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Determinants of functional income distribution in OECD countries

Studie im Auftrag der Hans-Böckler-Stiftung

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Abstract

Wage shares have fallen substantially over the past 25 years. In the Euro area the (adjusted) wage share declined by almost ten percentage points. Recently, there has been a renewed interest in the determinants of functional income distribution. IMF (2007a) and EC (2007) find that technological change has been the main cause of the decline in the wage share and that globalization has been a secondary cause. This study, firstly, tries to replicate these studies to investigate the robustness of their findings. Secondly, the estimated wage share equation is extended to allow for distributional effects of financial globalization and for different effects of union density according to social security system. We find that the estimations on which the conclusions of IMF and EC are based suffer from serious econometric problems and that their findings are not robust. In particular, the effect of technological change is often not statistically significant. Globalization (in production), however, has a robust effect. Results from the extended model suggest economically important (and mostly statistically significant) effects of financial globalization and of union density of non-Ghent countries. However, overall the results are sensitive to the specification and the estimation method.

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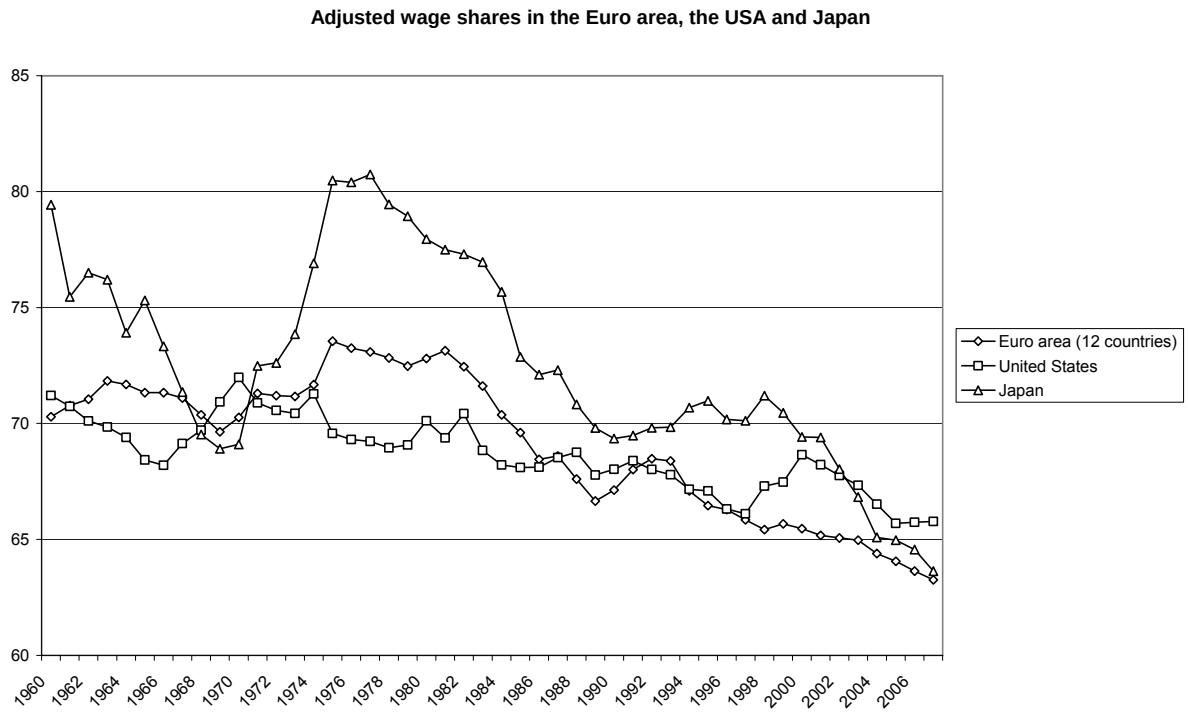
1 Introduction

In the last quarter century dramatic changes in income distribution have taken place. This refers to the personal distribution of income as well as to the functional distribution of income. Distribution has become more polarized in most OECD countries (OECD 2008), with the very top income groups increasing their income shares substantially in the Anglo Saxon countries, in particular in the USA (Piketty and Saez 2003, 2007). Wage shares have fallen in virtually all OECD countries, with decreases typically being more pronounced in continental European countries (and Japan) than in the Anglo-Saxon countries. In the Euro area the (adjusted) wage share has fallen from 72.5 in 1982 to 63.3% in 2007 (Fig. 1). Overall, real wage growth has clearly lagged behind productivity growth since around 1980. This constitutes a major historical change as wage shares had been stable or increasing in the postwar era.

Figure 1. Adjusted wage shares in the Euro area, the USA and Japan, 1960-2007



Source: AMECO

This has led, in the past few years, to a renewed interest in the determinants of the distribution of income, with main economic research institutions such as the OECD and the IMF publishing studies on these issues. OECD (2008) documents changes in personal income distribution. IMF (2007a) and EC (2007) deal with changes in functional income distribution and OECD (2007) investigates the wage elasticity of the labor demand function. The main findings of IMF (2007a) and EC (2007) are that technological change has been the main cause of changes in functional income distribution, that globalization (of trade and production) has also played an important role and, finally, that changes in labor market institutions have played a minor role.

This study will, firstly, assess the validity of the findings of the EC and the IMF by replicating their estimations. In doing so, we will investigate the robustness of the results by performing panel analysis with different specifications such as fixed effects model, first-differences models and specifications with (non-overlapping) five-year averages. Secondly, we will extend the standard approach by including additional variables. In particular we will include a variable for financial globalization and we will allow for different effects of union density in countries belonging to the Ghent-system of unemployment insurance. Thirdly we will make use of the NAIRU theory that suggests that the same structural variable should determine income distribution as well as unemployment and also estimate the unemployment equation. This allows for the explicit investigation of some arguments that involve indirect effects of, for example, labour market institutions on income distribution via changes in unemployment.

The paper is structured as follows. Section 2 presents the theoretical background of the study by highlighting differences between the neoclassical, New Keynesian, Post Keynesian and Marxian theory of distribution as well as the NAIRU model. This section also reviews the key determinants of functional income distribution that have been highlighted in the literature. Section 3 offers a detailed review of the recent empirical literature on the issue, in particular two important studies of the IMF and the EC that serve as a reference point for the following empirical investigation. Section 4 presents the empirical results. First, the studies of the IMF and the EC are replicated. It turns out that some key findings are not robust. Then an extension of the model is tested that includes a variable for financial globalization and for the countries of the Ghent system. Section 5 concludes.

2 Theoretical background. Different theories and key arguments in the recent debate

This section will provide the theoretical background for the empirical analysis. It will, in section 2.1, compare the different explanations of income distribution in different schools of thoughts. This will highlight that while differences are clear-cut in long-run growth theories of neoclassical, Keynesian and Marxian origin, these differences get blurred in the medium-run, once capacity utilization is flexible and in an open-economy setting. Section 2.2 presents the NAIRU model as a general medium term model that synthesizes insights from different theories and thus serves as a pragmatic framework for our empirical analysis that is consistent with all three theoretical approaches. Section 2.3 presents the main factors for changes in income distribution that have been highlighted in recent debates. Section 2.4 wraps up by presenting graphically the standard explanation of the determinants of the wage share and our extension that will both be explored empirically in section 4.

2.1 Different theories of income distribution and the muddy waters of the medium-run open economy

It may be tempting to associate particular schools of thought in economics with particular explanations of the distribution of income: in neoclassical economics distribution is basically determined by technology and preferences, in Keynesian/Kaldorian economics it is effective demand and in Marxian economics it is class struggle. Unfortunately these results are obtained only in the highly restrictive setting a long-run equilibrium of a closed economy characterized by full capacity utilization. Moreover, some streams within Keynesian economics, in particular Kaleckians and Fundamentalist Post Keynesians, question the usefulness of this definition of the long run. Clearly, such a framework is hardly applicable for the task at hand, that is, the investigation of medium-run changes in income distribution when capacity is often underutilized, economies have been rapidly opening up in the process of globalization and there has been a strong decline of labor unions. We will thus present the different theories and highlight different streams within these theories and the ambiguities that arise in a medium-run analysis with variable capacity utilization and market power in open economies.

The dominant theories in economics are based on one version or another of *neoclassical theory*. We define neoclassical theory as one where individuals are rational and selfish and markets are clearing.[1] The starting point of the neoclassical analysis of distribution is typically the assumption of full capacity utilization and the clearing of markets. Therefore, presumably this is a long-run equilibrium. Income distribution is then determined by technology and preferences. The marginal product of labor which is given by available technology determines the labor demand curve and preferences determine the labor supply curve. The wage share will then exclusively depend on the parameters of the production function. EC (2007) offers a formal discussion of the effects of technological change in the context of a CES production function.

For neoclassical theory giving up the assumption of full capacity utilization has grave consequences, because it is not straightforward that wages should equal the marginal product of labor. If capacity utilization is less than optimal, the marginal product of labor is not a useful reference point any more. The effective marginal product of labor will depend on demand, while the technical (full-capacity) marginal product of labor may be irrelevant for the firm.

Neoclassical economics has gone through substantial modifications.[2] We may distinguish two streams. The *New Classical* version and its incarnation of the real business cycle theory insist on instantaneous market clearing and assume that the labor market is in full-employment equilibrium all the time. This version of neoclassical economics is starkly unrealistic and has

[1] See Stockhammer and Ramskogler (2009) for a discussion of what constitutes mainstream economics today.

[2] David Colander (2000) even declared the "death of neoclassical economics". The 1970s witnessed the Monetarist counterrevolution and a succession of reformulations of New Classical macroeconomics in the form of monetarism, the theory of rational expectations and the real business cycle theory. The lasting effect of these theoretical developments was not so much the acceptance of a particular claim (such as the neutrality of money), but a methodological revolution that since requires mainstream macroeconomics to built on strict microfoundations, usually understood to be resting on optimizing behaviour of selfish individuals. In the course of the 1980s two streams of modern neoclassical macroeconomics emerged. While the New Classical tradition, such as the real business cycle theory, adhered to the Walrasian concept of market clearing, the New Keynesian tradition uses optimizing assumptions and transaction costs or the assumption of asymmetric information to justify nominal or real rigidities in the short run.

little new to offer in terms of the theory of income distribution. As markets are always in equilibrium, income distribution has to be determined, again, by technology.

The *New Keynesian* stream provides microfoundations for non-clearing markets and has given rise to a rich literature on the role of institutions in the determination of unemployment and of growth. Recent contributions in this tradition are usually based on some version of a bargaining or NAIRU model. Implicitly or explicitly market power on the side of workers (or unions) and/or firm is recognized. As the bargaining power of both sides will depend on the institutional setting, this has fuelled interest in the institutional determinants of unemployment and, to a lesser extent, income distribution.

The *Keynesian theory* is distinct from the New Keynesians theory as the former is not anchored in some concept of equilibrium unemployment. Keynes rejected the notion of rationality[3] and instead highlighted the role of fundamental uncertainty and the importance of socio-psychological phenomena. The focus of his analysis has been on the *short-run* determinants of output and employment. Investment is driving demand; demand is driving employment and prices. Keynes rejected the notion that wage flexibility could cure unemployment (Keynes 1937). As wage contracts are normally written in nominal terms, it is nominal wages that could be cut. There is no way of reducing real wages. In a recession a nominal wage cut would easily translate into price cuts and end up in a deflationary spiral, though Keynes also carefully listed potentially expansionary effects of a reduction in prices. Real wages, in Keynes' analysis, are an ex post outcome of economic activity, not a choice variable.[4]

An open economy setting leads to modifications of Keynes' argument. Domestic prices will become less responsive to (domestic) wages and (domestic) demand. In the extreme case where domestic firms are international price takers, nominal wage changes would have no

[3] Keynes emphasized that social and consequently economic processes are not deterministic, but historically open. Therefore individual can never have sufficient information to form 'rational' expectations, because the future is not sufficiently determined (Lawson 1985).

[4] In the General Theory Keynes (1936) accepted the notion of a decreasing marginal product of labour. Thus there is a negative relationship between employment and real wages, but the causality is running from aggregate demand, which determines the level of employment to the marginal product of labour and the real wage, not from wages to employment. However Keynes later revised his position on this, realizing that this argument implies pro-cyclical real wages, which is not generally the case.

effect on prices what so ever. Depending on the degree of openness, the modifications for the Keynesian theory of income distribution may be severe.

In the *Post Keynesian growth models à la Robinson and Kaldor* income distribution is determined by the animal spirits of entrepreneurs. This is because of the so-called Cambridge savings equations, which assumes that the savings propensity out of capital income is larger than that of wage income. Note that this theory has a direct empirical prediction in our context: it predicts that there is a negative correlation between the rate of capital accumulation and the wage share. As technology as well as bargaining power plays no role in this theory, an exogenous increase in the profit rate does not make sense in this framework.

In the *Kaleckian approach* functional income distribution is at the very core of the analysis. While the analysis of the goods market and the principle of effective demand are similar, Kalecki assumed that firms have the power to set prices and prices would react little to changes in demand. Income distribution would then not be an ex-post outcome, strongly determined by effective demand, but would be rather stable. The degree of monopoly power would determine income distribution. The determinants of the degree of monopoly power are not perfectly clear in Kalecki. While Kalecki (1954) claimed that the organizational strength of workers would affect monopoly power, it is not clear how. In particular, one would expect an increase in the organizational strength of labor to translate into an increase in money wages first and rather than into a direct decrease of the mark up.

