TECHNOLOGICAL ADVANCE, THE LABOUR SHARE OF NATIONAL INCOME AND INCOME INEQUALITY IN THE EU

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Abstract

The paper tests the hypothesis that member states of the European Union have been experiencing declining share of labour income due to technological advance. In the literature, this decline is associated with inequality in the distribution of income, reduction in aggregate demand, and threats to social cohesion. In this paper, the results of an econometric test based on a labour demand equation derived from the CES production function, confirms the hypothesis that technological progress negatively affected the labour share of income in the EU, everything else remaining constant. This finding has important implications for EU Member States, including that some form of policy intervention would seem to be necessary, as left to its own devices, the capitalist system, which has brought about technological progress, could lead to a continuing fall in the share of labour income.

Keywords: share of labour income, inequality, technological advance, globalisation, CES production function, labour demand

JEL Classification: E25, J30, L51

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1. INTRODUCTION

It has been observed in several studies[1] that in many countries the share of national income that is earned by labour[2] has been declining over time. According to the OECD (2012), over the period from 1990 to 2009 the share of labour compensation in national income declined in 26 out of 30 developed economies for which data were available. According to ILO (2012), this decline is also observable in developing countries. This decline is associated with increased inequality in the distribution of income reduction in aggregate demand, and threats to social cohesion, as will be explained in this paper.

The purpose of this paper is to test the hypothesis that the share of labour may have been secularly declining mostly due to technological advances, the return from which were mostly appropriated by capital owners rather than by employees. The focus of the paper will be on the EU Member States.

The paper is organised as follows. Following this introduction, Section 2 will present a brief literature review on the factors that may have led to the falling labour share, including technological advance and the likely downside effects of the falling labour share. Section 3 will show that in the EU wage rates rose at a slower rate than labour productivity, a tendency that contributed to the falling share of income and which may have been caused by technological progress. The fourth section will econometrically test the premise that technological change influences labour demand in the EU Member States and as a result it also negatively affects the share of labour income. A labour demand equation derived from the CES production function will be used for this purpose. Section 5 will conclude the paper with a number of implications relating to the econometric results.

2. LITERATURE REVIEW

2.1 The measurement debate

Simply defined, the labour income share in a given country is the compensation to those offering labour services divided by the total value added in that country.

Measuring the labour share of income, however, is not straightforwardly done by multiplying the number of employees by the average wage rates and dividing by GDP. Sweeny (2013),

[1] The many authors who addressed this issued include Flaherty and O'Riain (2013), Bassanini and Manfredi (2012), Stockhammer (2012); Lawless and Whelan (2011); Checchi and Penolosa (2005); Gomme and Rupert (2004); Askenazy (2003); Bentolila and Saint-Paul (2003); Gollin (2002); Krueger (1999); Lane (1998) and international organisations, the OECD (2012); ILO (2007) and IMF (2007) have examined the decline. A review of the literature on the share of labour is given in Schneider (2011).

[2] The share of labour is generally measured as the compensation to employees (including employers' social contributions) plus the returns to labour to self-employed persons, divided by GDP at factor cost. The earnings of self-employed persons in compensation for their labour is estimated as C/H*S, where *C* is compensation to hired employees, *H* is number of hired employees and *S* is number of self-employed persons.

Stockhammer (2012) and Gomme and Rupert (2004) discuss a number of problems encountered when measuring the labour share of income, which include the well-known difficulties of correctly measuring gross value added, including understatement of incomes for tax evasion and tax avoidance purposes. There are additional problems relating to such issues as to whether depreciation and pension income should be included.

Another issue creating measurement problems is that the labour share should also include the labour services offered by self-employed persons. In many studies it is assumed that self-employed persons earn the same average earnings as hired employees. This assumption would not be correct if the distribution of the self-employed is different from that of the hired employees. For example, if there are proportionately more self-employed professionals (lawyers, doctors, etc.) and traders than is the case with hired employment, then income per person could conceptually be higher on average among the self-employed persons when compared to hired employees. On the other hand, if the self-employed persons include a larger proportion of small farmers, the share of the self-employed could conceptually be lower when compared to that of hired employees. Some authors try to correct for such distributional differences by imputing it from wage and salary data at sectoral level (Askenazy, 2003) or from survey data (Freeman, 2011).

2.2 Factors that influence the labour share

In the literature, various factors have been identified as having an influence on the labour share. These include technological advance, the globalisation process, emigration and sectoral shifts in the composition of output and employment.

Technological advance

Many authors view technological change as a major determinant of the fall in the share of labour (Jamuotte et al., 2013; Bassanini and Manfredi, 2012; European Commission, 2007). Such a change leads to a given output being produced by fewer workers, and this in turn this leads to higher returns to capital owners, who generally have a stronger say than workers in how the income from increased productivity is to be distributed. This asymmetrical power over the distribution of income is possibly one of the main reasons why the fruits of technological advance are not shared equally between employees and employers.

Technological changes could be attributed to the development in information and communications technology (ICT) (IMF, 2007), a development which is considered by Blinder (2006) as the third industrial revolution.

The globalisation process

The globalisation process is considered as another reason why the share of labour has decreased while the share of capital has increased. Athreye and Cantwell (2007) argue that the emergence of new countries as contributors to technology generation in the world economy can be associated with globalisation through trade, inward FDI, and international migration. This process is associated with the spread of technological advance and also with a deteriorating bargaining power of hired employees.

According to Roach (2009), increasingly powerful forces of globalisation – namely, the

combination of intensified cross-border competition and global labour arbitrage – have given rise to an increase in productivity. The globalisation process may have led to various changes favouring capital owners, given that this process may have been driven by powerful corporations. In addition, laws and policies favouring the supply side of the economy, and leading to the erosion of the power of labour unions, may also have led to a lower share of labour (Lavoie and Stockhammer, 2012; OECD, 2012; Storm and Naastepad, 2009; Atkinson et al., 2009). Another factor associated with globalisation is the greater influence of financial institutions (Palley, 2011).

Globalisation has also opened trade in most countries and this has been considered to be an important factor affecting the labour share of income, particularly if the competition by imports lowers the relative income of workers (Helpman et al., 2010; Egger and Kreickemeier, 2009).

Another development connected with the globalisation process is offshoring. Elsby et al. (2013) argue that that the decline of the share of labour in the U.S. since the 1970s could be attributed to offshoring mostly concentrated in the labour-intensive component of the supply chain. By offshoring the more labour-intensive part of U.S. production, the remaining production in the U.S. economy would be expected to become more capital intensive. If, in addition, capital is more than unitary-elastic with respect to labour, the U.S. labour share would fall.

Other factors affecting the labour share

Reed and Latorre (2009), in a study on the UK labour market, found that emigration tends to decrease wage rates, and according to Dustmann et al (2013) this is likely to be felt mostly in lower paid workers. This finding also emerges in a study by Nickell and Salaheen (2008). Jaumotte and Tytell (2007) note, in this regard, that a fall in average wage rates need not result is a falling share of labour as this is depends on the labour demand wage elasticity.

