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What Do We Know About the Labor Share and the Profit Share? Part I: Theories

by

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ABSTRACT

This series of working papers explores a theme enjoying a tremendous resurgence: the functional distribution of income—the division of aggregate income by factor share. This first installment surveys some landmark theories of income distribution. Some provide a technology-based account of the relative shares while others provide a demand-driven explanation (Keynes, Kalecki, Kaldor, Goodwin). Two questions lead to a better understanding of the literature: is income distribution assumed constant?, and is income distribution endogenous or exogenous? However, and despite their insights, these theories alone fail to fully explain the current deterioration of income distribution.

Subsequent installments are dedicated to analyzing the empirical literature (part II), to the measurement and composition of the relative shares (part III), and to a study of the role of economic policy (part IV).

Keywords: Wage Share; Labor Share; Profit Share; Ergodicity; Technology
JEL Classifications: D33, E24, E25

CONTENTS

1 INTRODUCTION: HOW BIG OF A SLICE DOES THE PIE-MAKER GET?

Of the tendencies that are harmful to sound economics, the most seductive, and in my opinion the most poisonous, is to focus on questions of distribution. [...] But of the vast increase in the well-being of hundreds of millions of people that has occurred in the 200-year course of the industrial revolution to date, virtually none of it can be attributed to the direct redistribution of resources from rich to poor. The potential for improving the lives of poor people by finding different ways of distributing current production is nothing compared to the apparently limitless potential of increasing production.

– Robert E. Lucas Jr. (2003)

This paper addresses the functional distribution of income, i.e., it discusses the size of the slice of the economic pie going to each factor of production, as a reward. As the aggregate shares in output are considered, the functional distribution of income is deeply rooted in macroeconomic analysis. The functional distribution of income is not to be confused with the personal distribution of income, which studies the distribution of income across individuals, or households, and which has traditionally received a microeconomic treatment.[2] However, it would be a mistake to pitch both distributions against each other or to believe that they have nothing in common. As will be shown, the same underlying forces may be shaping both the functional and the personal income distributions, in the same way that there can be two related symptoms of the same disease.

The issue of income distribution is both old and new. On one hand, income distribution is the oldest question in economics: How much of the economic pie does each factor, and therefore social class, receive? Ricardo (1817) famously opens his magnum opus by elevating the question to the principal problem of political economy:

[2] The work of James K. Galbraith on the macroeconomic dimension of inequality is a rare and welcome exception.

The produce of the earth – all that is derived from its surface by the united application of labour, machinery and capital, is divided among three classes of the community, namely, the proprietor of the land, the owner of the stock or capital necessary for its cultivation, and the labourers by whose industry it is cultivated. But in different stages of society, the proportions of the whole produce of the earth which will be allotted to each of these classes, under the names of rent, profit, and wages, will be essentially different [...] To determine the laws which regulate this distribution is the principal problem in Political Economy [...]

– David Ricardo (1817), p. 1

Besides Ricardo, economists have treated the topic in a way that can only be described as bipolar (Solow, 1958). Going down history lane, the times of manic interest were under the Physiocrats and classical economists (including, of course, Marx), the early 20th century and its first statistical inquiries, as well as the 1950s and 60s. The depressive phases fill the gaps. The topic fell notably into oblivion during the marginalists' times as well as in the 30s, 40s, 70s and 80s. In the 1990s interest in income distribution grew, albeit for its most visible manifestation at the time, the personal type (inequality). The 2000s saw a marked deterioration of the functional distribution, in the U.S. and worldwide, and with it, an increase in the research devoted to understanding the underlying causes. The topic has gained enormous traction since the mid-2000s, an interest reinforced by the global crisis of 2008 and the greater availability of distribution statistics (Giovannoni, 2013b).

A reason for the distribution of income to fall into oblivion may be that relative shares have been fairly constant over long periods of time (Giovannoni, 2013c), so much so that the relative constancy of the factor shares came to be considered alternatively a "bit of a miracle" (Keynes 1939), a "stylized fact" (Kaldor 1961) or even a law ("Bowley's law").[3] Long ago, Keynes noticed that the stability of the labor share, over a fifty-five year period, is

A well-known statistical phenomenon [which] confirms the probability of constant or diminishing, rather than increasing, profit per unit of output when output increases. I mean the stability of the proportion of the national dividend accruing to labour, irrespective apparently of the level of output as a whole and of the phase of the trade cycle. This is one of the most

[3] A term coined by Samuelson (1964a) referring to the works on aggregate wages and national income of the British statistician Arthur Bowley (1969-1957). See Bowley (1900, 1920, 1937)

surprising, yet best-established, facts in the whole range of economic statistics both for Great Britain and for the United States [...] It is the stability of the ratio for each country which is chiefly remarkable, and this appears to be a long-run, and not merely a short-period, phenomenon. [...]