More formally, Kalecki assumed (similar to Keynes) that a wage increase would be passed on to prices. He assumed that prices would not be responsive to demand and he assumed a procyclical labor productivity (due to overhead costs). Again, these propositions will be watered down in an open-economy setting. Due to international competition the ability of firms to pass on domestic wage increases will be limited. Consequently, changes in (domestic) money wages will have effects on income distribution.

In *Marxian* theories income distribution crucially depends on the relative power relations in class struggle. Distribution is understood to be determined prior to circulation in the sphere of production. In a simple Marxian macro model (such as that by Goodwin 1967), the wage share is a negative function of unemployment. Unemployment will negatively depend on output. Demand will negatively depend on the wage share as profits are reinvested in the

Marxian theory. The Marxian theory has direct implications for the relation between the wage share and capital accumulation.

To sum up, while differences are clear-cut in long-run growth version of neoclassical, Keynesian and Marxian theories, these differences get blurred in more realistic medium-run setting, where capacity utilization is flexible and the economy is open. Thus the different economic paradigms highlight different driving forces for income distribution – for neoclassical economics it is technology and preferences, for Keynesian in the Marxian theory and the (autonomous) expenditures of capitalists, for Marxists, the relative balance of power in class struggle in the Post Keynesian theory, and for Kaleckian the degree of monopoly power of firms – but the respective theoretical models are sensitive to their assumptions. The following section will present the NAIRU model as a general medium-term model that synthesizes insights from different theories and thus serves as a pragmatic framework for our empirical analysis that incorporates insights from all three theoretical approaches.

2.2 The NAIRU model as general medium-run framework

Much of the modern macroeconomic literature is based explicitly or implicitly on some kind of a NAIRU or bargaining model. While the NAIRU model is usually associated with a particular interpretation, namely that the NAIRU is exogenous, Stockhammer (2008) argues that the NAIRU theory, broadly understood, is consistent with different interpretations. In particular, New Keynesian, Post Keynesian and Marxian theories suggest different closures with respect to the demand function and with respect to the question of whether the NAIRU is exogenous or endogenous. The standard interpretation is the New Keynesian interpretation which assumes no effect of income distribution on demand and an exogenous NAIRU. The Post Keynesian (Kaleckian) interpretation assumes a wage-led demand regime, a positive effect of inflation on demand (at least over some relevant region of moderate inflation rates) and an *endogenous* NAIRU. The Marxian theory assumes a profit-led demand regime and an endogenous NAIRU. The following presentation does therefore not imply any particular closure, but is understood as a general framework.

At the core the NAIRU model consists of a wage bargaining curve and a price setting curve. Wage bargainers will set wages (W) based on the bargaining strength of workers (Z^W), on the

expected price level (P^E), and on the unemployment rate (U). If prices and labor productivity deviate from their expected levels, wages adjust imperfectly.

$$W = W(u, P^E, Z^w) \quad (1)$$

Prices will depend on various determinants of the price setting power of firms (Z^F), on expected wages (W^E), on the (technical) marginal product of labor (MPL), which will itself depend on technology (t) and on the available capital stock (K).[5]

$$P = P(W, MPL(t, K), Z^F) \quad (2)$$

Changes in actual unemployment are then decomposed into changes in the NAIRU and deviations of actual unemployment from the NAIRU, which are (assuming adaptive expectations) proxied by the change in inflation.

$$u_t = f(\Delta P) + u^* \quad (3)$$

$$u^* = F(t, K, Z^w, Z^F) \quad (4)$$

For any equilibrium (NAIRU) rate of unemployment there is a corresponding level of wages:

$$W^* = g(t, Z^w, Z^F) \quad (5)$$

Note that one implication of this approach is that in a reduced-form setting the equilibrium wage and the equilibrium unemployment depend on the same set of variables, which is apparent from equations 4 and 5.

As the wage share (WS) is by definition equal to wages times employment divided by nominal output (WS = W.N/P.Y), there will be a unique wage share corresponding to the NAIRU and its associated wage level.

$$WS^* = h(t, Z^w, Z^F) \quad (6)$$

[5] Rowthorn (1999a, 1999b) has shown that the medium-run NAIRU depends on the capital stock if the elasticity of substitution of less than unity as empirical studies suggest.

The NAIRU theory is a general framework in that it does not detail the factors that will influence the bargaining power of workers and the price setting power of firms. Key differences in the empirical applications of the theory lie in how these factors are implemented.

2.3 Key arguments in the recent debate

The recent debate on the determinants of functional income distribution has focused on the relative impact of technological change, globalization and changes in bargaining power between capital and labor. This section will present the key arguments in terms of how these factors are considered to affect income distribution, how these factors have been proxied in empirical research and what the main findings have been. Finally, the section will also draw attention to another factor, financialization, that has so far been neglected.

2.3.1 Technological change

Of course in a world of complete markets, perfect competition, full employment and well behaved aggregate production functions, income shares are determined by technology. However, none of these assumptions is likely to hold in the real world. Nonetheless, the basic neoclassical argument still carries a lot of weight in the present debate. It is argued that since the early 1980s, technological change has become capital augmenting rather than labor augmenting (which it used to be in the postwar era). Consequently wage shares have been falling. A more sophisticated version of the technological change story is that of skill-biased technological change. Computers and other ICT (information and communication technology)-capital are complements to high-skilled labor and a substitute to low-skilled labor. As the use of ICT-capital increased, the demand for high-skilled labor increased and that of low-skilled labor decreased, which came with rising (falling) wages for high (low)-skilled workers. It so happens that the wage share overall is falling.

Empirically technological change has been proxied by time trends, capital-labor ratios and ICT capital (and combinations of these). Ellis and Smith (2007) for example use a time trend and Guscina (2006) uses a time trend after 1985. Needless to say, a time trend will only convince a believer of the effect of technological change: as we know that wage shares have a

declining trend, it is hardly surprising that time trends do have an effect on the wage share. Benolila and Saint-Paul (2003) use the capital-labor ratio, IMF (2007a) and EC (2007) use the capital-labor ratio and ICT capital. This makes more sense. However, while common in the literature, it is not straightforward to interpret the capital-labor ratio as a technologically determined variable. The argument presumes that the capital stock has changed *because of* changes in available technology or because of a change in relative prices of capital and labor. From a Keynesian point of view, the capital stock is the outcome of investment decisions driven by animal spirits. The capital-labor ratio will thus be not *caused* by a change in technology, but by a change of investor sentiment. It will, however, *embody* technological change as entrepreneurs will typically use the latest technology available. Thus it is not a priori clear whether the changes in the capital-labor ratio can be interpreted as a proxy for (autonomous) changes in technology. The use of ICT-capital is a less ambiguous proxy for technological change as it reflects implemented technological change independent of the motives of its implementation.

The literature typically finds strong effects of technological change on income distribution. For example IMF (2007a) finds that technological change has been the most important cause for the decline in wage shares. Many studies use rather strong wording. EC (2007) concludes that ”for the period for which the data is available (i.e. from the mid-1980s to early 2000s), the estimation results clearly indicate that technological progress made the largest contribution to the fall in the aggregate labour income share” (EC 2007, 260).

2.3.2 Globalization

In recent debates the role of globalization features prominently in empirical analysis. The standard trade theory argument is built on the Stolper and Samuelson (1941) Theorem, which states that the abundant factor will gain. For northern countries, supposedly, this is capital whereas labor is abundant in developing countries such as China and India that have recently entered the global economy. Globalization is thus supposed to benefit capital in the north and labor in the south.

However, things are more complicated than Stolper-Samuleson suggest. The Stolper-Samuelson theorem assumes that neither capital nor labor is mobile; its effects take place through trade. However, the recent period of globalization has been marked by an increase in

capital mobility. “If capital can travel across borders, the implications of the theorem weaken substantially” (EC 2007, 45). Moreover, classical international trade theory is unable to explain the actual pattern of trade, which takes place mostly among developed countries. According to standard trade theory it is not obvious why North-North trade should affect income distribution (assuming that relative factor prices are similar). Second, labor is not a homogenous input. While unskilled labor (in the North) may loose from globalization, skilled labor may indeed gain.[6] If so, it is a priori not clear how the total wage share in the North should be affected.

The Political Economy of Trade approach argues that even trade among similar countries may affect income distribution. Rodrik (1997) argues that trade liberalization benefits the more mobile factor, which will typically be capital. Unlike the Stolper-Samuelson approach, Rodrik’s argument is set in a bargaining framework. The change in distribution takes place because of a redistribution of rents, not because the equalization of factor costs. Moreover, in the Stolper-Samlueson theorem one would expect distribution to change *after* production has been relocated. Epstein and Burke (2001), based on a bargaining model, argues that due to threat effects redistribution can take place without changes in production locations.

In empirical research (trade) openness, i.e. imports plus exports compared to GDP, is the most commonly used indicator for globalization (used by EC 2007, Rodrik 1997, Harrison 2002). IMF (2007a) offers several measures of globalization including the terms of trade and measures of offshoring and immigration. Harrison (2002) and Rodrik (1998) also use measures of capital account liberalization.

While there are differences in the theoretical arguments the empirical assessment is rather clear. Basically all studies find substantial effects of globalization on functional income distribution. For example IMF (2007a) concludes “globalization is one of several factors that have acted to reduce the share of income accruing to labor in advanced economies” (IMF 2007a, 161).

[6] Modern models in trade theory use different types, i.e. skill-levels, and allow for intermediate goods. The effects of globalization in these models become more complicated and less easily tractable.

2.3.3 Bargaining power

Once one abandons the assumption of perfect competition income distribution becomes the outcome of a bargaining process between firms and labor, typically represented by labor unions. A higher bargaining power of workers will lead to an increase in wages and, if labor demand is inelastic, to an increase in the wage share. There is little of disagreement so far. The question rather is what affects the bargaining power of workers and firms.

Recent empirical research (on OECD countries) tends to identify the bargaining power with labor market institutions (LMI). The background for this is a long debate on the determinants of unemployment that has led to the development of databases for labor market institutions that have then also been used in the analysis of income distribution. Thus IMF (2007a) and EC (2007) include union density, employment protection legislation, unemployment benefit generosity and the tax wedge as wage push variables that may also affect income distribution. Benolila and Saint–Paul (2003) include (only) a variable measuring strike activity. Azmat, Manning and van Reenen (2007) is the only study (which investigates only the distributional effects in certain service sectors) that focuses on the bargaining power of firms.

The Political Economy approach (Rodrik 1997, Harrison 2002) has highlighted that globalization also affects bargaining power (rather than merely relative prices) and consequently interprets globalization variables as related to bargaining power.

EC (2007) and IMF (2007a) find surprisingly small, if any, effects of union density. They also find that several labor market institutions have 'perverse' effects, i.e. higher unemployment benefits and higher employment protection legislation is found to lead to lower wage shares, which is interpreted to be caused by a very elastic labor demand function.

2.3.4 Financialization

Financialization refers to the increased influence of financial institutions and financial motives on non-financial activities. Financial deregulation has had two important effects on the bargaining position of labor. First, firms have gained more options for investing: they can invest in financial assets as well as in real assets and they can invest at home as well as

abroad. They have gained mobility in terms of the geographical location as well as in term of the content of investment. Second, it has empowered shareholders relative to workers. The development of a market for corporate control has aligned management's interest to that of shareholders (Lazonick and O'Sullivan 2000, Stockhammer 2004). Rossmann (2009) illustrates this with reference to private equity funds, which buy firms by way of debt that is transferred to the firm. The surplus is siphoned to the private equity fund through dividend payments or fees. The restructured firms then are heavily burdened with servicing their debt and have little alternative to pursuing an aggressive cost-cutting strategy. For countries, where data is available, the increase in dividend payout is well documented (Duménil and Lévy 2001, 2004). Epstein and Powers (2003) document the increasing income share of rentiers.

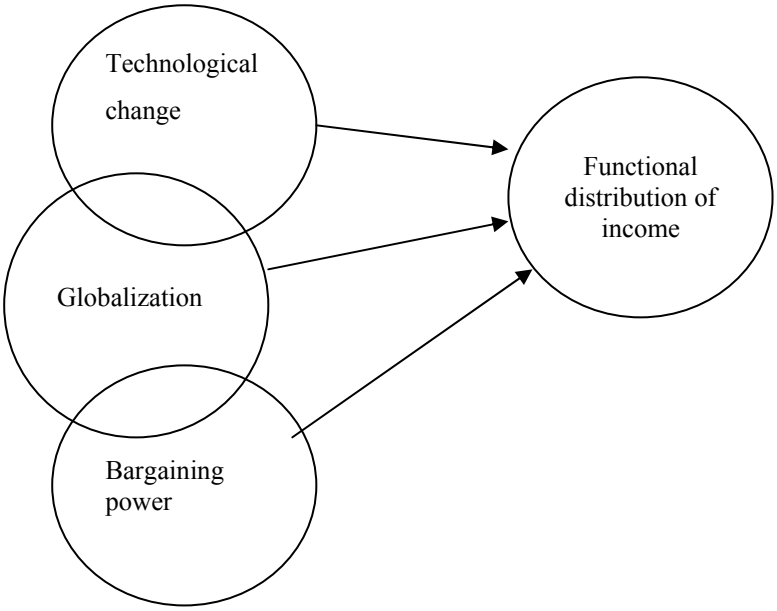
Unfortunately there is no single measure of financialization. It encompasses several dimensions like internal (domestic) financial deregulation and external (international) financial deregulation ("financial globalization") as well as changes in corporate governance. So far econometric studies on changes in functional income distribution in OECD countries have not included financialization variables. Studies on developed as well as developing countries have included variables of financial globalization. Rodrik (1998) and Harrison (2002) have included measures of capital controls and capital mobility. ILO (2008) argues that financial globalization has contributed to the decline in the wage share, but does not provide econometric evidence. Remarkably, IMF (2007b) in a study on *personal* income distribution within countries has included foreign direct investment (FDI) stocks.[7]

2.4 The standard explanation and an extension

The NAIRU theory gives a reduced-form distribution function in which income distribution is determined by various factors effecting bargaining power and by technology. As discussed in the previous section the recent (empirical) literature has focused on the relative impact of technological change, globalization and changes in bargaining power between capital and labor. The implicit structure of this argument is depicted in Figure 2. In the empirical part (section 4) we will present estimation results for such specifications.