Structural economic changes, leading to an increase in the share of services and to a decline in the share of manufacturing may have also contributed to the decline in the labour share of GDP (Arpaia et al., 2009; Young, 2004; De Serres et al, 2002). For example, a large manufacturing sector may be associated with a large proportion of employees being unionised, with strong bargaining power against the owners of enterprises. The shift away from manufacturing to services may have eroded such bargaining power.

In the short run, a counter-cyclical change in the labour share has also been observed (European Commission, 2007; Hansen and Prescott, 2005). One reason for this could be that employers tend to maintain employment when there is a reduction in output due to the costs of hiring-and-firing. As a result the share of labour increases at the expense of the share of capital. The opposite happens during a recovery, such that employment would increase less-than-proportionately relative to output.

2.3 The downsides of the decline in the labour share

Several undesirable effects of the decline in the labour share have been identified in the literature.

Inequality

The main implication of the falling share of labour relates to income inequality between those who offer the services in the form of labour and those whose contribution relates mostly to ownership (Karanassou and Sala, 2013). This needs not translate into a situation where all workers become relatively poorer and all capitalists become richer. For example, some highly skilled and highly educated workers may actually have enjoyed an increasing share of income (IMF, 2007; Autor et al., 2006). In addition, self-employed persons are themselves owners of enterprises, so that while their share of income as providers of labour may have declined, their share of income as owners may have increased. However, if wage earners are taken collectively, as already indicated, their share has been observed to have decreased over time in many countries. As Jacobson and Occhino (2012) argue, labour income is more evenly distributed across households than capital income. The decline in labour share resulted in total income being less evenly distributed and more concentrated at the top of the distribution. Therefore, this contributed to increase income inequality.

Decrease in consumption

The falling labour share may also lead to a decrease in aggregate demand due to, among other things, the possibility that high income households have a lower propensity to consume than lower income households. Dynan et al. (2004) show that the rich do save more, while Kwak (2014) referring to this possibility, argues that there is a strong argument to be made that a capitalist society needs systematic redistribution to survive.[3]

Impact on growth

The impact on economic growth is not straightforward as it depends on various factors. First of all, faster growing returns to capital compared to returns to labour might relatively reduce spending power of a large proportion of the population, which in turn leads to a reduction in demand, already considered above as a result of the falling propensity to consume. This effect depends on whether aggregate demand is wage-led or profit-led. Onaran and Galanis (2012) examine this issue and conclude that the effect differs between countries, as there are two opposing forces involved, namely (i) as the labour costs decrease, profit rates may increase; (ii) but these are counterbalanced by a decrease in the propensity to consume. The increase in profit rates could possibly increase investment and improve competitiveness. On the other hand, the falling labour share could result in weaker purchasing power of a large proportion of the population.

Curci et al. (2011) also put forward this argument, and contend that that arresting the decline in the wage share can help put recovery from the global economic crisis on a more sustainable path. A comprehensive income-generating strategy would have expansionary effects on aggregate demand and employment, without aggravating fiscal deficits.

Loss of social cohesion and civil unrest

Social cohesion is a major objective of the EU, and yet some 25% of EU citizens are at risk of poverty or social exclusion (Eurostat news release, 184/2013). The declining share of income may counteract the social-cohesion objective, and possibly lead to social unrest

[3] On this issue see also Ostry et al. (2014).

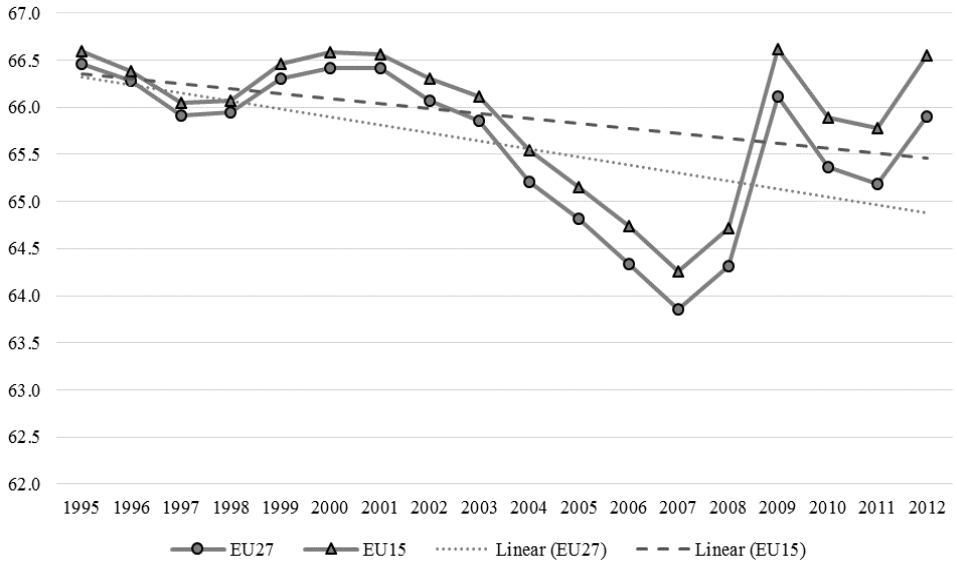
(Curci et al., 2011). It should be recalled that the effect of incomes on satisfaction does not generally depend on their absolute value but on their relative value, so even if labour income increases in absolute terms, a fall in the labour share may lead to social dissatisfaction. Rodrik (1999) equates income inequality with social conflict, and conducts a series of quantitative tests to show that income inequality impedes the social harmony required to sustain economic growth. The connection between income inequality and social well-being is also discussed in Wilkinson and Pickett (2009) who show that population health tends to be better in societies where income is more equally distributed. They refer to recent evidence that suggests that many other social problems, including mental illness, violence, imprisonment, lack of trust, teenage births, obesity, drug abuse, and poor educational performance of schoolchildren, are also more common in more unequal societies.

3. THE FALLING LABOUR SHARE IN THE EU OVER TIME

3.1 The labour share in the EU since 1990

The labour share of income differs between the EU Member States,[4] but there is a common feature in this regard namely that their labour share has been declining over time, as can be seen in Table 1, which presents relevant data for EU Member States for the 23 year period between 1990 and 2012.[5] Looking at the EU as a whole (Figure 1)[6] it can be seen that there were short term upswings in the labour share during the economic slowdown of the early 2000s and during 2008-09, but the secular trend shows a clear decline.

Figure 1: The share of labour income in the EU27 and EU15 since 1990



Source: Ameco

[4] This index is readily available in the European Commission's Directorate General for Economic and Financial Affairs (DG ECFIN) AMECO database. This indicator assumes that the self-employed earn the same average earnings as employees.

[5] It is to be noted that data for the wage shares for countries that acceded to the EU after 2004 were not available for the whole 23-year period.

[6] EU-15 includes Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the United Kingdom while EU-27 includes EU-15 and new Member States' economies, namely Bulgaria, Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia and Slovenia. The addition of new Member States does not alter the overall trend of EU-15 in a significant way due to the relative small share of their economies.

