap estimates should be interpreted as a maximum potential difference of the estimate using this method.

For the sake of simplicity, we use the simple method of output gap estimation based on the annual data. To formulate CD PF, we need to define the "potential" values of L, K and A. Equilibrium, or cyclically adjusted inputs of production factors (L´), (K´) and (A´) are used to estimate potential output (Y_p) of the Slovak economy. Therefore, Equation (1) is reformulated as follows:

$$Y_p = (A')(L')^{\alpha}(K')^{\beta} \tag{8}$$

$$Output\ gap = (Y/Y_p - 1) \times 100(\%) \tag{9}$$

For the purpose of this analysis, we define the labour supply (L´) as the trend employment, calculated as HP-filtered total work force. The supply of capital (K´) is defined as the existing stock of capital and actually represents the potential contribution of capital to economic growth (hence, K = K´). The trend of the total factor productivity (A´) is obtained by applying the HP filter on the Solow residual. Original (non-filtered) time series of the Solow residuals are calculated separately for both alternative factor share settings. Raw data for L and K are based on the data from the AMECO database. To at least partially decrease the "endpoint" problem built into the HP filter, the forecasts of Y, L and K until 2017 are also included, even though the output gap is estimated only until 2015.[16]

The use of a pure statistical method to estimate (L´) and (A´) has its drawbacks, but, in our opinion, these are counterbalanced by the simplicity and transparency of this method, and the method is satisfactory for the purpose of our study. However, it should be noted that the European Commission employs a much more complex approach.[17]

The results of our calculations are shown in Table 4. The differences between the two estimates for each year do not exceed 0.6% of the potential output. Also, with the exception of 2011, both alternative approaches lead to the output gap estimates of equal signs. Thus, if we use this simple method of the output gap estimation, the alteration of factor shares does not lead to fundamentally different estimates of the cyclical position of the Slovak economy, but the differences in the output gap estimate are nontrivial and sufficiently large to have important policy assessment implications. Also, it can be expected that changing the assumptions about (L´) and (A´) would further increase the differences between the output gap estimates.

[16] That is, we use European Commission forecasted values of Y, L and K until 2017 as an input into the HP filter, and we then use filtered data (namely (A´) and (L´)) for 1995 – 2015 to obtain the estimate of the output gap. To avoid confusion, please note that acronyms A, L, K are related to equation (1) while acronyms (A´), (L´), (K´) represent filtered data of A, L, K that serve as input to equation (8).

[17] See Havik et al. (2014).

Another substantial implication of an alternative setting of factor shares is the difference in the development of the total factor productivity. A lower share of labour (considering α_{adj3}) automatically leads to a higher share of capital. A relatively higher weight of the linear uptrend of (K´) in the determination of the potential output implies less steep growth of (A´), and vice versa. Specifically, using the simple methodology above, we estimate that, between 1995 – 2015 the average annual growth of (A´) for Slovakia was either 2.5%, considering α = 0.65 or 2.1% if $\alpha = \alpha_{adj3}$ = 0.48.

T a b l e 4

Output Gap Estimates for the Slovak Economy
(CD PF, alternative settings of factor share)

	Output gap (%Y_p)		**Difference**
	α = 0.65	$\alpha = \alpha_{adj3}$ = 0.48	
1995	0.72	0.99	–0.27
1996	2.74	2.96	–0.23
1997	3.82	3.78	0.04
1998	2.67	2.21	0.46
1999	–1.52	–1.88	0.36
2000	–3.83	–3.89	0.07
2001	–4.76	–4.79	0.03
2002	–4.62	–4.56	–0.05
2003	–3.48	–3.18	–0.30
2004	–2.67	–2.17	–0.49
2005	–1.36	–0.93	–0.42
2006	1.71	1.91	–0.20
2007	7.06	6.85	0.21
2008	7.94	7.37	0.57
2009	–1.18	–1.49	0.31
2010	0.67	0.46	0.21
2011	0.19	–0.12	0.32
2012	–0.85	–1.03	0.18
2013	–1.69	–1.66	–0.04
2014	–1.41	–1.16	–0.24
2015	–0.52	–0.31	–0.22

Source: Authors' calculations.