– John Maynard Keynes (1939), pp.48-9

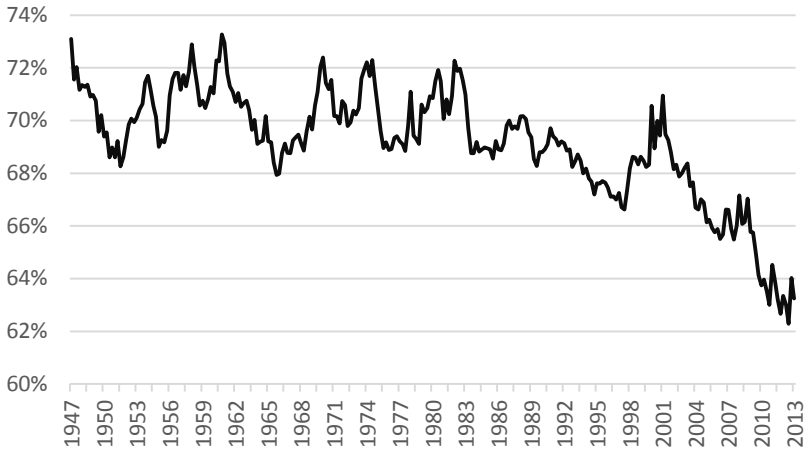
But the labor share cannot reasonably be considered constant anymore. The actual stability of the distribution of income came to be put into question starting in the 1970s. Real wages and labor productivity became disconnected, leading the US labor share to track downward around that time. The trend became clearly visible in the 1980s (see Fig. 1). The good economy and low unemployment of the late 1990s did produce an increase as expected,[4] but it was unable to invert the trend. The major recession of 2008 barely produced an uptick. In the 2000s, the trend won, and the labor share has been decidedly falling, posing a serious puzzle to economists since then. It is this puzzle, the reasons why the labor share has been falling while it used to be constant, that this paper aims to elucidate. Just what is known about the labor and profit shares?

In this first of a four-part series, some theories devised during the "years of high theory"[5] are investigated. The present paper highlights a few contributions characteristic of those years. This paper does not claim any exhaustive account. Rather, it is better understood as consisting of a series of lightposts, casting light at distant intervals, in such a way that a general direction emerges but many areas remain in the darkness. To cast light onto those areas, the reader is directed to the subsequent installments of this first theoretical part addressing, in turn, the empirical evidence of the determinants of the labor share (part II), the labor share measures and structural features (part III) and economic policies (part IV).

[4] The labor share is procyclical; see Giovannoni (2013c) for more details.

[5] The sentence harks back to the special issue of the Cahiers d'Économie Politique (Papers in Political Economy) entitled "What have we learned on income distribution since the 'years of high theory'?", number 61. We here extend the "years of high theory" from the 1920s to the 1970s.

Figure 1 Labor Share of GDP in the U.S. Nonfarm Business Sector



Source: BLS, productivity and costs tables

The present paper is roughly organized in a chronological way in order to highlight the progression (or, the differences, departures) in economic thought. In turn, it will show the hints left by Keynes (section 2) as well as the contributions of Kalecki, Kaldor and Pasinetti and Goodwin (sections 3, 4 and 5, respectively). Section 6 describes the role of technology and the related assumptions regarding production functions, while section 7 presents some concluding remarks in the form of finding a common thread among those theories.

2 KEYNES: HINTS, CONCERNS, BUT NO THEORY

[...] there is evidence that in its early stages, Keynes' own thinking tended to develop in this direction [to study income distribution] -only to be diverted from it with the discovery (made some time between the publication of the Treatise on Money and the General Theory) that inflationary and deflationary tendencies could best be analysed in terms of the resulting changes in output and employment, rather than in their effects on prices.

– Nicolas Kaldor (1956), p. 83

Keynes' theory of income distribution can be assessed through his two most important works, the Treatise on Money and The General Theory of Employment, Interest and Money. The term "distribution" is cited thirty-two times in the General Theory, but no book, chapter, or section title includes the word "distribution" – there is not even a "distribution" entry in the index. This count indicates a certain interest but is scarcely an indication of a main theme. The reason for this relative absence is that the purpose of these two books is not the study of income distribution; in those works Keynes talks respectively about money and aggregate demand, that is, what it takes to generate employment and income, not how the income is distributed once created (see Kaldor's quote).