Table 1: The share of labour income in the EU member states since 1990

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Austria	70.4	70.7	71.3	71.9	71.7	69.9	69.2	68.7	68.0	67.9	66.8	66.1	65.4	65.3	63.9	63.2	62.5	62.0	63.2	65.6	64.8	64.0	64.9
Belgium	68.7	70.6	70.8	71.7	71.1	70.2	70.7	70.5	70.0	70.9	69.8	70.9	71.2	70.4	68.8	67.9	67.6	67.1	68.3	70.0	68.3	68.6	70.2
Bulgaria						63.1	62.1	52.8	62.6	60.1	58.0	58.8	56.5	57.3	57.4	56.7	55.2	54.5	56.9	59.5	60.7	59.1	60.0
Cyprus						64.6	64.9	65.4	63.2	62.5	62.8	61.9	64.5	69.5	69.4	68.8	67.6	67.0	64.6	65.5	64.8	64.5	61.9
Czech Republic				49.9	51.7	50.8	52.2	53.0	51.4	51.5	52.1	52.0	54.0	55.2	55.2	54.9	54.6	54.4	55.1	55.0	55.8	56.7	57.9
Denmark	68.5	67.9	67.0	67.4	65.0	65.2	65.7	65.6	67.7	67.9	65.7	67.1	67.8	68.2	67.1	67.0	67.2	68.8	69.5	72.4	69.1	68.7	68.1
Estonia				59.4	66.1	64.0	61.3	60.1	58.4	56.5	55.9	54.6	54.4	54.7	55.5	54.3	54.9	57.6	61.7	64.1	60.0	57.2	57.9
Finland	72.3	75.7	73.4	68.5	66.5	64.3	65.4	64.1	62.6	62.6	60.9	61.0	61.0	62.3	61.8	62.9	62.5	60.7	62.7	67.7	66.3	66.5	67.7
France	68.2	68.2	67.8	67.9	67.3	67.3	67.6	67.1	66.3	66.8	66.3	66.2	66.7	66.7	66.5	66.7	66.4	65.6	65.9	67.8	67.5	67.9	68.5
Germany		67.0	68.0	68.1	66.9	66.7	66.3	65.5	65.3	65.9	66.8	66.3	65.8	65.9	64.7	63.7	62.2	61.2	62.1	65.1	63.4	63.5	64.6
Greece	69.8	65.0	64.1	62.3	62.0	63.2	62.8	64.6	64.5	65.5	63.2	61.3	64.6	62.6	61.9	62.2	60.7	60.4	60.4	61.9	61.9	60.3	57.1
Hungary						65.9	64.9	63.2	62.3	61.6	63.0	61.9	61.6	62.6	62.1	61.8	60.4	61.5	61.0	61.0	59.5	58.9	59.3
Ireland	65.7	65.8	67.6	66.2	65.8	62.5	61.3	59.2	57.6	56.0	54.3	53.6	51.7	52.2	53.7	55.0	55.7	57.1	62.0	61.9	58.8	55.9	55.6
Italy	67.7	68.3	68.1	67.3	65.1	63.2	63.2	63.8	63.0	62.5	61.6	61.2	61.3	61.7	61.5	62.0	62.7	62.1	62.7	63.5	63.6	63.5	64.5
Latvia			40.0	63.5	68.6	59.1	61.7	62.6	59.7	59.1	55.4	53.3	50.7	51.8	51.4	54.0	56.7	59.7	62.4	57.9	52.9	50.8	50.8
Lithuania				41.7	46.4	51.4	54.8	57.9	59.8	61.5	55.3	53.4	54.4	54.9	54.7	54.2	56.1	55.4	56.0	56.8	51.8	49.5	48.9
Luxembourg	56.6	56.1	58.2	57.6	56.9	57.1	56.9	58.5	58.4	56.2	56.9	60.1	59.9	57.0	57.2	55.8	52.6	51.5	56.0	60.5	56.9	56.6	57.8
Malta						59.9	59.0	58.0	57.2	57.0	55.1	57.9	57.3	58.2	60.2	58.8	59.2	58.3	57.8	60.0	56.9	57.8	58.7
Netherlands	67.4	67.8	68.9	69.7	68.1	67.6	67.2	66.4	66.9	66.8	65.9	66.2	66.6	66.9	66.7	65.0	64.5	64.3	64.7	67.4	66.6	66.3	67.3
Poland			69.9	68.3	66.0	65.3	67.2	67.1	65.9	65.4	63.1	64.9	62.6	60.3	56.1	55.3	54.3	53.6	55.7	54.2	54.7	53.8	52.9
Portugal	61.5	64.4	67.6	67.3	65.1	65.9	66.9	66.9	66.8	66.2	67.0	67.1	67.1	68.0	66.7	68.0	67.2	65.9	66.9	67.2	66.2	65.7	63.9
Romania	78.8	71.2	68.5	66.0	61.7	62.7	64.0	58.4	72.3	70.1	80.4	84.4	68.6	67.9	60.2	66.4	62.7	63.8	67.7	66.0	61.9	56.1	56.3
Slovakia						48.0	49.9	51.4	51.9	50.1	50.3	48.7	49.2	48.8	47.2	48.3	47.1	46.8	47.0	50.3	49.5	49.4	48.9
Slovenia						79.0	76.6	73.9	72.9	72.1	72.9	73.0	72.1	71.3	71.5	71.2	70.0	68.6	69.7	72.6	73.8	73.1	73.8
Spain	66.8	67.8	69.6	69.1	67.3	65.9	66.0	66.0	65.8	65.7	65.4	64.6	63.8	63.1	62.5	62.3	61.8	61.6	62.4	62.5	62.4	61.5	60.1
Sweden	70.5	70.7	69.4	67.3	66.0	63.9	67.0	67.0	67.6	67.2	68.4	70.3	69.8	68.8	67.9	67.4	65.9	66.9	68.0	70.1	67.3	67.1	68.3
United Kingdom	73.6	74.9	74.4	72.2	68.7	68.2	66.6	66.7	68.2	69.3	70.4	71.1	70.2	69.7	69.4	68.7	69.0	68.8	68.5	70.8	70.7	70.6	71.8
EU-27						66.5	66.3	65.9	65.9	66.3	66.4	66.4	66.1	65.9	65.2	64.8	64.3	63.9	64.3	66.1	65.4	65.2	65.9
EU-15		69.1	69.3	68.8	67.2	66.6	66.4	66.0	66.1	66.5	66.6	66.6	66.3	66.1	65.5	65.2	64.7	64.3	64.7	66.6	65.9	65.8	66.5

Source: AMECO

3.2 The effect of technological advance on the labour share

If it is assumed that the labour share is measured by *WL*/*Y*, where *W* is the wage rate, *L* stands for persons employed and *Y for* GDP, the labour share would remain constant if *W* increases by the same proportion as the output/labour ratio, *Y*/*L*. If *W* increases at a slower rate than the ratio *Y*/*L* (or faster than the *L*/*Y* ratio), the end result will be a decrease in the labour share, and vice-versa.

An estimate of the growth in the wage rates (*W)* compared to the growth in the output/labour ratio (*Y/L*) for the period 1990 to 2012,[7] shown in Table 2, indicates that in most of the EU-27 Members States, *W* rose at a slower rate than the *Y*/*L* ratio, explaining, albeit mathematically, the fall in the labour share during this period. This could possibly indicate, but does not prove, that the effect of technology may have increased output faster than labour, leading to a wage/productivity gap and therefore to a decrease in the labour share. In the next section we shall use cross-section data pertaining to EU Member States to test whether the labour share has been influenced by technological change.