[7] FDI flows illustrate the difficulties in distinguishing between financial globalization and globalization in production.

Figure 2. The standard explanatory factors of functional income distribution

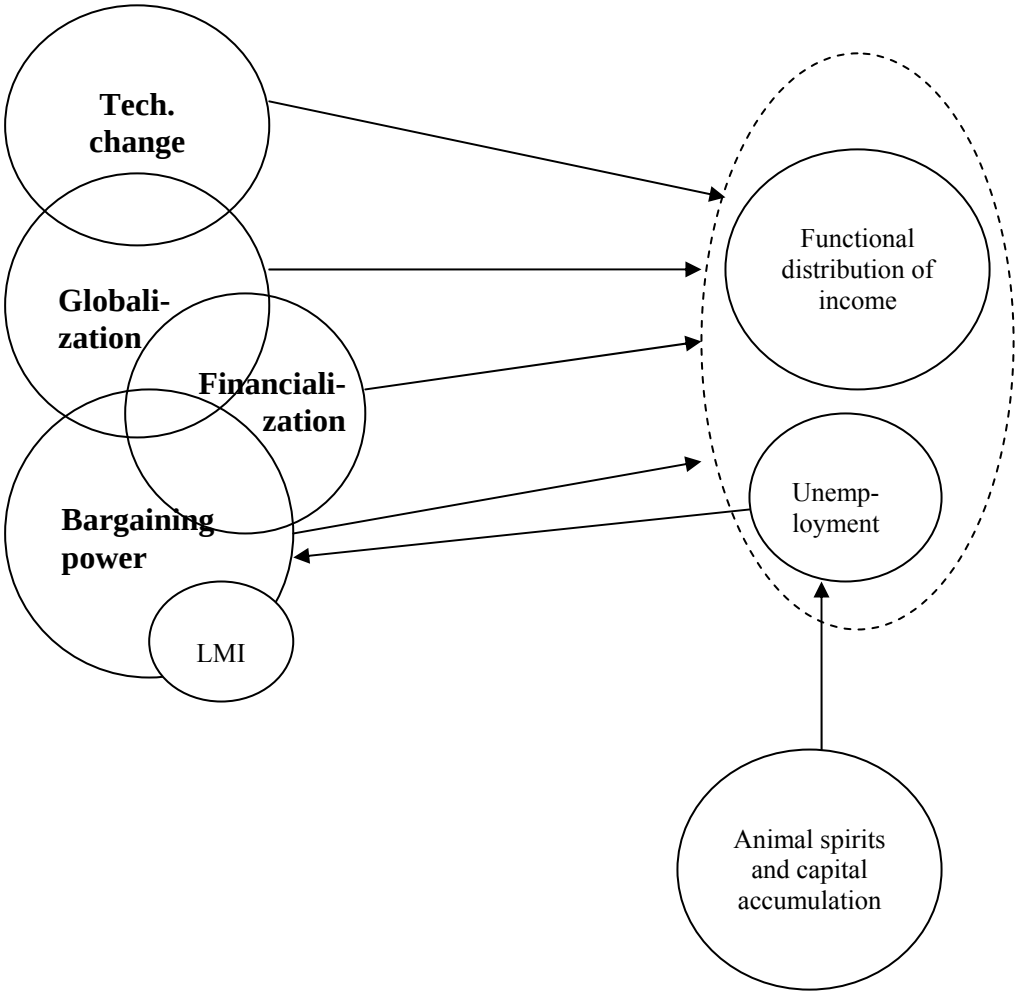


In Figure 2 the circles for technological change, globalization and bargaining power overlap. This reflects the difficulties in empirically distinguishing between these phenomena. These problems are in part for conceptual reasons, in part they are due to the empirical proxies. In many cases the distinction is difficult even at the conceptual level. For example without the development of modern communication technologies international production networks would not be feasible. As highlighted earlier, there are also ambiguities in the interpretation of globalization: has it changed economic fundamentals or merely the bargaining positions of labor and capital? It is thus important to keep in mind these problems of identification when interpreting empirical results as the empirical proxies will usually only partially capture the variable they are supposed to measure.

In addition we will also present an extended version of the model, the key contribution of which will, firstly, be that we also consider financial globalization as a proxy for financialization. Secondly, we will make use of the fact that the NAIRU model gives not only a reduced-form distribution function, but also a reduced-form unemployment function. This will allow for a plausibility check on some results in the distribution function. Thirdly, we also allow for a Keynesian effect of capital accumulation: if capital accumulation is governed

by animal spirits (or otherwise exogenous to the model) and there is no unit-elasticity of substitution of between capital and labor, unemployment will depend on the capital stock (Rowthorn 1999a, 1999b, Arestis et al 2007). The structure of the extended model is summarized graphically in Figure 3.

Figure 3. The extended explanatory factors of functional income distribution



3 The recent empirical literature on the determinants of functional income distribution

While income distribution has been a rather neglected research area by mainstream economic policy institutions, from 2007 onwards several high profile studies have appeared, for example IMF (2007a, 2007b) in the *World Economic Outlook* and EC (2007) in *Employment in Europe*; the OECD has published related studies on the effects of globalization (OECD 2007) and on personal income distribution (OECD 2008). This section will summarize IMF (2007a) and EC (2007) in detail, because these are directly comparable to the following empirical investigation and then provide a brief survey of other related empirical literature.

3.1 IMF (2007a)

IMF (2007a) is probably the most prominent mainstream analysis of the determinants and changes in functional income distribution. It concludes that "globalization is one of several factors that have acted to reduce the share of income accruing to labor in advanced economies, although rapid technological change has had a bigger impact, especially in unskilled sectors" (IMF 2007a, 161).

IMF (2007a) uses a panel of 18 OECD countries with annual data for the period 1983-2002 to analyze the effects of globalization, changes in technology, labor market institutions. The study is most careful in discussing the effects of globalization, with indicators for offshoring, relative import and export prices and immigration. As far as technology is concerned the text highlights the role of ICT capital stock, but the econometric analysis also contains the capital-labor ratio. After including a richer set of LMI variables, the study includes union density and the tax wedge.

The analysis is carried out mostly by a sectoral fixed effects panel estimation with one instrumental variable estimator reported as robustness check for the baseline specification.[8] There are no period fixed effects included.

[8] The text is not clear which variables were instrumented and how they were instrumented.

Table 1 summarizes the regression results of IMF (2007a). It finds statistically significant effects of ICT capital, mixed results on the labor-capital ratio negative effects of various globalization variables and negative effects the tax wedge and of unemployment benefits. Some comments are necessary. First, the table reports no diagnostic statistic for autocorrelation. While the standard errors used are robust to autocorrelation (and heteroscedasticity), there is no indication that the coefficient estimates themselves are. Indeed, attempts to replicate similar (i.e. simplified versions with the same dependent variable) estimations will indicate rather serious autocorrelation problems (with DW values below 1; see section 4.4).

Table 1. Wage share regression of IMF (2007a)

Table 5.2. Impact of Labor Globalization and Technological Change on Labor Shares

Dependent Variable: Labor Share	Fixed Effects Estimation (excluding labor market policies)	Fixed Effects Estimation	Instrumental Variables Estimation
Relative export price (log of)	–0.117***	–0.113***	–0.165***
Relative import price (log of)	0.076**	0.087***	0.138***
Labor-capital ratio (log of)	0.055**	0.015	–0.025
Offshoring	–0.196*	–0.156*	–0.285***
Immigration	–0.627***	–0.553***	–0.746***
ICT capital	–2.871***	–2.643***	–3.517***
ICT capital squared	56.407***	44.962***	55.598***
Tax wedge	. . .	–0.002*	–0.002***
Unemployment benefits	. . .	–0.001***	–0.001***
Fixed effects	Yes	Yes	Yes
Observations	231	225	208
R-squared	0.61	0.62	
Anderson test	. . .	. . .	151.63***
Hansen test	. . .	. . .	6.61

Source: IMF staff calculations.
Note: * denotes statistical significance at the 10 percent level; ** denotes statistical significance at the 5 percent level; and *** denotes statistical significance at the 1 percent level. Standard errors are heteroscedasticity and autocorrelation robust. ICT = information and communications technology.

Source: IMF (2007a): Table 5.2

Second, the study notes that "The coefficients on the ICT capital stock, its square, and offshoring become statistically insignificant when time effects are included" (IMF 2007a, 188). Rather than concluding that these non-robust effects should be interpreted with caution, the IMF asserts that "This is not surprising since time effects are often used in empirical studies to capture the effect of worldwide technological progress and other broad global trends" (IMF 2007a, 188). This is a strange statement; it effectively says: because time effects are often interpreted to capture technological progress in the absence of proper variables controlling for technological progress, it is no problem that a supposedly better variable for technological progress becomes statistically insignificant once time effects are allowed for. If time effect were indeed capturing technological progress, they (not the genuine technological progress variables!) should become statistically insignificant once variables for technological progress are controlled for.[9] Moreover, in our context many variables suffer from measurement problems, thus there is no reason to exclude the possibility that time effects capture changes unrelated to technology.

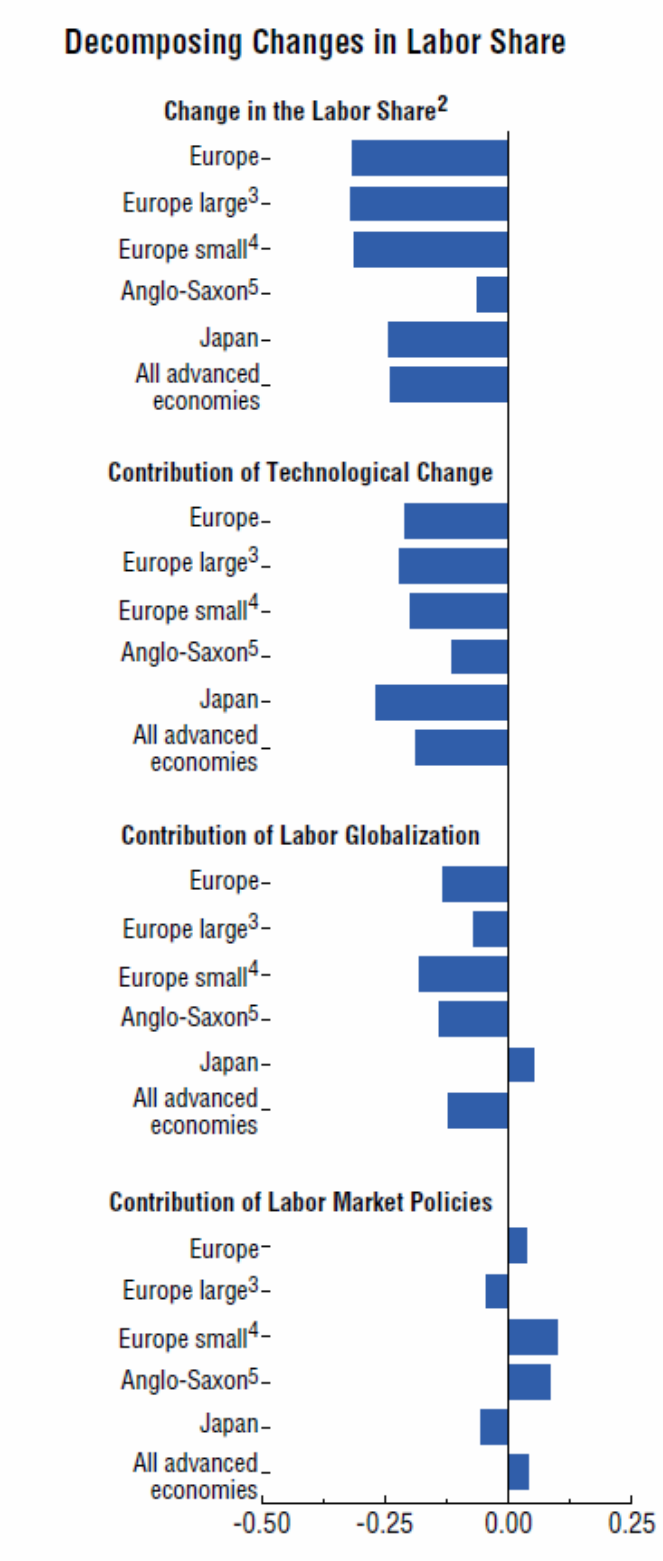
Third, ICT capital is the only variable that is included in non-linear form. EC (2007) as well as own attempts to replicate the results suggest that ICT capital has no statistically significant effect if included in standard form. While there is some justification for the non-linear form (IMF 2007a, 187) it is hardly conclusive. In particular one could argue that the more widespread the use of computers becomes the more it is likely to also substitute high skilled labor. More importantly, one would expect several other variables also to have non-linear effects. No tests of these and its effects on the robustness of the effects of ICT capital are reported.