For Davidson (1960), Keynes discusses income distribution as soon as 1930 in the famous parable of the widow's cruse:

If entrepreneurs choose to spend a portion of their profits on consumption [...] the effect is to increase the profit on the sale of liquid consumption goods by an amount exactly equal to the amount of profits which have been thus expended [...] Thus, however, much of profits entrepreneurs spend on consumption, the increment of wealth belonging to the entrepreneurs remains the same as before. Thus, profits, as a source of capital increment for entrepreneurs, are a widow's cruse which remains undepleted, however much of them may be devoted to riotous living. When, on the other hand, entrepreneurs are making losses, and seek to recoup these losses by curtailing their normal expenditures on consumption i.e., by saving more, the cruse becomes the Danaid jar which can never be filled-up; the effect of this reduced expenditure is to inflict on the producers of consumption-goods a loss of an equal amount. Thus the diminution of their wealth as a class, is as great, in spite of their saving, as it was before.

– John Maynard Keynes (1930), p. 139

Through this metaphor, Keynes specifies that the more capitalists spend, the greater the total amount of profits they receive. Conversely, entrepreneurs' spending cuts necessarily mean a lower overall profit level. Profits thus appear as a special category of income in the sense that they must be spent to generate more income (and new profits). If there is no profit and/or if capitalists do not spend, production and employment will stagnate. This reasoning is also attributed to Kalecki (by Joan Robinson), as the adage "capitalists earn what they spend and employees spend what they earn." Keynes thus isolates a very special variable in the functioning of the economy: profits. The widow's cruse parable tells us about the thinking of Keynes c.1930: the question of the functional distribution of income between wages and profits is not far—but a question Keynes discusses only "in passing." In 1930, Keynes preferred to treat the determinants and the level of income (both sector consumption / production), but does not compare to the aggregate level of income.

These observations give Keynes a special place among the theories of income distribution —for in Keynes there is no distribution theory *per se*, just hints at one. The father of macroeconomics and master of economic aggregates knows that income distribution matters but his purpose is elsewhere.[6] Keynes does not develop a theory of income distribution, and the marginalists' approach appears unchallenged, simple, and intellectually appealing (see section 6 esp. the Euler Theorem).

Keynes came really close to an analysis of income distribution in the General Theory. Indeed his major work is centered on three specific real variables: wages, employment, and output. Those alone define the share of labor:

$$\frac{W}{Y} = \frac{wN}{Y} \tag{1}$$

where W is the wage bill, w is the nominal wage, the level of employment N, and Y the level of production (or value added). After painfully precise definitions and analysis of each of those three variables we expect Keynes to add a "synthesis" section addressing income

[6] Keynes had plans to develop his "real economy" analysis, following developments the monetary Treatise on Money. It is sometimes said that Keynes hesitated to embark on a theory of income distribution in the early thirties, but after the article by Richard Kahn (1931), Keynes preferred the revision and integration of his earlier ideas on uncertainty (Treatise on Probability), on currency (the Treatise on Money) and a demand analysis. The result is the General Theory. See
Kahn, R. (1931) The Relation of Home Investment to Unemployment, The Economic Journal, 41, 162, 173-198.
Kahn, R. (1933) The Elasticity of Substitution and the Relative Share of a Factor, The Review of Economic Studies, 1, 1, 72-78.

distribution.[7] But Keynes only shares, as a conclusion, a concern with income distribution: that the "inequitable distribution of wealth and incomes" was an outstanding failure of the capitalist economy. The book ends there. Overall, the introductory paragraphs to chapter 18 might best expose Keynes' thought:

We take as given [...] the degree of competition [...] as well as the social structure including the forces [...] which determine the distribution of the national income. This does not mean that we assume these factors to be constant; but merely that, in this place and context, we are not considering or taking into account the effects and consequences of changes in them.

– John Maynard Keynes (1936), p.245

[7] Keynes treated equally brief personal distribution of wealth and income (i.e, of the income inequality) in the conclusion in terms of social philosophy of the General Theory.