Table 2: Average Annual Growth in Compensation per Employee, and GDP per Person Employed, 1990-2012

	(a) Compensation per Employee	(b) GDP per Person Employed
Austria	2.37%	2.98%
Belgium	2.80%	2.95%
Bulgaria	9.35%	9.51%
Cyprus	3.65%	3.57%
Czech Republic	8.99%	8.36%*
Denmark	3.60%	3.42%*
Estonia	12.12%	12.38%
Finland	2.73%	3.14%
France	2.62%	2.67%
Germany	1.47%	1.83%
Greece	4.25%	4.68%
Hungary	6.39%	6.87%
Ireland	4.45%	5.18%
Italy	1.93%	2.22%
Latvia	13.27%	13.62%
Lithuania	13.17%	12.94%*
Luxembourg	3.15%	3.23%
Malta	3.86%	3.83%*
Netherlands	3.00%	3.18%
Poland	7.92%	8.70%
Portugal	4.23%	4.15%*
Romania	11.92%	12.58%
Slovakia	9.68%	9.89%
Slovenia	4.61%	4.91%
Spain	2.48%	3.04%
Sweden	2.79%	2.82%
United Kingdom	3.59%	3.70%

Source: AMECO, own calculations

[7] The growth rate for *W* and *Y*/*L* was calculated through the equation $Y_t = Y_o\, e^{rt}$, where *Y* denotes the dependent variable (*W* or *Y*/*L*) and e^{rt} is a time trend, which takes values of 1, 2, 3,…T. The equation becomes linear if transformed into natural logs, and using OLS, and estimate of *r* (the growth rate) can be obtained,

4. ECONOMTRIC TEST OF THE EFFECT OF TECHNOLOGICAL ADVANCE ON THE LABOUR SHARE: A CROSS-SECTION ANALYSIS

This section tests the hypothesis that technological change has negatively affected the falling labour share in the EU. The approach adopted in this section is to estimate a labour demand equation, derived from a production function. The result could shed light on the effect of technology on labour demand, everything else remaining constant, and in turn this would have implications on the labour share of income, as explained below.

4.1 The Production Function

The basic assumption underlying a production function is that output depends on labour and capital, given the state of technology. The variable representing capital is often difficult to measure, and data on this variable are generally not readily available (Dean, 1964). In addition, there is the problem of measuring capital utilisation. One way of circumventing this problem is by deriving and using the marginal productivity condition derived from the production function, which is the approach adopted in this study. The underlying production function that will be utilised is of the CES type,[8] allowing for the possibility of efficiency changes and non-constant returns to scale as shown in equation (1):

$$Y_{it} = T_{it}^{\chi} [bL_{it}^{-\rho} + (1-b)K_{it}^{-\rho}]^{-\nu/\rho} \qquad (1)$$

where Y_{it} represents value-added produced by the inputs, namely labour (L_{it}) and capital (K_{it}) for each of the 26 countries over 5 years. The subscript i, takes a value of 1,2, …27 and the subscript refers to the t takes a value of 1,2,..5. The expression T_{it}^{χ} captures shifts in the production function, due to technological differences between countries,[9] which could influence employment even if wage rates and output do not vary between the countries concerned. When the function is based on time series data, the expression is often represented by a time trend e^{rt} where r is the rate of growth of Y_i as a result of technological advance, with wage rate and output remaining constant, and t is time, taking the value of 1, 2, …T. In the present specification shown as Equation (1), the change is across countries so the exponent χ captures the effect of technological differences across countries.[10]

The coefficients of equation (1) can be interpreted as follows:

- b is related to the distribution of income;
- ρ is related to the elestacity of substitution (σ) which is equal to $1/(1+\rho)$. In the Cobb-Douglas production function, the value of σ is restricted to unity, implying that ρ takes a

[8] A discussion on the properties of the CES is presented in Miller (2008).

[9] Technology measures shifts in production function which cannot be explained through labour or capital changes. In this sense T_{it}^{χ} captures any systematic factor other than labour and capital.

[10] When time-series data are used, the efficiency term of the production function is often interpreted as capturing Hicks-neutral technological change. Alternatively, one can allow for a non-neutral type of technological change (David and Van de Klundert, 1965) in the sense that the factor augmenting efficiency changes are not assumed to be the same for labour and capital. Although the technical change parameter is usually applied to time-series data, we shall use the concept of efficiency in our cross-section analysis to allow for shifts in the production function due to differing factor enhancing endowments across countries.

value of zero. By using the CES production function, we are implicitly allowing for the possibility that a certain percentage decrease in factor prices need not generate a corresponding percentage increase in factor demand;

- v is the homogeneity parameter, which measures the degree of returns to scale, and would indicate constant returns if its value is unity, decreasing returns if its value is a positive fraction and increasing returns if its value is higher than unity.
- χ captures the effect of technological differences between countries on output.

4.2 Deriving a labour demand equation

The labour demand equation can be derived by first specifying the marginal productivity condition, and assuming, as is standardly done in economic theory, that the marginal product of labour is equal to the wage rate (W) as shown in equation (2):

$$\mathrm{MP_L} = \partial Y_{it}/\partial L_{it} = W \qquad (2)$$

Applying this condition to equation (1) we obtain:

$$\partial Y_{it}/\partial L_{it} = vb\, T_{it}^{\chi\,(-\rho/v)}\, L_{it}^{-(1+\rho)}\, Y_{it}^{(1+\rho/v)} \qquad (3)$$

Combining equations (2) and (3), re-arranging, and expressing the resultant equation in log form, the following equation is obtained:

$$\ln L_{it} = \sigma \cdot \ln(\mathrm{vb}) - \sigma \cdot \ln W_{it} + [1+ \sigma(v\text{-}1)]/v \cdot \ln Y_{it} - (1- \sigma)/v \cdot \chi \ln T_{it} \qquad (4)$$

where $\sigma=1/(1+\rho)$, which can be interpreted as representing the elasticity of substitution between labour and capital. Equation (4) can therefore be expressed as follows for estimation purposes:

$$\ln L_{it} = \alpha_0 + \alpha_0 \ln W_{it} + \alpha_2 \ln Y_{it} + \alpha_3 \ln T_{it} \qquad (5)$$

where the coefficients have a number of interesting properties, namely:

- α_1 takes a value of $-\sigma$, that is the elasticity of substitution with a negative sign, indicating the extent to which labour responds to a change in wage rates.
- α_2 represents the elasticity of employment with respect to output. This coefficient will, under certain conditions, take a value of a positive fraction if increasing returns to scale are assumed.
- α_3 captures the effect of technological differences on labour demand. It is expected to have a negative sign, indicating that with technological advance, the number of employees per unit of output would decrease.

It should be noted that the coefficient on $\ln Y_i$

$$\alpha_2 = [1+ \sigma(v\text{-}1)]/v \qquad (6)$$

which means that the labour demand elasticity with respect to output is not uniquely related to v

but also to σ. It can be shown that $v=(1-\sigma)/(\alpha_2-\sigma)$, so that if α_2 is a positive fraction ($0<\alpha_2<1$), v would be higher than unity, implying increasing returns to scale.