The IMF then proceeds by calculating the contributions to changes in the labor share based on these regression results (see Figure 4). This clearly indicates that technological change has by far had the strongest relative effect on the wage share, that effects of globalization are also substantial and the effects of labor market institutions are minor (and go in different directions in different countries). Several comments are in place. First, IMF (2007a) is not entirely clear

[9] In purely technical terms it could be argued that, if time effects and technological change variables are highly correlated, this inflates standard errors so that both variables may become insignificant. In any case, it ought to serve as a warning against bold interpretations.

on whether changes in the capital-labor ratio are counted as technological change. The IMF's interpretation of Figure 4 only mentions ICT capital.

Figure 4. Contributions to the change in the wage share according to IMF (2007a)



Source: IMF 2007a, Figure 5.12

Second, offshoring makes up a substantial part of the effects of globalization. However, its effect is not robust to the inclusion of time effects.

The analysis then is extended by analyzing the high skilled and the low skilled wage share. These wage shares are defined with respect to high and low skill *sectors*, not with respect to the skill level of workers. This is important as the so-defined low skill wage share is declining because the employment share of these sectors is declining. The regression analysis is then performed on the wage shares in skilled and unskilled sectors separately.[10] This finds that globalization has had a strong negative effect on skilled labor and technological change a weaker and also negative effect. The first is said to be consistent with the outsourcing in the skilled sector. Nothing is said about the composition of these effects. In particular, a large part of the negative effect of globalization on skilled wage share seems to come from immigration. Immigration consistently has a substantially higher (by a factor of 3!) coefficient than in the regression for the unskilled wage share.

Last but not least, technological change has a *negative* effect on the skilled wage share. It is not clear how this is consistent with the IMF's overall story.[11] Moreover, the unskilled wage share has experienced negative effects from technological change and minor effects from globalization.

3.2 EC (2007)

EC (2007) is another prominent study on the determinants of the changes in functional income distribution. The study is based on a panel of annual data for 13 OECD countries from 1983 to 2002. It is similar in spirit to IMF (2007a); its focus is on the effects on different skill levels.[12] Its measure of globalization is rather crude (openness) and it uses more LMI

[10] For enlightening critical comments on the IMF's analysis of the high-skill and low-skill sectors see Onaran (2008, 5).

[11] The largest effect on the skilled wage share is the employment shift between sectors (Fig. 5.13 in IMF 2007). Presumably the IMF's defence would be that this shift also captures technological change.

[12] Being based on the KLEMS dataset, it is able to use a measure of the wage share of high-skilled, medium-skilled and low-skilled workers (rather than sectors).

variables and the OECD measure for product market regulation (PMR) in eight services sectors.

The estimations are performed with a standard panel estimator with sectoral fixed effects. A footnote reports a robustness check with an instrumental variable estimator. There are no time effects included and the output gap is included as a cyclical variable. No diagnostic statistics are reported and autocorrelation is not discussed as a potential problem.

EC (2007) notes that "openness of the economy (…) affects both rents in the goods market and bargaining power in the labour market" (EC 2007, 255), but stops short of concluding that the expected sign of openness is a priori indeterminate.

Table 2 gives the main regression results of EC (2007). Looking at the effects on the total wage share, we note that the capital-labor ratio has a positive effect and openness has a negative effect. ICT (per employee) and PMR have no statistically significant effects. Among the LMI variables, unemployment benefits, employment protection legislation and the tax wedge have negative effects and minimum wages have a positive effect. Unemployment benefits, active labor market policies as well as ICT have no statistically significant effect. Several of the variables that have no effect on the total wage share, however, do have effects on different skill groups.

Again we notice the absence of a discussion of the issue of autocorrelation. Similar estimations, i.e. with the same dependent variable and similar, but not identical set of explanatory variables, did indicate serious autocorrelation problems (see section 4.4).

Table 2. Wage share regression of EC (2007)

Table 5: Estimation results of a system of equations[1]

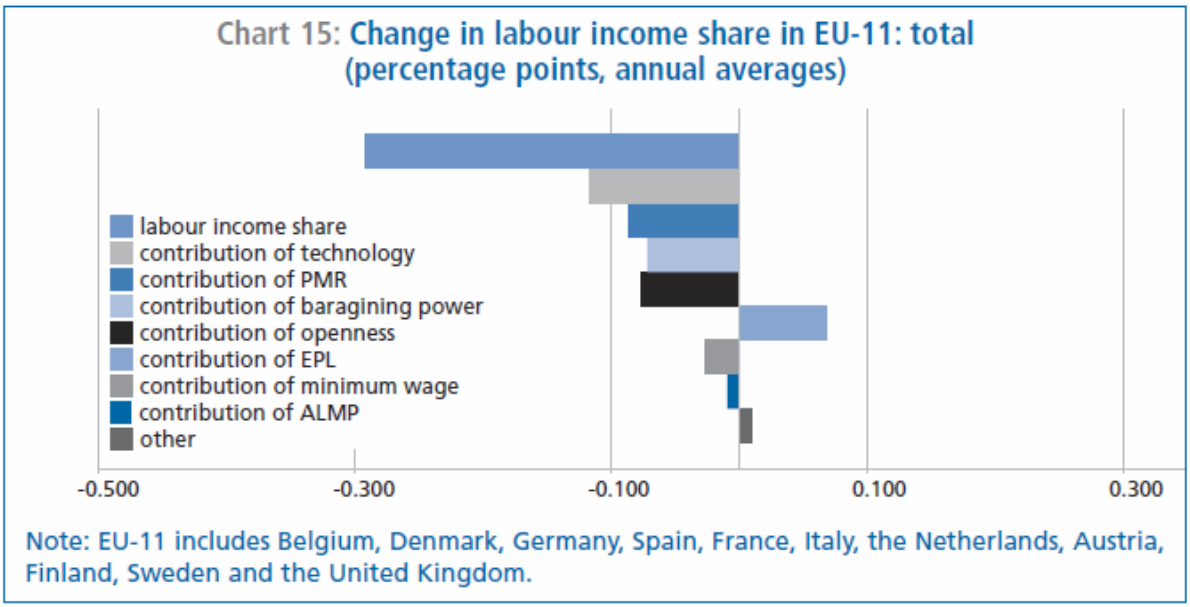
	Skill composition of labour			Total labour
	low-skilled	medium-skilled	high-skilled	
Constant	-32.577***	88.414***	45.863***	101.694***
	(5.213)	(5.867)	(2.742)	(5.445)
Capital-labour ratio (in log)	-4.770***	8.900***	5.788***	9.917***
	(1.655)	(1.862)	(0.870)	(1.728)
ICT use (in log)	-4.140***	1.587***	2.104***	-0.449
	(0.355)	(0.399)	(0.186)	(0.370)
PMR (in log)	3.752***	0.111	-2.587***	1.276
	(0.917)	(1.032)	(0.482)	(0.958)
Openness	0.003	-0.059***	0.004	-0.052***
	(0.014)	(0.016)	(0.007)	(0.014)
Union density	-0.232***	0.190***	0.090***	0.048
	(0.039)	(0.044)	(0.021)	(0.041)
UBenefit	-0.103***	-0.197***	-0.013	-0.312***
	(0.028)	(0.031)	(0.015)	(0.029)
EPL (in log)	-2.071*	-5.584***	3.060***	-4.595***
	(1.057)	(1.190)	(0.556)	(1.104)
Labour tax wedge	-0.289***	0.042	-0.084***	-0.330***
	(0.046)	(0.052)	(0.024)	(0.048)
Minimum wage	0.439***	-0.241***	-0.045	0.153*
	(0.075)	(0.085)	(0.040)	(0.079)
ALMP	0.056***	-0.057***	-0.005	-0.006
	(0.010)	(0.011)	(0.005)	(0.010)
Output gap	-0.144***	0.220***	-0.031	0.045
	(0.052)	(0.059)	(0.027)	(0.055)
Indirect tax share	0.178	-0.518***	0.260***	-0.080
	(0.110)	(0.124)	(0.058)	(0.115)
Fixed country effects	Yes	Yes	Yes	Yes
Observations	207	207	207	207
R-squared	0.98	0.98	0.99	0.86

Source: EU KLEMS database, AMECO database and Bassanini and Duval (2006)
Note [1]: Standard errors are between brackets. One, two, and three asterisks indicate that the parameter is significant at the 10, 5, and 1% levels, respectively.

Source: EC 2007, Table 5

The contributions of factor groups from 1983 to 2002 are presented graphically in Figure 5. EC (2007) concludes that "technological progress made the largest contribution to the fall in the aggregate labour income share" and "globalisation also had a negative impact on the aggregate labour income share but to a lesser extent" (EC 2007, 260)

Figure 5. Contributions to the change in the wage share according to EC(2007)



Source: EC 2007, Chart 15

It also notes that the "loss was unevenly spread over the different skill types as the high-skilled workers were able to increase their share while the low-skilled workers lost income share as a result of technological progress". (EC 2007, 260) And "globalisation also had a negative impact (…) primarily on the medium-skilled workers" (EC 2007, 260)

Regarding LMI, EC (2007) argues that labor demand from low-skilled workers is elastic whereas that of high and medium-skilled workers is inelastic. Therefore an increase in LMI and thus the bargaining power of low-skilled workers will decrease their wage share because the employment effect dominates the wage effect. Moreover, low-skilled workers are substitutes of capital and medium/high-skilled workers are complements of capital.

3.3 Other neoclassical studies

Table 3 gives an overview of the existing literature.

Bentolila and Saint-Paul (2003) stick closely to the neoclassical approach, that is, they derive the wage share from a production function and discuss different types of technological change. Their aim is to decompose changes in the wage share into movements along a technology-determined curve, namely the [wage] share-capital curve, shifts of its locus and

Table 3. Overview empirical literature explaining change in the wage share

Study	*Dep. Var.*	*Estimation method*	*Explanatory variables*	*Sample*	*notes*
IMF (2007a)	WS [Tab 5.2]	Panel FE	Px, Pm, L/K, offshoring, immig, ICT, ICT^2, TW, UB	18 OECD countries, 1982-2002 Obs: 200	
	Un/skilled WS	Panel FE	Px, Pm, Lskilled/K, Lunsk/K, offs, imm, ICT, ICT^2, LMI, PMR		un/skilled refers to sectors
EC 2007	Total WS [Tab 5]	Panel FE	K/L, ICT, PMR, open, LMI, govt/Y	13 countries, 1983-2002 (KLEMS)	Un/skilled WS refers to un/skilled workers
Ellis and Smith 2007	WS	FE panel	Δy, PMR, EPL, oil p, REX, EM X/Y, trend	Not clear, probably: OECD countries 1961-2004	Uses time trend since 1985 as proxy for tech change
Guscina 2006	WS	panel FE Also in diff	Open, lagged Δx, EPL	18 OECD countries, 1960-2000	Sample split at 1985
Nunziata 2005	w/p	panel FE (FGLS) with lagged dep var	w/p(t-1), u, EPL, BRR, TW, COORD, X; intereactions, TOTS, TFPS	20OECD countries 1960-94	
Studies with sectoral data					
OECD 2007	Sectoral lab demand	Panel in diffs	W/Pinput, K, R&D, IMP, EXR With/out Y in some specification ("un/condistional LD")	Annual sectoral data, 1987-2003 Obs: 1700	
Bentolila and Saint-Paul 2003	Sectoral WS	Arellano-Bond GMM	TFP (-), ΔL (-), [country-wide] labor conflict (-), (ind-spec) K/Y, (ind-spec) oil price	13 sectors in 12 OECD countries, 1972-93	ΔL is supposed to capture "current labor adjustment costs" (p.19)
Azamat Manning and Van Reenen 2007	Sectoral WS; (national WS)	OLS panel, FE: c, ind, t	PO (public ownership), BTE (barriers to entry)	3 network sectors in 18 OECD countries, 1970-2001 obs: 1000	
Studies with non-OECD countries					
Rodrik 1998	w/p	Panel 5 yr avg	Y/L, Ypc, demo, open, cap lib	100 c, 1960-94 max 500	
Harrison 2002	WS	OLS, FE panel, IV Annual data, 5y avg.s	L/K, Y_pc, cap controls, open, FDI, gov't	130 c 40 yrs obs: max 1500	
Jayadev 2007	WS	OLS, FE panel Annual data	Y, CA open, trade open, real int, gov't	62-89	
Other studies					
Golden and Wallerstein 2006	Pay inequality		Level of w bargaining, UD, MF, trade, mig, gith gov't, u, initial ineq	OECD Obs= 27	

deviations from it" (Bentolila and Saint-Paul 2003, 25). The equation eventually estimated includes total factor productivity (TFP), the change in employment, industrial conflict, the capital-output ratio and oil prices. The last two are allowed to have industry-specific effects. There is no control for business cycle fluctuations. Thus one can only speculate by which variable these movements off the technologically-determined distribution are captured (by TFP or by the change in employment?).