3 THE INCOME DISTRIBUTION POLITICAL ECONOMY OF MICHAL KALECKI

At the same time that Keynes wrote his magnum opus, Michal Kalecki started a series of working papers specifically on income distribution. Kalecki refined his views in a series of articles and books (Kalecki 1935, 1938, 1942, 1954, 1962). For Kalecki, income distribution is inherently related to the ability of "capitalists" to pass wage increases on to prices. Thus income distribution is primarily a matter of degree of imperfect competition and, within it, the balance of power between actors. Income distribution, market structure and pricing are interrelated and explain economic growth and the business cycle. Among the different vintages of Kalecki's theory we will present the latest (1954) and most preferred by Kalecki himself.

3.1 Assumptions and Framework

Kalecki's model is best understood when exposed "from the ground up," i.e., starting from its assumptions; there are five primary ones. Note that not all assumptions are relevant to Kalecki's theory of income distribution; for that purpose, only 1, 2 and 4 are necessary. Assumptions 3 and 5 set the broader framework.

1. There are two antagonistic classes: "capitalists" and "workers."
2. Imperfect (oligopolistic) competition is the norm. Each firm is facing a downward-sloping demand curve, meaning that each firm is demand-constrained. This is in contrast to perfect competition where each firm faces an infinitely elastic demand curve, so that demand changes do not affect prices -only costs and prices do (Lopez and Assous, 2010).
3. Information is imperfect. Information (or lack thereof) plays a critical role in investment decisions.
4. Less-than-full employment. As a result of 2 and 3, the economy is considered in a situation of chronic underemployment of the factors of production, i.e. excess capacity prevails.
5. The economy is a monetary economy in the sense that credit plays an important role. "Capitalists" and the State can finance their spending by borrowing from banks.

A note on the method seems necessary as well, for two things single out Kalecki's theory among heterodox economists. First, Kalecki does not assume price rigidity. A separate and related theory of prices is developed where prices are endogenous and a function of the degree of monopoly, the same parameter which, we will see, matters for the distribution of income. Second, Kalecki is interested in the macroeconomic picture and especially in the distribution of income in the aggregate, but he takes pains to derive a model that is micro-founded.

Now that the framework is set we can derive Kalecki's profit equation. The latter stems from the two national accounting identities defining output, one from the spending and one from the income side. First, assuming away the government and foreign sectors for simplification,

$$Y \equiv C_w + C_c + I \tag{2}$$

where C_w, C_c represents workers' and capitalists' consumption, respectively. Second, production is the sum of total wages and total profits ($\prod$), so that:

$$Y \equiv W + \Pi \tag{3}$$

Assuming that all wages are consumed, i.e., $W = C_w$, and combining equation (2) and equation (3) we arrive at the definition of profits as

$$\Pi = C_c + I \tag{4}$$

Equation (4) is an identity so that the direction of causality is unknown. However, Kalecki remarks that if there is a profit, it must be the case that some output was sold in the first place. Thus, there must have been some demand first and causality in (4) must run from expenditure (conveniently put on the RHS) toward profits (voluntarily placed on the LHS). Kalecki finds a result also envisioned in Keynes and confirmed in Kaldor: *capitalists earn* (Π) *what they spend* $(I + C_c)$*, while workers spend what they earn* $(W = C_w)$*.*

3.2 The Desired Share of Wages

There are several vintages of Kalecki's theory of income distribution, the most famous of which involves the share of profits as fixed and given (Kalecki 1954). The exogeneity of the profit share is justified by the market structure, and the existence of the capitalist class which has the decision-making power. In this formulation, the share of profits (β) that is desired by capitalists is defined as β^* :

$$\beta = \beta^* \tag{5}$$

Therefore, the wage share is defined as $\alpha^* = 1 - \beta^*$, i.e., it is derived as a residual when the balance of power leans towards capitalists.

The share of profits $\beta = \Pi / Y$ and equation (5) can be used to extract the level of activity such as:

$$Y^* = \frac{1}{\beta^*}\Pi \tag{6}$$

Equation (6) states that the production level depends both on the share and the level of profits. Coefficient $1/\beta^*$ can be called an "income distribution multiplier" (my words, not Kalecki's) and is equal to the inverse of the share of profits desired by capitalists. The level of expenditure that capitalists contribute to profits is given, so that profits are also given. This means that production varies inversely with the share of profits. Capitalists must curtail production in order to increase their profit share. Thus, with constant spending on the capitalists' part, a higher profit share can only be achieved if output and employment are limited.