Conclusions

In this paper, we reviewed the stability of factor shares within the Cobb--Douglas production function framework over time and across countries. We calculated adjusted factor shares based on Gollin (2002) and introducing some modifications. Using the data for 20 EU member states for the period 1995 – 2015, we found evidence of divergent factor shares across countries, with labour shares ranging either between 0.518 – 0.715 in the case of α_{adj2} or between

0.479 – 0.723 in case of α_{adj3}. Therefore, we may conclude that the development of the actual factor shares in the EU countries is not consistent with the policy practice of setting identical factor shares for all EU member states.

For the example of the output gap estimate for Slovakia, we demonstrated the implications of the use of identical versus country-specific factor shares. We showed that the difference between two alternatives did not exceed 0.6% of the potential output. Using the simple CD PF specification, we demonstrated that, even though altering the factor shares did not lead to fundamentally different estimations of the cyclical position of the Slovak economy, the estimated difference in the output gap was not trivial. Another important consequence of an alternative setting of factor shares is the difference of the estimated (A´). For example, the use of the actual labour share, i.e. $\alpha = \alpha_{adj3} = 0.48$, instead of the standard setting of $\alpha = 0.65$, leads to lower value of (A´) and therefore, to a lower estimated role of technological progress.

When looking into the reasons behind identified differences in labour shares across EU countries, our analysis has shown that more developed economies tend to have a higher income share of labour at the expense of capital. On the other hand, we did not find any evidence of the possible linear relationship between the labour shares in the EU countries and their employment rates/capital--output ratios. We observed that, alongside the dynamic economic convergence of EU countries before 2008, the dispersion of adjusted factor shares was decreasing, even though this was at a slower pace relative to the decreasing dispersion of their GDPpc. However, it should be noted that, except for one, all major labour share trend shifts took place between 2007 – 2010, i.e., during the years of the pronounced impact of the global financial crisis. Nevertheless, based on the past evidence, we can expect that further economic convergence of EU countries in terms of their GDPpc will also lead to the convergence of their factor shares. Thus, in such a situation, the argument against the use of identical factor shares for all EU countries would lose its momentum over time.