It should also be noted that the coefficient on $\ln T_{it}$

$$\alpha_3 = (1-\sigma)/v \cdot \chi \qquad (7)$$

which means that effect of technological change on labour demand is influenced by the elasticity of substitution and by returns to scale.

It should be noted also here that the effect of technology is unbiased in that it affects labour and capital equally. There is considerable debate on the matter relating to biased and unbiased technological progress, but allowing for this would have introduced unnecessary complications in the estimation procedure. The question arises therefore as to whether technology also affects the share of capital. Given the stronger decision power of capital owners, when compared to labour, it is likely that the gains from technology will be mostly enjoyed by capital.

4.3 Estimating the labour demand equation

With reference to Equation (5) a priori, one expects that α_2 takes a negative sign, α_3 a positive sign, and α_4 a negative sign, given that the labour demand function is assumed to be derived from the production function.

We investigate labour demand in the private sector[11] for a cross-section of EU-27 countries utilising annual data on total hours worked (L), wage rates (W), and gross value added (Y) with data averaged over the period of five years (2008 to 2012). The data is mostly sourced from the EUROSTAT database (see data appendix). Technology is sourced from Pillar 9a of the Global Competitiveness Report (Technological Adoption) and defined as the (i) availability of latest technologies (component index 9.01) and (ii) FDI and technology transfer (component index 9.03). All variables, with the exception of T, are measured in natural logs as indicated in equation (5).

The choice of 26 countries was conditioned by EU Membership up to 2012, which enjoys the benefit of availability, reliability, and comparability of data.[12]

4.4 Estimation Results

Equation (5) was estimated using the panel data approach using the random effects method. This

[11] Private sector is defined as total activities less public administration, defence and compulsory social security.
[12] Luxembourg was omitted from the regression analysis as it was an extreme outlier. Luxembourg had an unexceptionally large output-to-labour ratio because of high net number of cross-border workers. Therefore estimation of equation (5) gave a large standardised residual for Luxembourg. It is important to outline that national accounts employment data for industry is not available in hours worked, thus this study had to rely on Labour Force Survey data.

estimation technique was taken into consideration to control for time-specific effects.

It was estimated first by assuming that all observations of employment indicate labour demand, which means that the labour market in all countries was characterised by equilibrium or excess labour supply. From the available data, the estimation results are as follows:

$$\ln L_{it} = \underset{(16.317)}{3.349} \underset{(-37.679)}{- 0.770 \ln W_{it}} \underset{(128.275)}{+ 0.968 \ln Y_{it}} \underset{(-5.481)}{- 0.668 \ln T_{it}} \quad (8)$$

$$N = 130 \qquad R^2 = 0.993 \qquad \text{Adj } R^2 = 0.993$$

The estimated parameters are in line with a priori expectations and have plausible magnitudes. The numbers in parentheses are the estimated *t*-values and indicate that the estimates are statistically different from zero at the 95% level, whereas the correlation coefficient is on the high side.

The estimated equation shows that the coefficient of *W* takes a value of -0.770, indicating that a 10% increase in wage rate generates a decrease in employment of 7.70%, everything else remaining constant. As already explained this is an estimate of the elasticity of substitution, which is less than unity justifying the use of the CES production function rather than the Cobb-Douglas one. This parameter has important implications as its magnitude provides an insight into the labour/output ratio changes as the countries' wage rates change.

The estimated parameter α_2, that is the coefficient on output, takes a value of 0.968. This would seem to suggest that as the private sector expands, the cost per unit of output decreases, since the coefficient on *Y* implies that there are increasing returns to scale, as indicated by the parameter *v* in the underlying CES production, which as a result takes a value of value of 1.16. In other words, the value of *v* shows increasing returns to scale, meaning that a given increases in inputs generate a more-than-proportionate increases in output. A *t*-statistic test on the coefficient of *Y* indicates that it is statistically lower than unity at the 95% level of significance.[13] The returns to scale parameter has important implications for the size of countries. It confirms that larger countries, which employ more labour and capital, are able to enjoy increasing returns to scale. This is in line with the hypothesis that larger countries have a cost advantage over smaller size economies.[14]

The estimated coefficient for technological change is in line with theoretical expectations. The result shown would seem to suggest that, as expected, technological progress across countries leads to a reduction in labour demand, other things remaining constant. The way the index is constructed implies that the percentage difference between the highest and lowest is 1.45% so, keeping everything else constant, a 1% improvement in technology between the technological leader and technological laggards would give rise to less than 1% decrease in labour demand.

Equation 8 can be rearranged so as to have the labour share of income ($LS = LW/Y$) as the dependent variable by multiplying both sides of the equation by *W* and dividing both sides by *Y* as follows:

[13] On the basis of the computed *t* value (4.29), we reject the null hypothesis that α_2 is equal to 1.
[14] On this issue see Briguglio (1998)

$$\ln LS_{it} = 3.349 + 0.230 \ln W_{it} + 0.032 \ln Y_{it} - 0.688 \ln T_{it} \quad (9)$$

The estimated parameters confirm that the labour share of income (*LS*) is negatively affected by technological change across European countries, as indicated by the coefficient on *C*.[15]

4.5 Existence of excess demand and segmenting the sample

In the real world, wage rates may not clear the market in all periods. If excess demand for labour exist, employment would not measure labour demand, given that at in such a case, unfilled job vacancies, which are part of labour demand, would not be included.

An approach to take into account labour market disequilibrium is by assuming that employment represents labour demand only when excess demand is absent, that is when the rate of unemployment is equal or higher than what is known as the Non-Accelerating Inflation Rate of Unemployment (NAIRU) or natural rate of unemployment (NRU)[16] during the 2008–2012 period.

For this purpose the labour demand equation was re-estimated by excluding those countries characterised by excess labour demand, assuming that those countries with an unemployment rate lower than NAIRU were characterised by excess labour demand. Based on the data on NAIRU[17] four countries were found to be characterised by excess demand, and were therefore excluded from the sample.[18] The estimation results of this approach are as follows:

$$\begin{array}{lccccc} \ln L_{it} = & 3.143 & - 0.789 \ln W_{it} & + 0.965 \ln Y_{it} & - 0.507 \ln T_{it} & \\ & (14.806) & (-35.701) & (113.164) & (-4.112) & (10) \\ \text{N} = 110 & & R^2 = 0.993 & & \text{Adj } R^2 = 0.993 & \end{array}$$

where *L*, *W*, *Y*, *T*, and have the same meaning as before.