Profits are defined as the sales proceeds minus total costs. For simplification we define total costs as comprising only of wages and raw materials (or intermediate products). Sales proceeds in turn are defined as prime costs (wages and raw materials) marked up by a factor k, that Kalecki calls the degree of monopoly. The degree of monopoly is defined as the price-to-cost ratio in a particular industry. By definition then (see Lopez and Assous, 2010)

$$\Pi = (k-1)(W + P_{mat}) \tag{7}$$

where P_{mat} represents the price of raw materials, i.e. costs other than wages. Using equation (3) and (7) we get an expression for output

$$Y = W + (k-1)(W + P_{mat}) \tag{8}$$

Dividing through by the wages bill W and taking the inverse we arrive at the wage share α.

$$\alpha = \frac{1}{1 + (k-1)(j+1)} \tag{9}$$

with $j = P_{mat}/W$. In the particular and simpler case of the absence of raw materials (or if their price is constant) we can rewrite equation (9) as

$$\alpha = 1/k \tag{10}$$

This last expression states that the wage share is inversely related to the degree of monopoly. A very competitive market with low degree of monopoly will see a very high wage share whereas an oligopolistic market will see a much lower labor share.

Therefore, the wage share is given by four factors, all interrelated:

1. The intensity of the class struggle, through which capitalists and unions clash;
2. The importance in total value added of imperfectly competitive firms;
3. The degree of monopoly, which the markup "reflects" (Kalecki, 1954);
4. The ratio of aggregate prices to materials prices, j.

The first three factors are self-explanatory or are taken from equation (9). Recall also that the wage share arrived at in equation (9) and (10) are wage shares *desired* by capitalists. Would capitalists always achieve their desired share of profits? Again, this depends on the balance of power in the class struggle.

In order to see why, we define the wages bill as:

$$W = Y - \Pi \tag{11}$$

$$W = \Pi / \beta^* - \Pi \tag{12}$$

$$W = \frac{1-\beta^*}{\beta^*}\Pi \tag{13}$$

Equation (13) states that the desired income shares are given by the decisions of capitalists' expenditures (reflected in profits). We now have a whole system based on the decisions of capitalists:

1. Capitalists spend;
2. the amount of capitalists' spending implicitly determines

(a) their income, and,

(b) overall income, out of which wages and salaries are paid, once profits have been distributed,

(c) capitalist spending determines (among other things, see above) the distribution of income.

3.3 Power Relations and Class Struggle

The evolution of the wage rate is part of a more complex mechanism. Kalecki considers two cases: either an increase in the wage rate leads to a constant share of profits, or capitalists accept a decline in the share of profits.

In the first case, as we have seen, the balance of power lies in capitalists' hands: the increase in the wage rate causes an extra cost of production for capitalists, but capitalists enjoy enough monopoly and bargaining power to pass on the full wage increases on to the price of production. In this case the increase in the nominal wage rate corresponds to a real wage stagnation and workers' purchasing power is unchanged.

The second case is more complex. If capitalists are not powerful enough in relation to unions, then capitalists are not able to pass all wage increases on to prices. This causes two things. On one hand, capitalists' profits remain unchanged since they depend on capitalists' willingness to spend. On the other hand, salary increases lead to a larger wages bill, which mechanically

increases consumption. As a result, companies are subject to higher demand, at least in the short run, and so capacity utilization rises. The end result is that consumption and investment are at higher levels. This corresponds to a situation with greater production, but with a smaller share of profits. The result: growth comes with a declining share of profits—we have wage-led growth. Kalecki is more interested in this latter case. Under this scenario, there are sufficiently strong unions to counteract capitalists' decisions by increasing consumer demand; hence, giving rise to profits and employment.

3.4 Policy Implications

The capitalist class dominates the economic system proposed by Kalecki. This dominance is characterized by a too-high profit share to maintain or generate full employment and economic growth. In that case, the share of profits hinders economic growth and what is needed to restore growth and employment is wage-led growth.

Kalecki discusses an exogenous intervention to avoid such undesirable outcome: the intervention of the state for wage-led growth (Lopez and Assous, 2010). This requires us to generalize the framework presented so far to include a foreign and public sector.

In an open economy with a government sector, the above remains true, with the provision that each variable is defined net of taxes, and we have:

$$\Pi \equiv C_c + I + (G - T) + (X - M) \tag{14}$$

which means that capitalists are no longer entirely controlling the profit level / share. A higher fiscal deficit and/or trade surplus increases profits, output and employment, but it may come at the expense of capitalists' profit share. Capitalists may want net exports $(X - M)$ to increase, because their production would go up and exports may be a way to beat a competitor. However, positive net exports may lead to a lower profit share, depending on the fiscal balance.

But what fiscal stance would capitalists prefer? As equations (6) and (14) indicate,

- A high fiscal deficit $(G - T) > 0$ may increase profits, but this would reduce the profit share further.