TFP is included to capture capital-augmenting technological change and is supposed to shift the distribution curve. The change in employment is supposed to capture "current labor adjustment costs" (Bentolila and Saint-Paul 2003, 19) without further explanation. Together with industrial conflict it is supposed to cause deviations from the distribution curve. Changes in oil prices are supposed to shift the distribution curve.

The estimations are based on data from 13 sectors in 12 OECD countries from 1972 to 1993. Estimations are performed using a dynamic panel GMM (Arellano-Bond) estimator. The authors make no serious attempt to actually decompose the effects (as they claim to do). The economic interpretation of the results is restricted to comparisons with other estimates for the elasticity of substitution between labor and capital.

Ellis and Smith (2007) investigate the contribution of technological change, globalization and bargaining power on the wage share. They estimate a wage share equation including product market regulation, employment protection legislation, the real exchange rate, oil prices, the exports to Emerging Economies and a time trend. The sample of estimation is not entirely clear from the paper. It probably covers 1960 to 2004 for most OECD countries. Several variables are used with substantial extrapolation. For example PMR is assumed constant from 1961 to 1974 at 1974 levels. Similarly EPL data are back-casted from 1984, i.e. for most of the sample.

The authors find persistent effects of the time trend and interpret this as evidence for the role of technological change. While this may be the authors' preferred interpretation, there is nothing intrinsically technological about a time trend. The paper thus fails to provide evidence for its core argument.

Guscina (2006) aims at identifying the effects of technological change, globalization and bargaining power. Openness is used as a proxy for globalization, lagged productivity growth for technological change and EPL for bargaining power. The estimations are performed for the pre-1985 and post-1985 sample separately because 1985 is assumed as the beginning of the technological revolution. Estimations are also performed with the employment share and the Gini coefficient as dependent variables. The sample covers 18 OECD countries for the period 1960-2000. The estimation is performed by a standard fixed panel estimator with country fixed effects (but not time effects) and, as a robustness check in differences without any fixed effects.

The authors find negative effects of openness (only statistically significant effects post 1985) and no statistically significant effects of employment protection legislation. There are statistically significant effects of productivity growth, namely positive ones prior to 1985 and negative ones thereafter. The author interprets this as evidence of change in technological progress.

3.4 Other studies on changes in income distribution

There are numerous studies that are related but not directly comparable, i.e. that either do not investigate the determinants of the (national) wage share econometrically or that refer to very different groups of countries. Thus the following literature review has to be necessarily incomplete.

Azmat et al (2007) highlight the effects of privatization and barriers to entry to certain industries on the wage share. They do so by "exploit[ing] a number of policy experiments across several 'network' industries in many OECD countries to identify these effects" (Azmat et al. 2007, 29), i.e. deregulation and privatization in the telecom, gas and electricity, and transportation industries. They thus use data on three network industries in 18 OECD countries, for the period 1970-2001, i.e. their dependent variable is *sectoral* wage shares. Estimations are performed using standard fixed effects OLS panels. The fixed effects control for sectoral, country and time effects. Azmat et al (2007) find that privatizations have negative effects on the wage share and barriers to entry also have negative effects.

All the studies discussed so far have analyzed determinants of the changes in the wage share in OECD countries. Rodrik (1997) and Harrison (2002) are two studies that analyse the determinants of distribution on developed as well as developing countries. Because of their number, developing countries will invariably dominate their results, which therefore are difficult to compare to the other studies.

Rodrik (1998) investigates the effects of democracy and of capital mobility on *manufacturing wages* in an analysis covering around 100 countries. The estimations control for the manufacturing value added per worker, the output-capital ratio, the degree of openness and a measure of capital liberalization. The sample consists of (non-overlapping) 5-year averages and, in a variation, of a cross section analysis. Rodrik finds that democracy increases wages and openness reduces wages.

Harrison (2002) investigates the effects of globalization on wage shares in an analysis covering more than 100 countries over a period of up to 40 years. Openness, capital controls, the terms of trade and exchange rate crises are used as variables for globalization. The estimations also control for the capital-labor ratio, relative per capita GDP and government share in GDP. Harrison finds the capital-labor ratio has a strong (positive) impact and globalization has indeed had negative effects on distribution. Capital controls, have a positive effect. Openness, exchange rate crises and FDI-inflows have negative effects on the wage share.

Jayadev (2007) analyses the effect of financial openness and trade openness on the wage share in an econometric analysis covering up to 80 countries for the period 1970-2001. The openness variables are legal measures on openness. The estimations are performed using standards fixed effects panel analysis. Control variables include (in various specifications) per capita GDP, interest rates, a crisis dummy, the government share and the budget deficit. Capital account openness and trade openness are found to have negative effects on the wage share.

ILO (2008) argues that "financial globalization has led to a depression of the share of wages in GDP" (ILO 2008, 39), but does not provide econometric evidence. At the center of the ILO`s argument is that financial globalization may have had positive effects on growth, but that these are rather small.

All the studies discussed so far (except Rodrik 1998) offer an econometric analysis that has the wage share as the dependent variable. *Wolff and Zacharias (2007)* offer an innovative approach based on a micro data analysis that takes aspects of functional income distribution into account. They use a class approach to decompose changes in the distribution of household income for the USA 1989 – 2001. They define the capitalist class with respect to ownership of nonhome wealth and distinguish between various groups within the working class according to the skill level and whether employees have supervisory functions. They combine data from the US census with the CFS (consumer finance survey). They find that capitalist households receive more than 80% from income from nonhome wealth, whereas this ratio is below 20% for all other groups. They decompose the change in the Gini coefficient (of household income distribution) according to class, education and ethnicity and find that "the entire increase in inequality between 1989 and 2000 is attributable to the increase in inter-class inequality" (Wolff and Zacharias 2007, 24).

3.5 Wrapping up: What's missing in the IMF and EC studies?

IMF (2007a) and EC (2007) are the most relevant presentations of the mainstream view of the determinants of the changes in the functional distribution of income. They both explain the wage share in a flexible framework that allows to distinguish between effects from technological change, globalization and labor market institutions/bargaining power. The single most important factor found is technological change. ICT services and the capital labor ratio are used as proxies for technological change.[13] We note the following potential problems with these studies:

- From an econometric point of view there are several issues that deserve closer scrutiny. Given that the dependent variable, the wage share, is likely to be a unit-root candidate, surprisingly little attention has been given to the issue of autocorrelation in the residuals. There are several issues of robustness. For example IMF (2007a) does not control for short-run business cycle variables. Another important issue is whether results are robust to the inclusion of time effects. Neoclassical studies usually are quick in equating time effects and time trends as proxies for technological changes.

[13] Other neoclassically inspired works use time trends as proxies for technological change and can therefore not be regarded as serious tests of the role of technological change in determining income distribution.

However, given that bargaining power is notoriously difficult to measure there is no a priori reason to interpret time effects as being due to technological changes.

- Form a Keynesian view it is not obvious that the capital-labor ratio should be interpreted as a technological change. Investment, and as a consequence, the capital labor ratio will be driven to some extent by changes in animal spirits that are not primarily related to technology.
- In the empirical literature the bargaining power of labor is proxied by various labor market institutions. Essentially these measure welfare state generosity, which clearly is an important determinant of bargaining power. However, it should be obvious that power is a much broader concept that is not adequately captured by labor market institutions and union membership.
- Wage policy has received surprisingly little attention in this context. In the past 20 years governments in several European states have tried to influence wage policies in the direction of wage moderation. In many cases this crystallized in wage pacts signed by unions, employers and the government.
- Financialization has so far been neglected as a potential determinant of functional income distribution in studies on developed economies.

4 The determinants of functional income distribution. A panel analysis

This section will first examine the validity of the conclusions of EC (2007) and IMF (2007a) by replicating their analyses, i.e. by estimating specifications similar to theirs, and by investigating potential econometric problems. We thus will estimate a *standard wage share equation* that includes variables for technological change (*tech*), globalization (*glob*), and bargaining power (*BP*; in particular: labor market institutions) as presented graphically in Figure 2:

$$WS = f(Tech, Glob, BP) \tag{7}$$

Second, we will estimate an *extended wage share equation* that includes effects of financial globalization (*finglob*), capital accumulation (*KG*), allow for different effect of union density in countries belonging to the Ghent system and include a variable for wage pacts (*WP*). Additionally controls for short-run fluctuations of the business cycle (Δy) and other structural changes (X) will be included, corresponding to Figure 3.

$$WS = f(\Delta y; Tech, Glob, BP, Finglob, WP, KG; X) \tag{8}$$

In addition the corresponding reduced-form unemployment equations will also be estimated. This will make it possible to check the plausibility of indirect effects of changes in, say, labor market institutions on distribution via (implied) effects on unemployment.

One clarification is in place at the beginning of this chapter. The previous section has identified several potential problems in the work of EC (2007) and IMF (2007a). The present study will not be able to correct all of these problems for reasons to be explained below. In particular we are unable to propose *one* correct specification. Rather, our aim is more modest: firstly, we wish to perform a series of tests of robustness using different estimation techniques; secondly we will extend the list of variables that may affect income distribution.

4.1 Variable definitions and data sources

The dependent variable is the adjusted wages share (*AWS*) from the AMECO database. In some specifications we will also use a non-adjusted wage share (*WS*) with is compensation of employees divided by the compensation plus operating surplus as taken from the AMECO database.

As variables for technology (the logarithm of) ICT services (*ICT*) from the KLEMS database and the capital-labor ratio (*KL*) will be used. KL is taken from AMECO. Variables for labor market institutions are taken from the Bassanini-Duval dataset, which is the most up-to-date dataset and has also formed the basis for the *OECD Employment Outlook 2006*. The following variables are included: union density (*UNDENS*), employment protection legislation (*EPL*), the unemployment benefit replacement ratio (*UBRR*), the tax wedge (*TW*) and product market regulation in network industries (*PMR*). Trade openness (*OPEN*) is measured as the sum of exports and imports divided by GDP, all of which are taken from the AMECO database. A table with variable definitions is in the Appendix (Table A.1). *TOT* is (the logarithm of) the terms of trade from AMECO.

The sample is 1979-2006 for the data from the AMECO dataset, but as the Bassanini-Duval dataset covers only the period 1982-2003, the effective sample for most estimations reported below is 1982-2003.

The following 15 countries are covered: Belgium, Denmark, Germany, Ireland, Spain, France, Italy, Netherlands, Austria, Portugal, Finland, Sweden, United Kingdom, United States, and Japan.[14] For Germany macroeconomic variables have been chained with growth rates for West-Germany prior to 1991 where necessary.

4.2 Time series properties

First we investigate the time series properties of the dependent variable individually. Only for three countries is the null of a unit root (without trend) rejected at the 5% level or better. Four more countries pass the test at the 10% level (Table 4). For 15 countries the ADF fails to reject the null of a unit root. The results are qualitatively similar if we allow for a (linear)

[14] Luxembourg, Greece, Iceland, Norway, Canada, Australia and New Zealand had to be dropped as they lack one or more of the relevant variables in the Bassanini-Duval dataset.

trend. While these results are hardly conclusive they suggest that the variables have a unit root.

Table 4. Unit root tests (ADF tests with two lags) for AWS for individual countries

	without trend		with trend			
Belgium	-2.638	*	-2.789		Test critical values (w/o trend):	
Denmark	-2.443		-2.201		1% level	-3.689194
Germany	-0.938		-2.754		5% level	-2.971853
Ireland	-1.697		-1.239		10% level	-2.625121
Greece	-1.694		-2.963			
Spain	-1.790		-3.723	**		
France	-3.141	**	-2.250		Test critical values (w. trend):	
Italy	-1.783		-2.845		1% level	-4.323979
Luxembourg	-2.768	*	-2.598		5% level	-3.580623
Netherlands	-2.758	*	-3.176		10% level	-3.225334
Austria	-0.189		-1.659			
Portugal	-3.525	**	-3.327	*		
Finland	-0.732		-1.884			
Sweden	-3.920	***	-3.811	**		
United Kingdom	-2.820	*	-3.083			
Iceland	-1.054		-2.605			
Norway	-0.367		-1.862			
United States	-1.931		-3.814	**		
Japan	-0.824		-1.630			
Canada	-0.757		-1.194			
Australia	-1.121		-2.134			
New Zealand	-1.821		-1.401			

Sample: 1979-2007

Secondly, we perform panel unit root tests. These are often considered to have a higher power than unit root tests on individual time series. However, they assume a uniform autoregressive process across countries. The panel unit root tests are also not conclusive. While the Levin, Lin and Chu test rejects the unit root hypothesis assuming a common autoregressive process at the 5%-level, all tests allowing for individual unit root processes fail to reject the null of a unit root.

Overall the unit root tests are not conclusive, but they suggest that countries exhibit individual unit roots. Thus we learn that we ought to be skeptical of the pooling assumption and that we ought to worry about spurious regression results.