In equation (10) all estimates agree with a priori expectations in terms of signs and have plausible magnitudes. Again, the *t*-statistics pertaining to *W*, *Y*, and *T* indicate that the parameters are statistically different from zero, and the coefficient on *Y* is statistically different from unity, at the 95% level.[19]

Repeating the procedure for equation (9) the results again indicate that technological advance negatively affects the labour share of income:[20]

[15] The OLS estimation of equation (10) gave practically the same results as those obtained by rearranging equation (9).
[16] NAIRU or NRU both refer to a rate of unemployment compatible with labour market equilibrium.
[17] The data on NAIRU was obtained from the annual macroeconomic database (AMECO) of the European Commission's Directorate General for Economic and Financial Affairs (DG ECFIN)
[18] The countries with excess labour demand are Germany, Poland, Cyprus, and Slovakia.
[19] On the basis of the computed *t* value (4.06), we reject the null hypothesis that α_2 is equal to 1.
[20] Alternative approaches were to use the value of *T* and an index for ranking countries according to the absolute value of *T* which gave similar results.

$$\ln LS_{it} = 3.143 + 0.211 \ln W_{it} + 0.035 \ln Y_{it} - 0.507 \ln T_{it} \quad (11)$$

4.6 Residual diagnostic tests

It should be noted that both equations performed satisfactorily in terms of residual diagnostic tests, for which we used the Jarque-Bera tests, which showed that the residuals are normally distributed, at 95% confidence interval respectively. Furthermore, to control for heteroscedasticity, the parameters were also estimated using the Huber-White sandwich estimators, showing that the standard errors remained practically unchanged. Regarding multicollinearity, the correlation between *W*, *Y* and *T* across countries was not found to be unduly high.[21] Two diagnostic tests were also conducted to test for the random effects method. The results of the Hausman test decisively favours the use of the RE estimator over fixed-effects in this analysis, while the Breusch-Pagan Lagrange multiplier test prefers RE over the simple OLS regression.

5. IMPLICATIONS OF THE RESULTS

5.1 Technological advancement or retrogression

The assumption that was tested and confirmed in this study is that technological progress negatively affects labour demand, everything else remaining constant. This conclusion was extended to explain why technological advance also negatively affects the labour income share.[22] One should not imply from this finding that policies aimed at dismantling technological advance and banning labour-saving devices would solve the problem, as this will result in a loss of productivity and will be counter-productive.

As Bernanke (2007) argues, policy approaches that would inhibit the dynamism and flexibility of the labour market would do more harm than good as technological advance is a critical source of overall economic growth and of improvements in the overall standard of living. It should be noted however, that the effect of technology will depend on the workings of the labour market. If, for example, labour-saving technology leads to loss of job in one industry, job mobility could mitigate this problem as those who lose their jobs could relocate into other industries.

5.2 Policies that address the labour share, without discouraging technological advance

The adverse effects of a declining labour share of income are generally not blamed on the workers themselves but on factors outside their control, including technological advance and a

[21] From the correlation coefficients it can be concluded that exogenous variables are not highly collinear. This means that multicollinearity is inconsequential.

[22] As indicated in the literature review section of this paper, other factors are likely to affect the labour share of income, such as the globalisation process and structural shifts. These could also have had some effects on the share of labour, however, these might have been captured in the technology variable, given that exposure to the globalisation process and structural shifts may have themselves conditioned technological changes.

higher degree of decision making enjoyed by the owners of capital, when compared to hired labour. Bernanke (2007) referring to the ethical aspect of the falling wage share argues that there are three principles relating to income, namely (i) economic opportunity should be as widely distributed and as equal as possible; (ii) that economic outcomes need not be equal but should be linked to the contributions each person makes to the economy; and (iii) that people should receive some insurance against the most adverse economic outcomes, especially those arising from events largely outside the person's control.

With regard to the third principle some form of policy intervention would seem to be necessary as left to its own devices, the capitalist system – which has often led to asymmetrical power over the share of income between owners and employees, has ushered in the globalisation process and has generated technological advance – could result in a continuing secular falling share of labour income. In this concluding chapter we shall refer to three major type of policy interventions namely (i) fiscal policy; (ii) active labour market policies and (iii) hours of work policy.

Fiscal Policy

Given the inequality factor and the demand shifts associated with the decreasing labour share, some authors suggest some form of progressive income tax to redress this problem. Atkinson et al. (2009) for example make a case for progressive income tax to redistribute income to labour earnings and from capital earnings which have grown at an unprecedented rate since the 1970s.[23] They argue that one reason for the growing share of capital income is the reduction in income tax progressivity.[24] According to OECD (2012) progressivity of income tax could be strengthened by cutting back tax relief that benefit mainly high-income groups, such as reduced taxation on capital gains.

Income tax progressivity, however has various downsides in that it could discourage effort, as well as research and innovation, which are the drivers of technological advance, and could stimulate outflow of capital in search of lower rates of taxation.

Active Labour Market Policies

An important objective of active labour market policies (ALMP) is to reduce market frictions by improving skills, labour mobility, and knowledge about job seekers and job vacancies. One of the factors leading to lower earnings relate to skill mismatches which arise with the changing structure of the economy, often driven by technological advance. Some authors (e.g. Bernanke, 2007) suggest that the best way to reduce disparities in income is to put in place policies that reduce mismatches in the labour market through educational programmes and training and retraining schemes. Acemoglu and Angrist (2001) argue that skilled workers and those with a good level of education are better able to respond to changing circumstances in the labour market. Baumol and Wolff (1998) in discussing this issue contend that the rapid pace of

[23] This was one factor identified in Piketty (2014).

[24] They state that early progressive income tax systems included a much larger fraction of capital income than most present progressive income tax systems especially if such excluded capital income accrues disproportionately to top income groups.

technological progress generally result in higher rates of structural unemployment, particularly for workers who are approaching retirement age and workers possessing low levels of educational attainment. For this purpose they argue that retraining schemes are of utmost importance to counteract the effect of structural unemployment.

Such labour market policies are recommended in OECD (2012), which study asserts that these policies can reduce inequality. As an example, OECD (2012) refers to a relatively high minimum wage aimed at narrowing the distribution of labour income, but warn that if set too high it may reduce employment, which could dampens its inequality-reducing effect.

Reduction in working hours

As explained above, labour replacing technology could lead to GDP growing faster than wage rates, and this could in turn lead to chronically high unemployment rates. Brynjolfsson and Mcafee (2012) consider the rapid technological advance as destabilising, as the jobs that being displaced by technology may be lost for good leading to long term unemployment.[25] This would be harmful to society given that gainful employment has dignity associated with it and that unemployment leads to a number of social ills.

Some economists (e.g. Coote and Franklin, 2013) consider that a shorter working week, without a reduction in pay, could reduce this tendency. In addition, according to the same authors, a shorter working week would lead to a healthier, more fulfilling and sustainable way of life.[26] A similar argument is also put forward by Kallis et al (2013) who conclude that while the results of reducing working hours are uncertain, this may be a risk worth taking, especially as an interim measure that may relieve unemployment while other necessary structural changes are instituted.

Such a measure would of course lead to higher costs for firms, who would have to employ more persons to produce the same level of output, everything else remaining constant. On the other hand, if the reduced man-hours do not produce a lower level of output[27] this measure would be counter-productive in that it will not increase labour demand.

A reduction in the statutory working weekly hours would therefore have advantages and disadvantages, thereby involving trade-offs between the social and economic benefits associated with the increased labour demand and the increased cost to businesses that will be created as a result.

5.3 A well-balanced package of policies

The best policy would of course be that which reduces income inequality while not holding back

[25] Keynes (1930) wrote that within his own lifetime "we may be able to perform all the operations of agriculture, mining, and manufacture with a quarter of the human effort to which we have been accustomed."

[26] This argument can be articulated in a Marxist discourse as to who is to appropriate the fruits of technological advance, that is whether employees should do this by enjoying more leisure at the expense of profit, or whether owners of capital should do this by increasing their profit.