• Any fiscal surplus $(G-T)<0$ may decrease profits but it will increase the profit share. If capitalists' objective is to maintain or even increase their profit share, the fiscal policy of choice is that of relatively low spending and high taxes.

More precisely, Kalecki examines three cases:

• The budget is balanced state expenditure and a tax levied on wages of an equivalent amount. In this case there is a crowding-out effect of consumption by the public expenditure so that the net effect is zero for the entire system. The government spending multiplier is one.

• The budget is balanced by state expenditure and a tax levied on profits of an equivalent amount. If capitalists' spending decisions remain unchanged, then profits before tax are not changed. We are in the case discussed previously with the same conclusions. Capitalists have the option to either pass the tax increase entirely on to wages or on to prices. Kalecki notes that the repercussion is never completely in one direction; mainly because a tax levied on profits results in a decrease in the share of profits. Consequently, the reasoning is the same as it was previously: the decline in the share of profits leads to greater consumption, and thus boosts the economy. This balanced budget multiplier is greater than one.

• Finally, if the budget is in deficit, the effect is twofold: the deficit benefits both capitalists and workers, and both growth and employment go up. The converse is that a fiscal surplus results in a tax levied on aggregate demand so that the surplus is levied on the whole dynamic of the system.

Kalecki's model combines different concepts we have discussed so far, especially some of the ideas of Keynes, whose early ideas Kalecki was not necessarily aware of. The major contribution of Kalecki's model is to propose a tractable framework in the case of under-employment. The immediate conclusion is that in an economy with excess capacity, State intervention is justified. The State can alter power relations between workers and capitalists and it can influence the distribution of income. Whatever the vintage, the distribution of income remains central to the theory of Kalecki. This distribution is defined by exogenous conditions such as state intervention, but this exogeneity does not result in a neutrality of distribution. In all, for Kalecki, a distribution in favor of profits—e.g., due to heightened bargaining power of capitalists over workers—is both the cause and the consequence of lower economic performance.

4 KALDOR AND PASINETTI: INCOME DISTRIBUTION FOR FULL EMPLOYMENT

[...] no hypothesis as regards the forces determining distributive shares could be intellectually satisfying unless it succeeds in accounting for the relative stability of these shares in the advanced capitalist economies over the last 100 years or so, despite the phenomenal changes in the techniques of production, in the accumulation of capital relative to labor and in real income per head.

– Nicholas Kaldor (1956), p.84

The Post-WWII the economics profession became very interested in the issue of economic growth. The Keynesian proposition that had been holding for two decades is that economic growth depends on effective aggregate demand. Heterodox economists, following Keynes (1936) and Harrod (1939), insisted on investment while neoclassical economists insisted on the role of savings and technological progress (Solow, 1956). But how were saving and investment related to economic growth?

Kaldor (1956, 1957) finds that income distribution matters to the correlation of savings with economic growth. This comes in contrast to the Solow (1956) growth model, for instance, where income distribution does not matter for economic growth (Bertoli and Farina, 2007).[8] Further, Kaldor demonstrates that, assuming heterogeneous saving rates for workers and capital owners, workers' savings rate does not matter much at all for income distribution. Only investment and capitalists' saving propensity matter; the same result as in Kalecki and Keynes! The model was then reprised by Pasinetti (1962), who had identified a "logical drift," but whose correction does not change Kaldor's main conclusion. For that reason we refer to an integrated "Kaldor-Pasinetti" model.

[8] Solow (1956) uses a Cobb-Douglas production function which by nature (or technical feature) assumes constant relative factor shares. This is not withstanding Solow's own skepticism in the constancy of such shares (Solow 1958). See section 6 for further details.

4.1 Stylized Facts

Kaldor's (1956, 1957) model discusses the features of an economy in a steady state position. The economy grows at a constant rate given by population, technological progress and investment. Resources are fully utilized and full employment prevails "in general" (see caveat below). All this is derived from Kaldor's assumptions, which he only made explicit later (Kaldor, 1961):

1. Constant labor productivity (output per capita),
2. Consistent capital productivity, hence
3. Constant capital-labor ratio,
4. Constant distribution of income,
5. Relative stability of real interest rates, and finally
6. Existence of large disparities in the rate of productivity growth.

Following Harrod (1939) this implies that the economy's growth path is stable if warranted savings are actually achieved. But how?