Table 5. Panel unit root tests for AWS

Group unit root test: Summary
Sample: 1979 2007
Exogenous variables: Individual effects
Automatic selection of maximum lags

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-1.872	0.031	22	583
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-0.216	0.415	22	583
ADF - Fisher Chi-square	45.271	0.419	22	583
PP - Fisher Chi-square	42.683	0.528	22	603

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

4.3 Econometric method

The purpose of this study is to investigate the robustness of the results of the IMF (2007a) and EC (2007) and to extend their analysis by including further variables. This confronts several substantial econometric problems. These range from heterogeneity across the countries within our panel to limited variability of some variables over time within one country.

To pool or not to pool? Panel analysis requires the assumption that a change in a variable has the same effect in different countries. As parts of this study will be based on annual data, the assumption of uniform coefficients is rather restrictive. Indeed the unit root tests on the dependent variable confirm the suspicion that the pooling restriction is violated. However, the number of variables (twelve and more) that we wish to investigate and, in many cases, their lack of variation within a country does not allow for a single country approach.[15] In particular it would make it impossible to use time series techniques that require more than one lag of each variable. Thus we proceed with a word of caution. The coefficient estimates of the panel analysis based on annual data have to be interpreted with caution and it has to be kept in mind that the pooling restriction (i.e. the assumption of identical coefficients across countries) is unlikely to be correct. The coefficient estimates have to be interpreted as average effects across a group of heterogeneous countries.

[15] In particular the various variables for labor market institutions often have little variation over time.

The first specification will be a standard fixed effects (FE) estimator as used by IMF (2007a) and EC (2007). As we will see, this estimator comes with serious autocorrelation problems. The second specification will be a first-difference estimator. This estimator should theoretically yield similar results to the fixed effects estimator and is preferable if the regression suffers from a high degree of autocorrelation in the residuals (Wooldridge 2002, 284). With all of these specifications we will report specifications with and without time effects and we report panel corrected standard errors that are consistent to heteroscedasticity and autocorrelation.

Thirdly we will present medium-run results based on non-overlapping 5-year average data. This is attractive in our context because some of the variables, in particular those for labour market institutions change slowly and because the pooling restriction is less restrictive here. The critical assumption regarding pooling now is that over a five year (rather than a one year) period the effects are the same. While this is still unlikely to be met, it certainly is more plausible. The method also has the advantage that it circumvents unit root problems as the residuals of the regressions have no (serious) autocorrelation problems. However, this approach comes at the cost of throwing out some information. In a somewhat different (but related) context Baccaro and Rei (2007) estimating reduced form unemployment equations have concluded that specifications based on non-overlapping 5-year averages are preferable on econometric grounds.

Because of the nature of our data, where the degree of integration is often unclear and, in some cases, variation over time is low, we regard the estimations based on (non-overlapping) 5-year averages as the most reliable ones.

This study will not use dynamic panel approaches. While presently fashionable in the literature, the Arellano and Bond (1991) estimator and the Blundell and Bond (1998) estimator are not designed to deal with potential unit root problems. Panel cointegration methods might be a logical next step in the analysis, but the tests are typically not designed to for our high number of variables. Among the dynamic panel estimators the pooled mean group estimator proposed by Pesaran, Shin and Smith (1999) may be an interesting extension as it allows for country specific short-run effects but imposes an identical long-run relation.

4.4 Replicating the standard model

In a first step we try to replicate the studies by the IMF and the EC. We use a similar set of variables and similar specifications. The explanatory variables include ICT and KL for technological change; UNDENS, EPL, UBRR, and TW as labor market variables; PMR for product market regulation and OPEN as measure of globalization. We will firstly estimate the relevant equation (like IMF and EC) in a panel with annual data using a fixed effects estimator, secondly, (unlike IMF and EC) using a first difference estimator and, thirdly, (unlike IMF and EC) with non-overlapping 5-year averages and a fixed effects estimator.

4.4.1 Replicating the standard model with annual data

As in IMF (2007a) and EC (2007), in the first specification all variables are contemporaneous and a basic OLS panel estimator with sectoral fixed effects (but not time effects!) is used. Then we will modify the specification by adding period affects, estimate the specification in difference form to prevent autocorrelation problems and use lagged variables to avoid simultaneity. The results of these estimations are summarized in Table 6. All reported t-values are based on panel corrected standard errors that are robust with respect to sector-specific heteroscedasticity and autocorrelation.

Specification 1 includes all variables in levels and uses contemporaneous variables. The specification includes sectoral fixed effects, but no period effects. By and large the results are in line with the findings by the IMF and the EC. ICT and KL have statistically significant negative effects, as does OPEN. UNDENS, however, has no statistically significant effect, whereas EPL, UBRR and PMR do. This specification suffers from serious econometric problems. First, the regression suffers from serious autocorrelation problems. The DW-statistic, assuming a uniform autoregressive process across countries, is 0.44. Not only are the coefficient estimates biased, but the DW-value is so low as to suggest spurious regression problems. Second, the specification does not include period fixed effects. The redundant fixed effects tests, however, rejects the null of redundant period fixed effects at the 1% level (F(21, 268): 2.36). Third, no attempt is made to address potential problems of endogeneity.

Table 6. Standard wage share equation with annual data

specification	1			2			3 (variables lagged)		
	coeff	t-value		coeff	t-value		coeff	t-value	
ict	-1.383	-5.753	***	-0.396	-1.242		-0.378	-1.194	
kl	-11.789	-7.135	***	-10.122	-3.939	***	-11.268	-4.323	***
undens	0.044	1.265		0.012	0.308		0.020	0.508	
epl	-2.547	-5.203	***	-2.887	-5.972	***	-2.992	-6.215	***
ubrr	-0.060	-4.283	***	-0.071	-5.105	***	-0.077	-5.588	***
tw	0.048	1.153		0.077	1.930	*	0.033	0.886	
pmr	-0.960	-3.950	***	-0.244	-0.787		-0.124	-0.406	
open	-14.512	-10.563	***	-18.155	-11.284	***	-20.315	-13.815	***
Sector FE	yes			yes			yes		
Period FE	no			yes			yes		
dw	0.438			0.439			0.472		
adj R2	0.817			0.836			0.845		

specification	4 (variables lagged)			5			6 (variables lagged)		
	coeff	t-value		coeff	t-value		coeff	t-value	
Δ ict	-0.379	-0.437		-0.260	-0.313		-0.248	-0.295	
Δ kl	-8.757	-1.924	*	0.178	0.040		-13.096	-2.712	***
Δ undens	0.066	1.014		0.094	1.462		0.054	0.779	
Δ epl	0.069	0.153		-0.242	-0.558		0.060	0.125	
Δ ubrr	-0.016	-0.777		0.026	1.235		-0.014	-0.582	
Δ tw	0.010	0.266		0.013	0.356		-0.020	-0.501	
Δ pmr	-0.082	-0.242		0.038	0.117		-0.186	-0.562	
Δ open	-8.778	-4.624	***	-7.608	-3.880	***	-5.252	-3.482	***
Sector FE	no			no			no		
Period FE	yes			yes			no		
dw	1.624			1.709			1.531		
adj R2	0.220			0.227			0.049		

specification	7 (variables lagged)			8 (variables lagged)		
	coeff	t-value		coeff	t-value	
Δ ict	-0.469	-0.541		-0.383	-0.445	
Δ kl	-2.277	-0.393		-9.017	-1.985	**
Δ undens	0.066	1.021		0.052	0.788	
Δ epl	-0.001	-0.002		0.046	0.103	
Δ ubrr	-0.018	-0.887		-0.016	-0.756	
Δ tw	0.011	0.300		0.011	0.296	
Δ pmr	-0.117	-0.347		-0.086	-0.255	
Δ open	-8.936	-4.609	***	-8.622	-4.551	***
Δ u(t-1)	-0.188	-1.899	*			
Δ tot				3.720	1.629	
Sector FE	no			no		
Period FE	yes			yes		
dw	1.639			1.577		
adj R2	0.227			0.224		

Sample: 1982-2003, countries: 15; t-values are based on panel corrected standard errors that are robust to hetereoscedasticity and autorcorrelation. ***, **, * denote statistical significance at the 1%, 5%, and 10% level respectively. Variable defintions: see text section 4.1 and Table A.1

Specifications 1, 2, and 5 are with contemporaneous explanatory variables, Specifications 3, 4, 6, 7, and 8 with lagged explanatory variables.

Specification 2 includes period fixed effects. Including fixed effects does not solve the autocorrelation problems (DW: 0.44). While results are generally qualitatively similar to specification 1, there are important differences. The effects of ICT and PMR are not statistically significant any more. Specification 3 uses lagged values of the explanatory variables to avoid endogeneity problems. The results are similar and the autocorrelation problems persist. Because of the serious autocorrelation problems all the estimations in level form have to be regarded as unreliable.

To prevent autocorrelation we estimate the equation in difference form. To make them comparable to the estimation in levels the sectoral fixed effects are omitted. Time effects have been included based on the redundant fixed effects test. The basic equation is estimated once with contemporaneous explanatory variables (specification 4) and lagged explanatory variables (specification 5). The estimations in difference form show reasonable DW values (1.62 and 1.71). The two specifications give rather similar results in that only OPEN has a statistically significant negative effect (at the 1%-level). This is also the case for all following specifications. KL is statistically significant at the 10% level (and negative) in specification 5. All other variables are not even statistically significant at the 10% level.

Finally, we do three tests of robustness. Specification 6 uses no fixed effects at all. KL turns statistically significant at the 1% level and has a negative effect. Specification 7 includes the (lagged) rate of unemployment and specification 7 includes the terms of trade. Unemployment has a negative effect that is statistically significant at the 10%-level. Only OPEN has a statistically significant effect (again at the 1% level), KL is statistically significant at the 5% level in specification 8.

4.4.2 Replicating the standard model with non-overlapping 5 year averages

Most of the effects of the explanatory variables we examine will take time. For example there is little reason to assume that a change in technology or in union density will affect income distribution *in the same year*. Moreover, there are reasons (such as institutional differences) to expect the adjustment speed to differ across countries. Therefore a medium-term analysis seems more appropriate than an analysis with annual data. It is less restrictive that, say, a

change in union density will have the same effect on distribution *over five years*. Thus we repeat the estimation using non-overlapping five year averages. The results are reported in Table 7.

Table 7. Standard wage share equation with (non-overlapping) 5-year averages

specification	1			2		
	coeff	*t-value*		*coeff*	*t-value*	
	5.640	0.176		23.392	0.518	
ict	-1.659	-3.460	***	-0.255	-0.417	
kl	-11.327	-3.263	***	-8.662	-1.677	*
undens	0.076	0.912		0.028	0.324	
epl	-2.857	-2.353	***	-3.511	-2.963	***
ubrr	-0.060	-1.754	*	-0.076	-2.222	**
tw	-0.013	-0.137		0.031	0.353	
pmr	-1.254	-2.438	***	-0.326	-0.395	
open	-17.028	-5.441	***	-20.623	-5.507	***
u(t-1)						
tot						
Sector FE	yes			yes		
Period FE	no			yes		
dw	2.016			1.805		
adj R2	0.825			0.843		
	3			4		
	coeff	*t-value*		*coeff*	*t-value*	
	47.978	0.789		44.459	0.950	
ict	-0.262	-0.407		-0.539	-0.858	
kl	-5.722	-0.818		-7.222	-1.393	
undens	0.042	0.528		0.059	0.615	
epl	-3.604	-3.030	***	-3.433	-2.834	***
ubrr	-0.071	-2.060	**	-0.083	-2.394	***
tw	0.060	0.624		0.001	0.015	
pmr	-0.425	-0.498		-0.560	-0.677	
open	-20.793	-5.464	***	-21.958	-5.836	***
u(t-1)	-0.153	-0.719				
tot				-0.063	-1.290	
Sector FE	no			no		
Period FE	yes			yes		
dw	1.817	0.000		1.831	0.000	
adj R2	0.842	0.000		0.845	0.000	

Sample: 1982-2003, countries: 15; t-values are based on panel corrected standard errors that are robust to hetereoscedasticity and autorcorrelation. ***, **, * denote statistical significance at the 1%, 5%, and 10% level respectively. Variable defintions: see text section 4.1 and Table A.1

Specification 1 uses sectoral fixed effects only. As in all the following specifications, there are no (serious) autocorrelation problems. ICT, KL, EPL, PMR and OPEN have statistically significant effects at the 1% level, UBRR at the 10% level. Specification 2 uses sectoral as well as period fixed effects. The redundant fixed effects test clearly suggests the inclusion of

both sets of fixed effects. Again ICT is not statistically significant once time effects are allowed for. EPL, UBRR and OPEN have statistically significant (at the 5% level or better) negative effects. KL has a statistically significant (negative) effect at the 10% level.

Specification 3 and 4 add unemployment and the terms of trade respectively. Both variables are not statistically significant. In both specifications OPEN, EPL and UBRR are statistically significant.

The negative effect of EPL and UBRR is perverse from a bargaining point of view. Higher EPL should increase workers' bargaining power and thus increase rather than decrease the wage share. From a neoclassical perspective, it will be tempting to conclude that labor demand is elastic and EPL and UBRR have positive effects on unemployment and thus indirectly affect the wage share. This interpretation, however, is at odds with the results of specification 3 which controls for unemployment, which should wipe out indirect effects. To further clarify this issue we estimate an auxiliary regression with unemployment as the dependent variable (Table 8). This clearly shows that there is no statistically significant effect of EPL and UBRR on unemployment. In the case of UBRR the sign is positive. According to these results only KL and TW have statistically significant (positive) effects on unemployment.