[27] This could happen if employees adjust their work speed so as to fill the time available for the work's completion in line with Parkinson's Law.

economic growth, technological advancement, and employment generation. However many policies involve trade-offs, as already explained. Devising policies that attain the objectives just listed simultaneously would not therefore be an easy task, and a package of policies may be required. For example, the downsides relating to production costs arising from the reduction of a statutory working weekly could be mitigated by policies that are aimed at reducing sick-leave abuse.[28] An increase in the progressiveness of income taxes for the purpose of income redistribution could act as a drag on the economy but these could be counterbalanced by non-tax policies that encourage entrepreneurship and risk taking. This is of course easier said than done, but doing nothing could mean a secular fall in the labour share with dire economic and social consequences.

[28] It can be argued that a reduction in weekly hours of work may itself lead to a reduction in sick leave as a result of a better mental and physical feeling by employees. Such an argument was proposed by the deputy mayor of Gothenburg, Sweden in an experiment to reduce the working week to 30 hours at full pay in that city. See "Sweden to trial six-hour public sector workday" in The Independent (UK) of Wednesday 09 April 2014.

6. REFERENCES

Acemoglu, D. & Angrist, J. 2001, "How large are human-capital externalities? evidence from compulsory-schooling laws" in *NBER Macroeconomics Annual*, eds. B.S. Bernanke & K. Rogoff, MIT Press, Cambridge, pp. 9-59.

Arpaia, A., Pérez, E. & Pichelmann, K. 2009, "Understanding labour income share dynamics in Europe", *Economic Paper Working Paper No. 379.*

Askenazy, P. 2003, "Partage de la valeur ajoutée et rentabilité du capital en France et aux États-Unis: une réévaluation; suivi d'un commentaire de Xavier Timbeau", *Economie et statistique,* vol. 363, no. 1, pp. 167-189.

Athreye, S. & Cantwell, J. 2007, "Creating competition?: Globalisation and the emergence of new technology producers", *Research Policy,* vol. 36, no. 2, pp. 209-226.

Atkinson, A.B., Piketty, T. & Saez, E. 2009, "Top incomes in the long run of history", *NBER Working Paper No. 15408*.

Autor, D.H., Donohue III, J.J. & Schwab, S.J. 2006, "The costs of wrongful-discharge laws", *The review of economics and statistics,* vol. 88, no. 2, pp. 211-231.

Bassanini, A. & Manfredi, T. 2012, "Capital's Grabbing Hand? A Cross-Country/Cross-Industry Analysis of the Decline of the Labour Share", *OECD Publishing, Social Employment and Migration Working Papers No. 133.*

Baumol, W.J. & Wolff, E.N. "Side effects of progress", *Jerome Levy Economics Institute of Bard College, Policy Brief No. 41*.

Bentolila, S. & Saint-Paul, G. 2003, "Explaining movements in the labor share", *Contributions in Macroeconomics,* vol. 3, no. 1.

Bernanke, B.S. 2007, *The level and distribution of economic well-being*, Greater Omaha Chamber of Commerce, Nebraska.

Blinder, A.S. 2006, "Offshoring: the next industrial revolution?", *Foreign affairs,* vol. 85, no. March/April, pp. 113-128.

Briguglio, L. 1998, "Small Country Size and Returns to Scale in Manufacturing", *World Development,* vol. 26, no. 3, pp. 507-515.

Brynjolfsson, E. & McAfee, A. 2012, "Race against the machine: How the digital revolution is accelerating innovation, driving productivity, and irreversibly transforming employment and the economy", *MIT Center for Digital Business Research Brief*.

Checchi, D. & García-Peñalosa, C. 2005, "Labour market institutions and the personal distribution of income in the OECD", *CESifo Working Paper No. 1608*.

Coote, A. & Franklin, J. 2013, *Time on Our Side: Why we all need a shorter working week*, New Economics Foundation, UK.

Curci, F., Khatiwada, S. & Tobin, S. 2011, "Market turbulence, employment and social unrest: Trends and outlook", *World of Work Report,* vol. 2011, no. 1, pp. 1-30.

David, P.A. & Klundert, T.v.d. 1965, "Biased Efficiency Growth and Capital-Labor Substitution in the U.S., 1899-1960", *The American Economic Review,* vol. 55, no. 3, pp. 357-394.

De Serres, A., Scarpetta, S. & De La Maisonneuve, C. 2002, "Sectoral shifts in Europe and the United States: how they affect aggregate labour shares and the properties of wage equations", *Economics Department Working Papers No. 326*.

Dean, G.A. 1965, "The Stock of Fixed Capital in the United Kingdom in 1961", *Journal of the Royal Statistical Society,* vol. 127, pp. 327-358.

Dustmann, C., Frattini, T. & Preston, I. 2008, "The effect of immigration along the distribution of wages", *Review of Economic Studies,* vol. 80, no. 1, pp. 145-173.

Dynan, K.E., Skinner, J. & Zeldes, S.P. 2004, "Do the rich save more?", *Journal of Political Economy,* vol. 112, no. 2, pp. 397-444.

Egger, H. & Kreickemeier, U. 2009, "Firm Heterogeneity and the Labor Market Effects Of Trade Liberalization", *International Economic Review,* vol. 50, no. 1, pp. 187-216.

Elsby, M.W., Hobijn, B. & Şahin, A. 2013, "The decline of the US labor share", *Brookings Papers on Economic Activity,* vol. 2013, no. 2, pp. 1-63.

European Commission 2007, *The labour income share in the European Union: Employment in Europe 2007*, European Commission, Brussels.

Eurostat 2013, *At risk of poverty or social exclusion in the EU28*. Available: http://epp.eurostat.ec.europa.eu/cache/ITY_PUBLIC/3-05122013-AP/EN/3-05122013-AP-EN.PDF [2014, 06/01].

Faherty, E. & Sean, O. unpublished, *Labour's Declining share of national income in Ireland and Denmark: similar trends and different dynamics*.

Freeman, R.A. 2011, *Labour income from self-employment and the labour share in the United States*, OECD, Paris.

Gollin, D. 2002, "Getting income shares right", *Journal of political Economy,* vol. 110, no. 2, pp. 458-474.

Gomme, P. & Rupert, P. 2004, "Measuring labor's share of income", *Federal Reserve Bank of Cleveland, Policy Discussion Papers*.

Hansen, G.D. & Prescott, E.C. 2005, "Capacity constraints, asymmetries, and the business cycle", *Review of Economic Dynamics,* vol. 8, no. 4, pp. 850-865.

Helpman, E., Itskhoki, O. & Redding, S. 2010, "Inequality and unemployment in a global economy", *Econometrica*, vol. 78, no. 4, pp. 1239-1283.

ILO 2012, *Global Wage Report 2012/13: Wages and Equitable Growth*, International Labor Organisation, Geneva.

IMF 2007, *World Economic Outlook*, IMF, Washington.

Jacobson, M. & Occhino, F. 2012, "Behind the Decline in Labor's Share of Income", *Federal Reserve Bank of Cleveland, February*, vol. 3.

Jaumotte, F., Lall, S. & Papageorgiou, C. 2013, "Rising Income Inequality: Technology, or Trade and Financial Globalization", *IMF Economic Review*, vol. 61, no. 2, pp. 271-309.