4.2 The Model

Kaldor extends Harrod's theory by using the fact that any savings rate provides a split of income between consumption and savings which is different for each social group. Kaldor uses two identities:

$$Y \equiv W + \Pi \tag{15}$$

$$S \equiv S_w + S_c \tag{16}$$

where, S_W and S_C are the savings amounts provided respectively by workers and capital-owners. Assuming that the only source of income for these two classes are wages and profits, the savings rate of the two social categories is defined as:

$$s_w = S_w/W, \; and \; s_c = S_c/\Pi \tag{17}$$

And in a closed economy without government savings equals investment (I), so that

$$I \equiv S = S_w + S_c = s_w W + s_c \Pi \tag{18}$$

Rewriting,

$$I = s_w Y + (s_c - s_w)\Pi \tag{19}$$

Solving for the profit share we get Kaldor's famous equation

$$\frac{\Pi}{Y} = \frac{1}{s_c - s_w}\frac{I}{Y} - \frac{s_w}{s_c - s_w} \tag{20}$$

Since the share of profits cannot be negative or zero, we must add the condition

$$0 < s_w < \frac{I}{Y} < s_c < 1 \tag{21}$$

Thus, provided that equations (20) and (21) are verified, which they necessarily are since they come from an identity, the savings rate in the economy is going to the one matching the *natural* rate of growth, so that the economy will be on a persistent, stable, full employment, growth path.

4.3 The Pasinetti Critique

Pasinetti (1962) complements Kaldor's model six years after its publication, having identified a "logical drift" leading to an "absurdity": if people save, they become owners of capital and they have to be compensated accordingly. A portion of profits must be attributed to workers; otherwise, workers have no motivation to save. This addition to Kaldor's theory did not change much of the key findings, hence the name Pasinetti paradox. The share of total profits in value added remains the same, with the same determinants, method and with the same assumptions. To see why, consider equation (18) which becomes

$$S \equiv S_w + S_K = s_W(W + \Pi_W) + s_K \Pi_K \tag{22}$$

$$S = I = s_W Y + (s_K - s_W)\Pi_K \tag{23}$$

where the subscripts W and K denote variables for workers and capital-owners, respectively. Solving for the profit share we get

$$\frac{\Pi}{Y} = \frac{1}{s_K - s_w}\left[\frac{I}{Y} - s_W + r.s_w\left(s_K \frac{I}{K} - \frac{K}{Y}\right)\right] \tag{24}$$

where r is the interest rate, i.e. the rate at which workers extend loans to capital-owners. Pasinetti remarks that in the long run the interest rate must equal the rate of profit, in which case, after a long derivation, we get the same result that Kaldor arrived at:

$$\frac{\Pi}{Y} = \frac{1}{s_K}\frac{I}{Y} \tag{25}$$

Pasinetti presents an approach that is more complete but arrives at the same result. *The most striking conclusion remains that workers can in no way influence the distribution between wages and profits*. And the savings rate of workers still cannot influence the macroeconomic division between wages and profits, which is solely determined by the decisions of capitalists. Kaldor's rule (attributed to Kalecki, and which is also present in the parable of the widow's cruse of Keynes) remains true: workers spend what they earn and capitalists earn what they spend. Table 1 summarizes the different values of the profit share according to three cases studied by Kaldor and Pasinetti.

Kaldor and Pasinetti arrive at the conclusion that a balanced growth path and full employment are consistent with a single rate of profit and a certain level of income distribution. The sustainability of the balanced growth path is maintained by the realization of the profit rates described in Table 1 (below).

Table 1 Formula Summary for Profit Shares and Profit Rates in Kaldor and Pasinetti

	Profit share Π/Y=	Profit rate Π/K=
General case	$\frac{1}{s_c - s_w}\frac{I}{Y} - \frac{s_w}{s_c - s_w}$	$\frac{1}{s_c - s_w}\frac{I}{K} - \frac{s_w}{s_c - s_w}\frac{Y}{K}$
Special case $s_w = 0$	$\frac{1}{s_c}\frac{I}{Y}$	$\frac{1}{s_c}\frac{I}{K}$
Special case $s_w = 0$ and $s_c = 1$	$\frac{I}{Y}$	$\frac{I}{K}$

4.4 Full Employment vs. Harrodian Dynamics

The dynamics along the natural growth path are better explained in reference to the work of Harrod, who introduces three growth rates:

- The actual growth rate g,
- The natural growth rate, g_n, necessary to achieve or maintain full employment,
- And finally the warranted growth rate, g_w, which is the rate of investment in the total desired product. Harrod decomposes the investment rate as:

$$\frac{I}{Y} = \frac{I}{K}\frac{K}{Y} = \frac{S/Y}{\sigma} = s.\sigma^{-1} \tag{26}$$

with $\sigma := \frac{1}{A_K} = \frac{K}{Y}$

The warranted growth rate is $g_w = s/\sigma$; it is the output growth rate compatible with entrepreneurs' investment. To Harrod, most entrepreneurs are optimistic; they anticipate profit from increased production prospects and the more they invest the higher the warranted growth rate.