Table 8. Standard unemployment equation with non-overlapping 5-year average data

specification	1			2		
	coeff	*t-value*		*coeff*	*t-value*	
	106.333	3.606	***	160.375	3.730	***
Ict	-0.561	-1.408		-0.044	-0.067	
Kl	12.898	3.976	***	19.179	3.842	***
Undens	0.122	1.645		0.097	1.329	
Epl	-0.639	-0.640		-0.605	-0.648	
Ubrr	0.038	1.443		0.033	1.253	
Tw	0.187	2.142	**	0.187	2.384	***
Pmr	0.506	1.173		-0.643	-0.910	
Open	-3.655	-1.377		-1.112	-0.348	
Tot						
Sector FE	yes			yes		
Period FE	no			yes		
Dw	1.680			1.606		
adj R2	0.834			0.847		

Sample: 1982-2003, countries: 15; t-values are based on panel corrected standard errors that are robust to hetereoscedasticity and autorcorrelation. ***, **, * denote statistical significance at the 1%, 5%, and 10% level respectively. Variable defintions: see text section 4.1 and Table A.1

4.4.3 Conclusion for the replication of the standard model

Our conclusion from this attempt to replicate the results of the IMF and the EC are thus sobering. Their result that technological change is the main driver of the increase in inequality is not reliable. The result relies on a specification that suffers from serious autocorrelation problems and is not robust to the inclusion of time effects.[16] In other words the results are not robust and do not withstand the fixing of obvious econometric problems. In particular ICT has no statistically significant effect once time effects are allowed for. KL has statistically significant effects in some specifications, but not in all.[17] The only variable that has a statistically significant effect that is robust across various specifications is openness.[18] Overall, the IMF's and the EC's strong claim that technological change is the prime cause for the decline in the wage share is not warranted on econometric grounds.

4.5 A more general specification

This section will extend the model estimated by the IMF and the EC. This more general model is also based on the NAIRU model (section 2.2. and 2.4, in particular Figure 3). It differs from the IMF/EC specification in the following ways:

- The counter-cyclical properties of the wage share are well known. We thus include GDP growth as a cyclical indicator to control for short-run fluctuations.
- Countries differ in the structure of their social security systems. In particular in countries belonging to the so-called Ghent system workers need to be union members in order to be eligible for unemployment benefits. Union membership in these countries is much higher than in other countries. If union density is used as a proxy for the bargaining power of labor, countries in the Ghent system are difficult to compare

[16] As there are measurement problems with all important variables there is no a priori reason to interpret time effects as technology shocks.

[17] This differs from IMF (2007a) and EC (2007). IMF uses the labor-capital ratio and reports no consistent effect. EC uses the capital-labor ratio and finds *positive* effects (on the total wage share).

[18] There is, however, a serious potential reverse-causation problem involved. If a country pursues a strategy of wage moderation to stimulate exports, such as Germany arguably has in the past decade, then this will increase exports. This will result in an increase in openness. But in this case the direction of causation was from wage moderation to globalization rather than the other way round.

to other countries. We thus use a dummy variable for the countries in this system (Denmark, Finland, Iceland and Sweden) and interact it with union density.

- Financialization has been highlighted as an important potential cause for the change in income distribution (see section 2.3.4). The EC/IMF specifications do not include any financialization variables. As variables for financialization we will use financial globalization as a broad variable measuring all foreign assets and liabilities (relative to GDP). In addition the real interest rate will be included as a specific, domestic measure of financialization.[19] These two variables cover only some aspects of financialization, although important ones. In particular it would be desirable to have measures of domestic financial liberalization. The two variables chosen have the advantage of being readily available and of having been used in the literature. Future research should expand the measures of financialization.
- Capital accumulation will be included as a variable for animal spirits. This variable has been used successfully in the unemployment equation that complements the distribution equation (Arestis et al 2007, Stockhammer and Klär 2008). The problem with including capital accumulation is that it fails to distinguish between endogenously induced capital accumulation and accumulation driven by animal spirits. It thus is a rather crude indicator.
- Finally we include a dummy variable for countries in which a wage pact has been signed. This variable tries to capture the influence of governments on wage bargaining. In many European countries wage pacts that typically include wage restraint as a package often covering areas like tax policy or education policies have signed between employers, unions and governments.

Additionally we will include some other control variables in some specifications to test robustness

- To control for changes in the sectoral composition in the economy the share of industrial employment to total employment is included. As industry typically is more capital intensive than services (with the exception of energy and transportation), one would expect the wage share to be inversely related with industrial employment.

[19] The role of interest rates on the mark up is discussed in Hein (2008).

4.5.1 Variable definitions

The rate of growth of real GDP (Δy) is taken from the AMECO database. It is used as short-run business cycle indicator.
Financial globalization (*FINGLOB*) will be measured by (the (logarithm of) the value of external assets and liabilities as a ratio to GDP as suggested by Lane and Milesi-Ferretti (2007). This variable includes external assets and liabilities. International holdings and transactions are classified in the following broad categories: portfolio investment, subdivided into equity securities and debt securities; foreign direct investment, which refers to equity participations above 10%; other investment (which includes debt instruments such as loans, deposits, and trade credits); financial derivatives; and reserve assets.
A dummy variable for wage pacts (*WP*) that takes the value of one in the year a wage pact is signed. The countries and dates of the wage pacts are taken from Table 10.1 in Schulten (2004). As the effects of a wage pact will typically materialize in the following year(s) we expect this variable to work with a lag.
The rate of growth of the capital stock (*KG*) is taken from the AMECO database.
The industrial share (*IND*) is the ratio of industrial gross value added to total gross value added (both at current prices), both of which have been taken from the AMECO database. The terms of trade shocks (*TOTS*) is the change in the terms of trade taken from the AMECO database.

4.5.2 Estimations with non-overlapping 5-year averages

Again, we regard the estimation with medium term data, such as non-overlapping 5-year averages as more reliable, because the effects may take time to materialize and the assumption of similar effects across countries is more plausible.[20] The results are summarized in Table 9.

Specification 1 excludes time effects, specification 2 includes them. Specifications 3 includes a terms of trade shock, specification 4 uses unemployment instead of capital accumulation and specification 5 uses the unadjusted wage share rather than the adjusted one. The results show the following pattern. As observed previously, ICT has statistically significant effects

[20] This specification, however, potentially suffers from endogeneity problems.

Table 9. Extended wage share equation with non-overlapping 5-year averages

	1			2			3		
	coeff	*t-value*		*coeff*	*t-value*		*coeff*	*t-value*	
	39.046	0.954		40.750	0.745		48.539	0.920	
ict	-1.203	-2.388	***	0.323	0.464		0.235	0.339	
kl	-6.707	-1.449		-5.542	-0.873		-4.417	-0.720	
undens	0.200	2.032	**	0.140	1.452		0.191	2.111	**
undens*ghent	-0.379	-1.258		-0.235	-0.854		-0.326	-1.215	
epl	-1.647	-1.238		-2.418	-1.983	**	-1.747	-1.433	
ubrr	-0.025	-0.677		-0.055	-1.585		-0.047	-1.350	
tw	-0.033	-0.323		0.017	0.185		0.016	0.170	
pmr	-1.996	-3.135	***	-0.976	-1.248		-1.381	-1.797	*
open	-9.763	-2.387	***	-15.446	-3.578	***	-13.891	-3.267	***
kg	14.051	0.355		59.444	1.367		82.798	1.947	*
finglob	-2.955	-2.137	**	-2.712	-1.894	*	-3.020	-2.212	**
rir	0.197	0.792		0.509	1.877	*	0.492	1.858	*
tots							-33.332	-2.687	***
u									
Sectoral FE	yes			yes			yes		
Period FE	no			yes			yes		
dw	1.991	0.000		2.053	0.000		2.065	0.000	
adj R2	0.833	0.000		0.858	0.000		0.871	0.000	

	4			5		
	coeff	*t-value*		*coeff*	*t-value*	
	41.799	0.773		140.157	3.319	***
ict	-0.094	-0.151		0.672	1.249	
kl	-5.763	-0.930		8.763	1.809	*
undens	0.180	1.872	*	0.185	2.447	***
undens*ghent	-0.244	-0.897		-0.387	-1.835	*
epl	-2.563	-2.160	**	-0.551	-0.601	
ubrr	-0.048	-1.366		-0.027	-1.052	
tw	0.049	0.501		-0.008	-0.109	
pmr	-1.075	-1.365		-0.075	-0.129	
open	-15.205	-3.471	***	-12.165	-3.707	***
kg				42.242	1.318	
finglob	-2.517	-1.799	*	-2.255	-2.131	**
rir	0.638	2.197	**	-0.049	-0.231	
tots						
u	-0.330	-1.629				
Sectoral FE	yes			yes		
Period FE	yes			yes		
dw	2.071			2.209		
adj R2	0.863			0.944		

Sample: 1982-2003, countries: 15; t-values are based on panel corrected standard errors that are robust to hetereoscedasticity and autorcorrelation. ***, **, * denote statistical significance at the 1%, 5%, and 10% level respectively. Variable defintions: see text section 4.1 and Table A.1
Specification (5) uses WS, the wage share, as the dependent variable all other specification use AWS, the adjusted wage share.

only if time effects are excluded. KL never has a statistically significant effect except in specification 5, where it has a positive effect. OPEN (at the 1% level) and FINGLOB (at the

5% or 10% level) have statistically significant (negative) effects in all specifications. UNDENS has statistically significant positive effects in all specifications except in specification 2. Including union density for Ghent-countries separately surprisingly shows a perverse effect as the coefficient estimate is larger than that of UNDENS itself. RIR has statistically significant positive, i.e. perverse, effects in three specifications. EPL and PMR have statistically significant (negative) effects twice.

Moving to unemployment as the dependent variable (Table 10), we find statistically significant negative effects of KG and statistically significant positive effects of RIR (all at the 5% level or better), and statistically significant (at the 10% level) negative effect of ICT. Surprisingly, in the unemployment equations there is no evidence that union density has different effects in Ghent and non-Ghent countries.

Table 10. Extended unemployment equation with non-overlapping 5-year averages

	1			2			3		
	coeff	*t-value*		*coeff*	*t-value*		*coeff*	*t-value*	
	29.096	0.989		30.434	0.754		25.789	0.668	
ict	-0.541	-1.857	*	-0.891	-1.816	*	-0.839	-1.796	*
kl	3.069	0.912		2.959	0.625		2.288	0.509	
undens	0.091	1.390		0.118	1.616		0.088	1.261	
undens*ghent	0.055	0.294		-0.011	-0.061		0.043	0.234	
epl	-0.832	-1.059		-0.455	-0.550		-0.855	-1.035	
ubrr	0.012	0.499		0.021	0.939		0.016	0.708	
tw	0.144	2.146	**	0.116	1.581		0.117	1.595	
pmr	-0.109	-0.283		-0.419	-0.742		-0.177	-0.303	
open	-0.866	-0.325		0.363	0.120		-0.564	-0.186	
kg	-120.691	-4.259	***	-134.261	-4.168	***	-148.188	-4.724	***
finglob	0.419	0.465		0.394	0.392		0.578	0.593	
rir	0.506	3.043	***	0.437	2.298	**	0.447	2.408	***
tots							19.876	1.806	*
Sectoral FE	yes			yes			yes		
Period FE	no			yes			yes		
dw	1.968			1.749			1.763		
adj R2	0.907			0.907			0.913		

Sample: 1982-2003, countries: 15; t-values are based on panel corrected standard errors that are robust to hetereoscedasticity and autorcorrelation. ***, **, * denote statistical significance at the 1%, 5%, and 10% level respectively. Variable defintions: see text section 4.1 and Table A.1

4.5.3 Estimation with annual data

As in previous results, specifications in levels form suffer from serious autocorrelation problems (DW 0.56), thus Table 11 only reports specifications with the first difference estimator (again sectoral FE are excluded such that results are comparable to a standard FE-specification in levels). Time effects have been included based on redundant FE tests.

Specifications 1 and 2 include the explanatory variables in lagged and in contemporaneous values respectively. To avoid endogeneity problems we prefer lagged values (specification 1) which will also form the basis of our robustness analysis. All the following robustness tests are based on the lagged explanatory values to avoid endogeneity problems. The results are broadly similar. GDP-growth has statistically significant (negative) effects in all specifications. Union density in non-Ghent countries has statistically significant positive effects (at the 1% level) in all specifications. OPEN has statistically significant (negative) effects at the 1% level in all specifications except for specification 4. RIR has a statistically significant negative effect in all specifications, except specification 2 where it has statistically significant positive effects. FINGLOB consistently has a negative sign, but is only statistically significant in specification 6. WP, which is included with two lags, has a negative effect that is statistically significant (at the 5% level) in all specifications except specification 2. A wage pact seems to reduce the wage share by almost half a percentage point two years later. Other variables are not statistically significant. Only for openness and union density (in non-Ghent countries) are the results robust with regards to contemporaneous or lagged variables.