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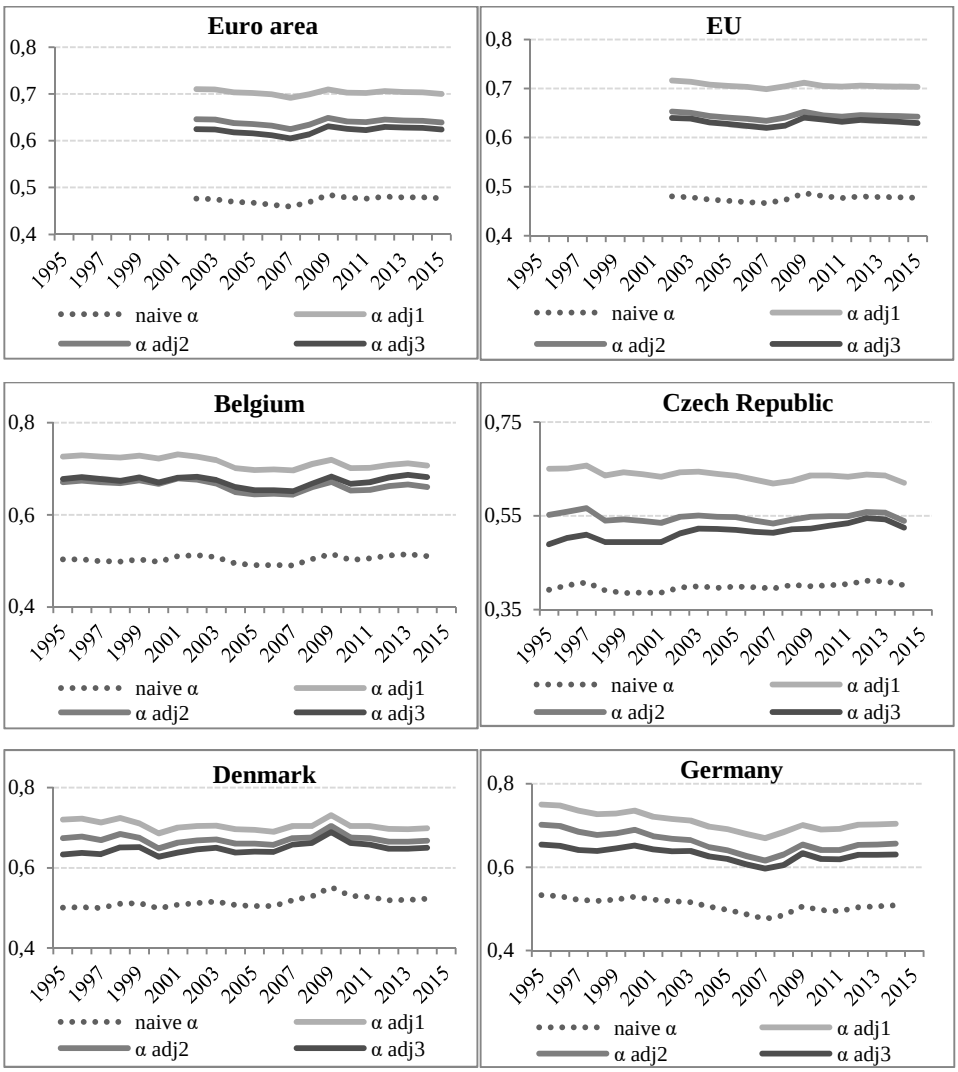
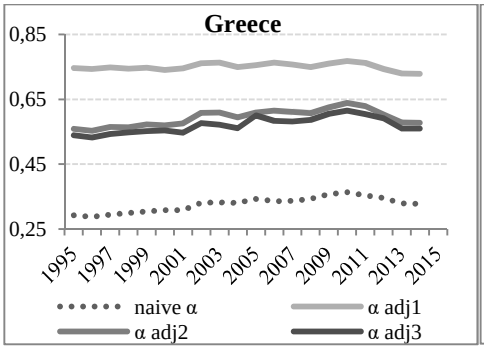
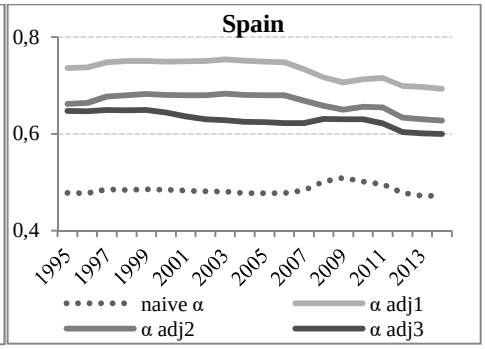
Appendix

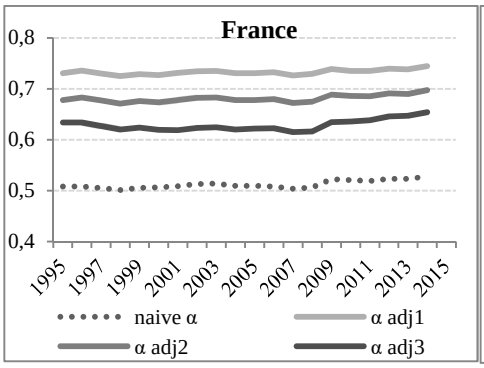
Figure 3

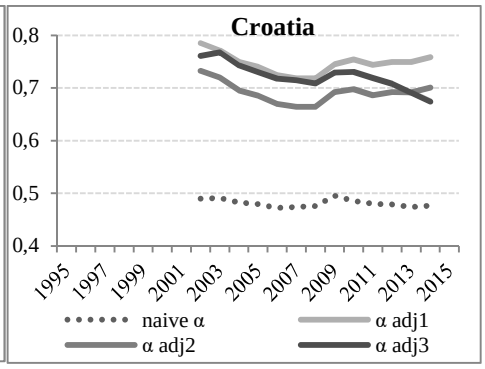
Comparison of Alternative Measures of Labour Shares in EU Countries (1995 – 2015)