Jaumotte, F. & Tytell, I. 2007, "How has the globalization of labor affected the labor income share in advanced countries?", *Research Department, IMF Working Paper*.

Kallis, G., Kalush, M., O'Flynn, H., Rossiter, J. & Ashford, N. 2013, "'Friday off': Reducing Working Hours in Europe", *Sustainability*, vol. 5, no. 4, pp. 1545-1567.

Karanassou, M. & Sala, H. 2013, "Inequality and Employment Sensitivities to the Falling Labour Share", *The Economic and Social Review*, vol. 43, no. 3, pp. 343–376.

Keynes, J.M. 1930, *Essays in persuasion*, WW Norton & Company.

Krueger, A. 1999, "Measuring labor's share", *The American Economic Review*, vol. 89, no. 2, pp. 45-51.

Kwak, J. 2014, *Good Times for Capital: In the Global Scenario*. Available: http://baselinescenario.com/2014/03/10/good-times-for-capital/ [2014, 06/01].

Lane, P., R. 1998, "Profits and Wages in Ireland, 1987-1996", *Journal of the Statistical and Social Inquiry Society of Ireland*, vol. 48, no. 5, pp. 223-252.

Lavoie, M. & Stockhammer, E. 2012, *Wage-led growth: Concept, theories and policies*, ILO, Geneva.

Lawless, M. & Whelan, K.T. 2011, "Understanding the dynamics of labor shares and inflation", *Journal of Macroeconomics*, vol. 33, no. 2, pp. 121-136.

Miller, E. 2008, "An assessment of CES and Cobb-Douglas production functions", *Congressional Budget Office Working Paper 5*.

Nickell, S. & Saleheen, J. 2008, "The impact of immigration on occupational wages: evidence from Britain.", *Federal Reserve Bank of Boston, Working Paper No. 08-6*.

OECD 2012, *Reducing income inequality while boosting economic growth: Can it be done?*, OECD Publishing.

Onaran, Ö. & Galanis, G. 2012, "Is aggregate demand wage-led or profit-led?", *ILO, Conditions of Work and Employment Series, ,* no. 31.

Palley, T. 2011, "America's flawed paradigm: macroeconomic causes of the financial crisis and great recession", *Empirica*, vol. 38, no. 1, pp. 3-17.

Piketty, T. 2014, *Capital in the Twenty-first Century*, Harvard University Press.

Reed, H. & Latorre, M. 2009, "The economic impacts of migration on the UK labour market", *Institute for Public Policy Research, Economics of migration Working Paper No. 3*, vol. 3.

Roach, S. 2009, "Labor versus Capital" in *Stephen Roach on the next Asia: Opportunities and Challenges for a new globalization* John Wiley & Sons, Canada.

Rodrik, D. 1999, "Where did all the growth go? External shocks, social conflict, and growth collapses", *Journal of economic growth*, vol. 4, no. 4, pp. 385-412.

Schneider, D. 2011, "The labor share: A review of theory and evidence", *SFB 649 Economic Risk, Discussion Paper 2011*, vol. 69.

Stockhammer, E. 2012, "Why have wage shares fallen? A panel analysis of the determinants of functional income distribution", *ILO, Conditions of Work and Employment Series*, no. 15.

Storm, S. & Naastepad, C. 2009, "Labor market regulation and productivity growth: evidence for twenty OECD countries (1984–2004)", *Industrial Relations: A Journal of Economy and Society*, vol. 48, no. 4, pp. 629-654.

Sweeney, P. 2013, "An inquiry into the declining labour share of national income and the consequences for economies and societies", *The Statistical and Social Inquiry Society of Ireland*.

Wilkinson, R.G. & Pickett, K.E. 2009, "Income inequality and social dysfunction", *Annual Review of Sociology*, vol. 35, pp. 493-511.

Young, A.T. 2004, "Labor's share fluctuations, biased technical change, and the business cycle", *Review of Economic Dynamics*, vol. 7, no. 4, pp. 916-931.

7. APPENDIX A

Countries in the EU-27 (2008-2012 Average)

	Total Hours Worked	Gross Value Added	Hourly Wages and Salaries	Technology
Austria	137,001.40	247,047.20	20.8	5.59
Belgium	140,323.80	295,173.90	25.5	5.85
Bulgaria	115,782.10	29,701.40	2.6	4.31
Cyprus	13,894.80	13,989.60	14.7	5.1
Czech Republic	181,124.40	126,894.90	7.2	5.37
Denmark	87,175.70	189,607.60	31.9	5.54
Estonia	22,009.00	12,739.50	5.8	5.53
Finland	83,737.60	149,413.40	22.4	5.48
France	813,360.40	1,621,955.20	21.7	5.53
Germany	1,256,177.30	2,118,746.00	22.7	5.41
Greece	150,549.30	173,295.90	13.2	4.57
Hungary	138,044.10	75,439.00	5.3	5.31
Ireland	61,516.80	142,780.10	25	6.23
Italy	771,325.20	1,304,924.70	19.2	4.41
Latvia	34,683.60	16,910.00	4.5	4.67
Lithuania	47,215.00	25,338.20	4.1	5.42
Luxembourg	7,270.10	33,440.00	28.5	6.01
Malta	5,670.80	5,209.30	10.9	5.71
Netherlands	240,650.80	489,314.40	23.8	5.77
Poland	575,231.20	297,621.70	6	4.68
Portugal	176,532.90	135,562.20	10	5.75
Romania	362,387.20	108,676.10	3.2	4.21
Slovakia	84,041.00	56,439.90	5.7	5.34
Slovenia	34,618.70	29,400.20	12.3	4.79
Spain	629,046.50	902,358.60	15.2	5.41
Sweden	149,673.80	295,102.50	22.7	5.92
United Kingdom	955,757.60	1,501,773.90	17.2	5.76

Note on the data. The units of measurement are: gross value added in EUR million; and hourly wages and salaries per employee in EUR.

8. APPENDIX B: THE DATA

The data used for estimating equation (7) refer to average period between 2008 and 2012. The definition and the sources of the data are as follows:

8.1 Total Hours Worked (L)

Definition: Total average number of actual annual hours of work, in private sector.
Source: Labour Force Survey
The data on employment was multiplied by average number of weekly hours of work.
URL for employment:
http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=lfsa_egan2&lang=en, extracted on 23-April-2014
URL for average number of usual weekly hours of work:
http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=lfsa_egan2&lang=en, extracted on 13-April-2014

8.2 Wage Rates (W)

Definition: Hourly wages and salaries in cash and in kind borne by employers for the purpose of employing staff, in industry, construction and services (except public administration, defence, and compulsory social security).
Source: Labour Cost Survey
URL for wage rates:
http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=lc_lci_lev&lang=en, extracted on 23-April-2014

8.3 Output (Y)

Definition: Output is measured at basic prices, in private sector.
Source: National Accounts
URL for output:
http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=nama_nace21_c&lang=en, extracted on 23-April-2014

8.4 Technology (T)

Definition: Average of two indices namely (i) availability of latest technologies (component index 9.01) and (ii) FDI and technology transfer (component index 9.03) of the Global Competiveness Report (Various Issues).