Table 11. Extended wage share equation with annual data

	1			2 (variables contemporaneous)			3		
	coeff	*t-value*		*coeff*	*t-value*		*coeff*	*t-value*	
ΔΔ y	-28.842	-6.842	***	-30.416	-7.203	***	-28.9544	-9.795	***
Δ ict	-0.148	-0.189		-0.395	-0.549		-0.4215	-0.309	
Δ kl	-5.032	-1.075		-9.396	-2.114	**	-0.0049	-1.432	
Δ undens*(1-Ghent)	0.166	2.649	***	0.201	3.253	***	0.1251	2.413	***
Δ epl	0.426	1.086		-0.074	-0.191		0.4836	0.555	
Δ ubrr	0.005	0.254		0.014	0.723		0.0066	0.332	
Δ tw	0.006	0.164		0.017	0.51		0.0036	0.208	
Δ pmr	-0.176	-0.582		-0.013	-0.046		-0.0914	-0.874	
Δ open	-5.464	-3.014	***	-5.025	-2.773	***	-4.8274	-4.271	***
Δ finglob	-1.006	-1.435		-0.555	-0.843		-0.9771	0.619	
Δ rir	-0.1	-2.437	***	0.151	3.625	***	-0.1015	-3.359	***
WP	-0.465	-2.225	**	-0.102	-0.503		-0.4747	-2.591	***
Δ kg	-6.607	-0.33		-25.577	-1.262		-1.875	0.157	
Sectoral FE	no			no			no		
Period FE	yes			yes			no		
dw	1.683	0		1.708			1.803	0	
adj R2	0.387	0		0.409			0.4045	0	

	4			5			6 (WS as dep var)		
	coeff	*t-value*		*coeff*	*t-value*		*coeff*	*t-value*	
ΔΔ y	-30.671	-7.023	***	-29.688	-6.975	***	-23.91	-6.628	***
Δ ict	0.001	0.001		-0.161	-0.206		-0.146	-0.215	
Δ kl	-4.764	-1.005		-5.954	-1.272		-4.536	-1.155	
Δ undens*(1-Ghent)	0.195	3.07	***	0.152	2.408	***	0.145	2.762	***
Δ epl	0.51	1.304		0.396	1.012		0.29	0.849	
Δ ubrr	-0.001	-0.071		0.004	0.238		0	-0.002	
Δ tw	0.019	0.536		0.008	0.225		0.013	0.422	
Δ pmr	-0.108	-0.359		-0.179	-0.594		0.068	0.267	
Δ open	-3.304	-1.598		-5.297	-2.903	***	-3.69	-2.351	***
Δ finglob	-0.864	-1.23		-0.924	-1.318		-1.05	-1.76	*
Δ rir	-0.093	-2.15	**	-0.088	-2.128	**	-0.087	-2.448	***
WP	-0.451	-2.053	**	-0.444	-2.124	**	-0.363	-1.998	**
Δ kg	3.098	0.151		-11.798	-0.582		-1.925	-0.116	
Δ ind	-27.103	-2.501	***						
Δ tots				3.82	1.831	*			
Sectoral FE	no			no			no		
Period FE	yes			yes			yes		
dw	1.653			1.639			1.75		
adj R2	0.396			0.393			0.382		

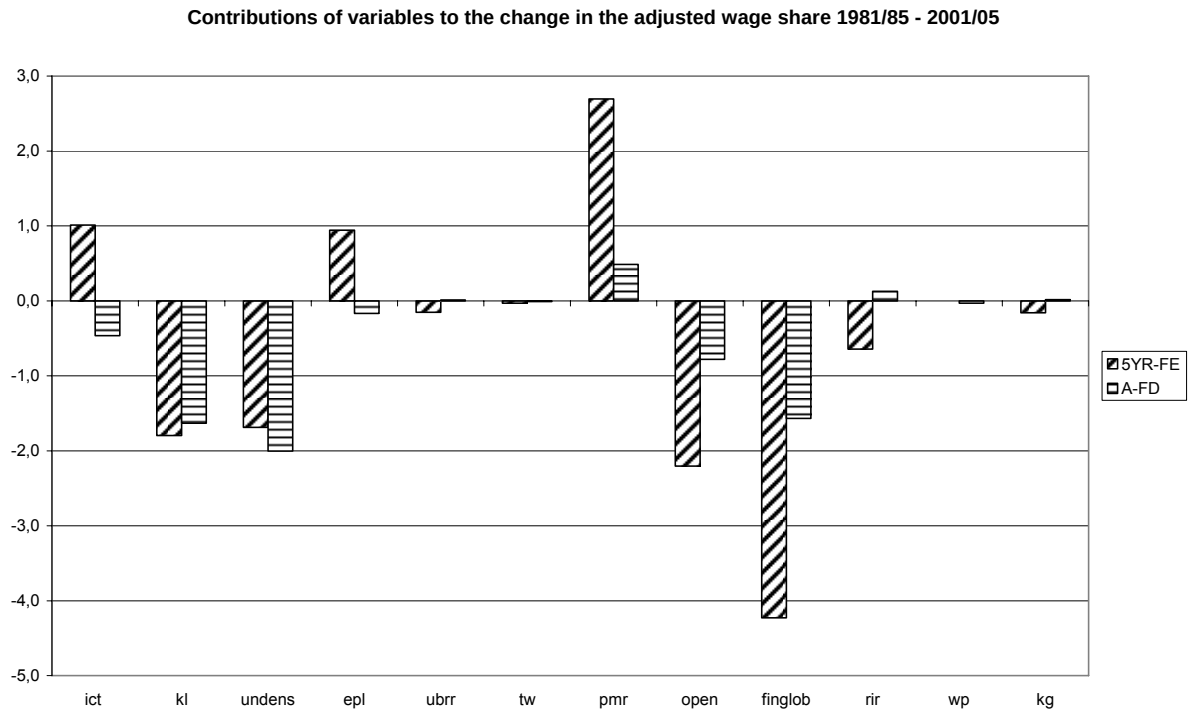
Sample: 1982-2003, countries: 15; t-values are based on panel corrected standard errors that are robust to hetereoscedasticity and autorcorrelation. ***, **, * denote statistical significance at the 1%, 5%, and 10% level respectively. Variable defintions: see text section 4.1 and Table A.1

Specification 2 is with contemporaneous explanatory variables, all other specifications with lagged explanatory variables. Specification (6) uses WS, the wage share, as the dependent variable all other specification use AWS, the adjusted wage share.

4.6 Economic significance: contributions to the change in the wage share

To evaluate the economic effect, we calculate the contributions of the estimated effects of the variables to the change in the dependent variable between the early 1980s (the 5-year average 1981-85) and the early 2000s (the 5-year average 2001-2005).[21] The calculation of the contributions thus roughly corresponds to those presented as Figure 5.12 of IMF (2007a) and Chart 15 of EC (2007).[22] All these calculations refer to a hypothetical average country, i.e. the respective mean across countries in our sample. The contributions are summarized in Figure 6.

Figure 6. Contributions of explanatory variables to the change in the adjusted wage share 1983-2003



[21] Note that the calculation is performed irrespective of whether the coefficient in question is statistically significant or not. See McCloskey and Ziliak (1996) and Ziliak and McCloskey (2004) for a discussion of statistical and economic significance.

[22] The only difference is that rather than comparing two years (e.g. 1982 and 2002), we use moving averages around these years to smooth fluctuations due to the business cycle.

The contributions are calculated based on two specifications: the basic fixed effects specification with non-overlapping 5-year data (5YR-FE, specification 2 in Table 9) and the basic first-difference specification with (lagged) annual data (A-FD, specification 1 in Table 11). There are substantial differences according to the two specifications. We regard the estimation based on 5-year averages as the most reliable and present the other for robustness. Financial globalization emerges as the single most important variable by a substantial margin in the preferred specification. According to our calculation, financial globalization contributed to a decline of the wage share by 4.2%-points. Openness contributed around 2%-pts., the capital-labor ratio and (non-Ghent) union density both contributed somewhat less than 2%pts. In the difference specification the capital labor ratio, (non-Ghent) union density, and financial globalization have substantial contributions to the change in distribution (ranging from -1.5 to -2), whereas the contribution of openness is somewhat below 1. All other variables are extremely sensitive to the specification.

Notably, statistical significance and economic significance do not coincide. Only openness and union density in non-Ghent countries have had rather consistently statistically significant effects. Financial globalization has had statistically significant effects only with 5-year averages. In this specification it has an economically large effect. In first difference estimations with annual data, however, its effect is much more modest. The capital-labor ratio only occasionally has statistically significant effects. However, its economic contribution (just below 2%-points) is substantial and surprisingly consistent in the two specifications. The calculations, however, do confirm that ICT-services play little, if any, role in explaining the change in the wage share. Its effects are neither statistically significant nor do the coefficient estimates imply large effects.

Overall this suggests that the results are not very robust and have to be interpreted with caution.

4.7 Limitations of the present study and open questions

The extended model presented in section 4.4 is an important improvement over the standard version of the reduced-form distribution equation. However it remains preliminary in several respects that should be addressed in future research.

Firstly, the present study has focused on the robustness of results. While we have addressed some of the econometric problems of previous studies, it is fair to say, that not all have been solved satisfactorily. For example our preferred estimator based on non-overlapping 5-year averages may suffer from endogeneity problems. The underlying problems are rather basic problems of panel analysis: while it is doubtful whether the pooling restrictions do hold, the number and quality of the variables involved require panel analysis.

Secondly, the measure for financial globalization remains rather broad. This is at the same time an asset and a liability. Being a broad measure it serves well in the context of the explorative investigation performed here. Presumably, different aspects of financial globalization will have different effects. Moreover, 'domestic' financialization has not been properly included. Having more differentiated measures for globalization would also allow to better identify the channels through which financialization affects functional income distribution.

Thirdly, on a more conceptual level, our results pose some puzzles for the NAIRU theory. The NAIRU theory predicts that the same set of variables should influence equilibrium unemployment and equilibrium income distribution (see section 2.2). Our results fail to support this assertion. While (non-Ghent) union density, openness and financial globalization are the most important determinants of income distribution, unemployment seems to be determined by capital accumulation and interest rates.

5 Conclusion / summary

Functional income distribution has changed substantially in the course of the last three decades. Wage shares have declined in all OECD countries. In the Euro area the decline in the adjusted wage share has been 10%-pts since 1981.

The IMF and the EC have recently published studies that investigate the causes of this decline. Both concur that technological change has been the most important factor contributing to the decline in wage shares and that globalization has also contributed to the decline, though to a lesser extent. Both see some minor contributions by labor market institutions.

The aim of this study has been to replicate, investigate the robustness and extend the work of the IMF and the EC. To this end a wide set of possible specifications including estimations in levels, differences and five-year averages have been performed.

We have found serious problems with the studies of the IMF and the EC. The regression results which their conclusions are based on suffer from econometric problems, in particular high autocorrelation in the residuals which leads to a bias in the results. The findings on the role of ICT critically depend on the exclusion of time effects, which ought to be included based on standard statistical tests. Fixing these econometric problems, i.e. estimating IMF/EC-type specifications in difference form or in non-overlapping 5-year average, leads to different results. Globalization (measured as openness) emerges as the only variable that has a robust effect among the variables considered by the IMF and EC.

The results of the IMF and the EC can therefore not be regarded as reliable. In particular the claim that technological change has had a strong (and statistically reliable) effect independent of time effects is incorrect.

The study has also extended the analysis. Most importantly we have included a variable measuring financial globalization and allowing for different effects of union density in countries of the Ghent system, where union membership is a prerequisite for receiving unemployment benefits.

We find that openness (globalization) and union density rather consistently have statistically significant effects. Globalization has a negative effect and union density a positive effect. We also find some (but not consistent) evidence that wage pacts, real interest rates and financial globalization have negative effects on the wage share. In terms of economic contributions (in a hypothetical average country) financial globalization has had strong effects, capital deepening, union density and openness have also had substantial effects.

Overall our findings support the view that income distribution has changed due to globalization in production and finance, changes in the bargaining power between capital and labor rather than through technological change.

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7 Appendix

Table A1. Variable definitions

Variable	*Definition*	*Source*	*Notes (abbreviation in the data source and comments)*
AWS	Adjuested wage share	AMECO	ALCD2
WS	Wage share	AMECO	UWCD/(UWCD+UOGD)
u	Unemployment rate	AMECO	
Δy	Real GDP (dlog)	AMECO	OVGD
ICT	ICT services	KLEMS	CAPIT_QI
KL	Capital-labor ratio	AMECO, OECD Economic Outlook dataset	Net capital stock at constant prices, total economy (OKND, AMECO)/total employment (OECD)
UD	Union density	BD 1982-03	undens In some specifications interacted with Ghent-System dummy variable
EPL	Employment protection legislation	BD 1982-03	epl
UBRR	Unemployment benefit replacement ratio	BD 1982-03	rr1
TW	Tax wedge	BD 1982-03	twcoup
WP	Wage pact dummy	Schulten 2004	
PMR	Product market regulation in network industires	BD 1982-03	regref
OPEN	imports plus exports divided by GDP	AMECO	
FINGLOB	Financial globalization	Lane and Milesi-Ferretti 2007	foreign assets and liabilities as a ratio to GDP
RIR	Real interest rate	AMECO	Long-term interest rate deflated by the GDP deflator
KG	Growth of capital stock	AMECO	
TOT	Terms of trade	AMECO	APGS
IND	Industrial share	AMECO	industrial gross value added at current prices (UVG2) / total gross value added at current prices(UVG0)