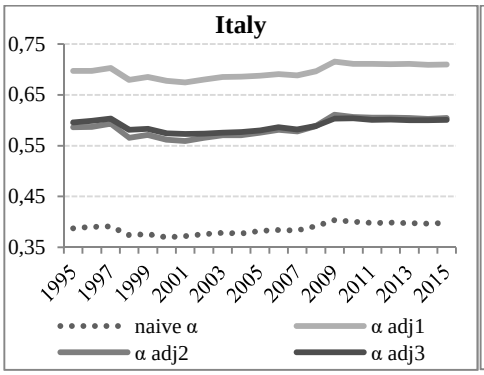



Greece
0,85
0,65
0,45
0,25
1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015
naive α
α adj1
α adj2
α adj3


Spain
0,8
0,6
0,4
1995 1997 1999 2001 2003 2005 2007 2009 2011 2013
naive α
α adj1
α adj2
α adj3


France
0,8
0,7
0,6
0,5
0,4
1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015
naive α
α adj1
α adj2
α adj3


Croatia
0,8
0,7
0,6
0,5
0,4
1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015
naive α
α adj1
α adj2
α adj3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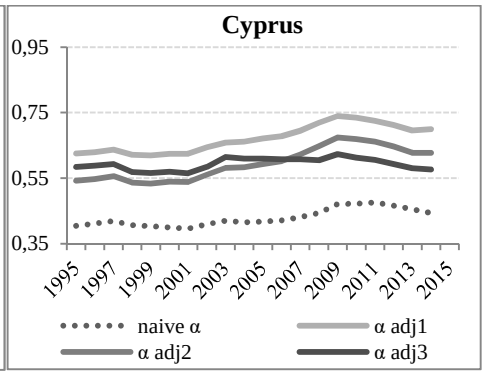
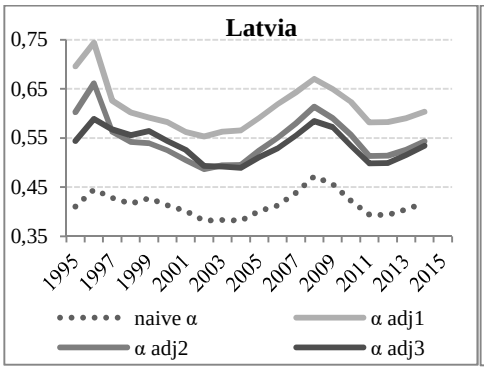
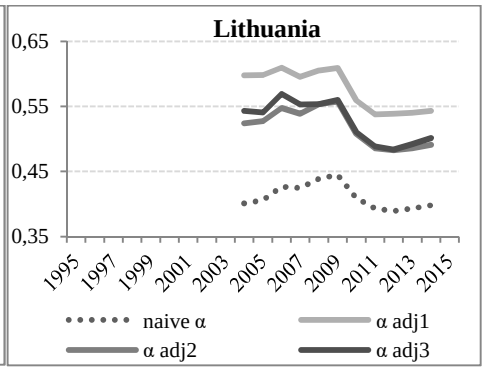
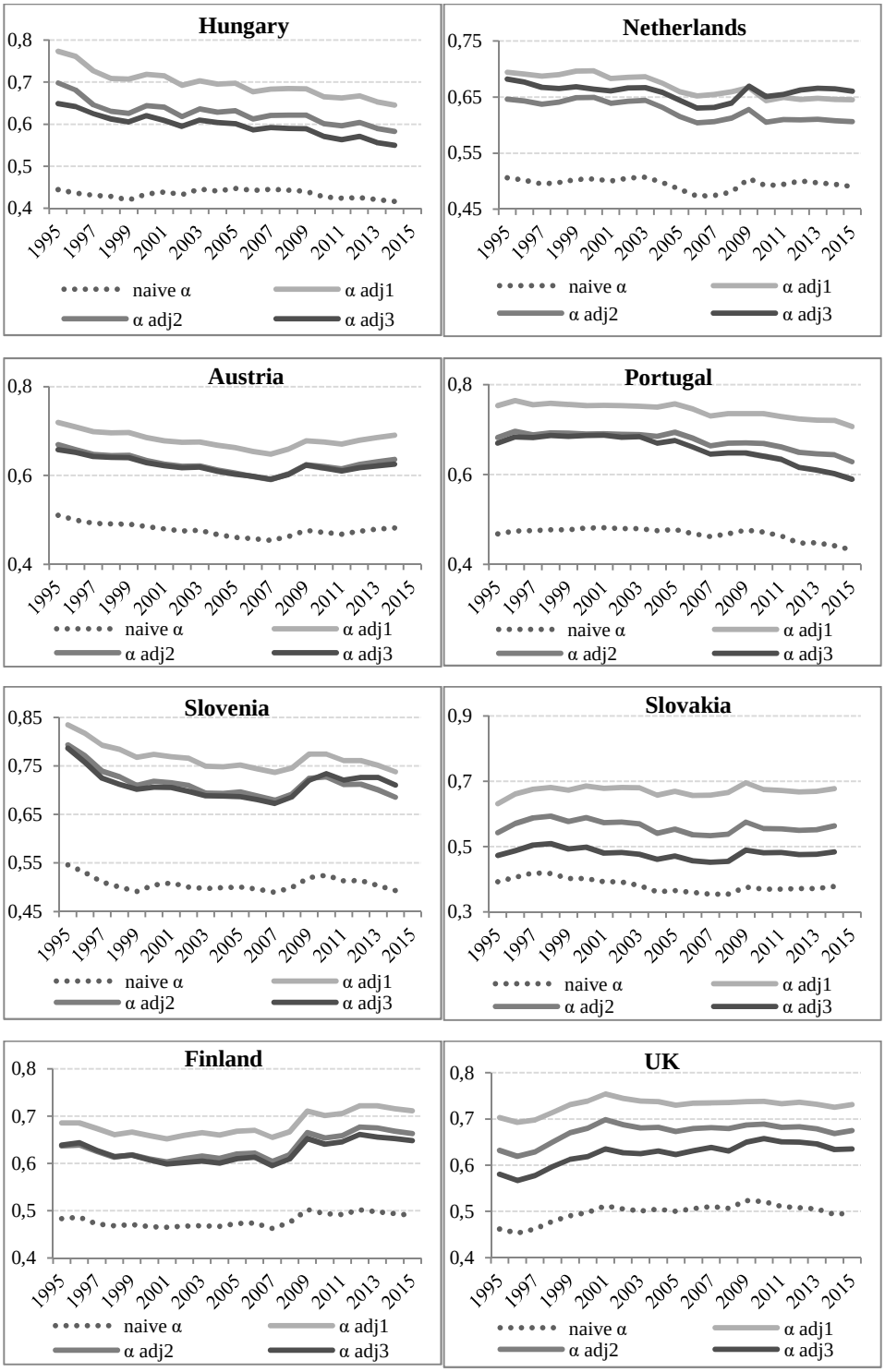
0,75
0,65
0,55
0,45
0,35
1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015
naive α
α adj1
α adj2
α adj3


Cyprus
0,95
0,75
0,55
0,35
1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015
naive α
α adj1
α adj2
α adj3


Latvia
0,75
0,65
0,55
0,45
0,35
1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015
naive α
α adj1
α adj2
α adj3


Lithuania
0,65
0,55
0,45
0,35
1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015
naive α
α adj1
α adj2
α adj3



Source: European Commission AMECO database (2016) (naïve α), authors' calculations of α adjustments.