To achieve balanced growth and full employment in Harrod's model, we need the three growth rates to be equal: $g = g_w = g_n$. This requires that the expectations of entrepreneurs generate an actual growth rate that coincides perfectly with the natural growth rate. Harrod points out that this case is unusual, historically, and there is no reason for this to happen automatically and always. As a result, full employment is not the norm.

The theoretical framework of full employment advanced by Kaldor thus appears as the particular, ideal case; a case rarely considered by Harrod. Kaldor only introduces the possibility of a *minor* imbalance. Kaldor introduces the realization of $S = I$ *ex-post* and introduces the possibility of a slight deviation $S \neq I$ *ex-ante*. What will happen if the system is close to, but not in, equilibrium?

When investment is higher than savings, the excess demand generates inflation in the consumer goods sector. With sticky nominal wages, inflation lowers real wages, with two major consequences. First, a rising price of consumer goods leads to income consisting of a smaller proportion of consumption and a greater share of savings. Second, a lower real wage rate leads to a lower labor productivity in perfect competition, which restores the constancy of the share of profits. Therefore, and whichever way, Kaldor's model presents the peculiarity that a slight imbalance is automatically compensated for by price adjustment.

4.5 A Full Employment Keynesian Model

Kaldor and Pasinetti's approach to income distribution follows the Keynesian tradition in the very particular context of the "stylized facts," namely, assuming full employment. It is therefore not true in the general case, as Keynes believed that full employment occurs only "by chance," and that it is rare that $g = g_n = g_w$. Despite this criticism, Kaldor (1956, 1957, 1961) remained faithful to the assumption of full employment.

Kaldor has been strongly criticized for this assumption. Samuelson (1964b) refers to Kaldor as "Jean-Baptiste Kaldor" (p.345). Weintraub (1981) quipped "*Lord Kaldor, in his cheering section, highlights a defined share of the profits of the original application [investment], or savings, [theory] deficient for many because of its foundations [in terms] of full employment*". Marglin (1984) points out that the assumptions Kaldor makes are *"more neoclassical than neo-Keynesian*" (p.534). From the point of view of this assumption of full employment, Pasinetti is more explicit than Kaldor.

One can make the following comments, all being equivalent:

1. Consequences of Kaldor's stylized facts:

(a) The assumption of balanced growth implies the realization of full employment.

(b) Kaldor is not interested in the ups and downs of the economy as it is assumed to be stable in a long run.

(c) The central question is whether the savings rate (thus, incidentally, the distribution and rate of return) accompanies or helps maintain full employment growth, as opposed to how to achieve full employment from a situation of unemployment.

2. The distribution theory presented by Kaldor is the result of the savings of workers and capitalists which generate a certain level of fully invested savings. This investment comes with a certain level of economic growth, which is fixed by assumption. The distribution of income resulting from investment decisions must be such that the share of profits accommodates a constant growth. Therefore, for Kaldor, the distribution of income does not allow for the achievement of stable growth or full employment, since by assumption, growth is stable and full employment is realized.

3. Income distribution has an endogenous role of proportionality that cannot explain the fluctuations in the growth rate. Near full employment, there is a certain growth rate accompanied by a certain distribution, the two being in a constant ratio.

4. Kaldor's model is an ergodic model: the future is a continuation of the past, through an automatic (price!) adjustment mechanism. There is no regime change in which accumulation is endogenous, and the possibility of underemployment is not taken into consideration.

Such specific assumptions limit the reach of Kaldor's model. One may even wonder what the real Keynesian content of the model is. Is the model in the form of a "synthesis"? Nevertheless, it does not contradict the spirit of Keynes's view of full employment, a situation in which Keynes saw "no objection" to neoclassical economics. This suggests that Keynes and Kaldor are in agreement with the neoclassical authors in regards to full employment; income distribution plays an accompanying role—not a determining role.

Kaldor's model, confined as it is, introduces three major insights. First is the introduction of distribution in the economic discourse, which is underlying but not explicit in the work of Keynes. Second: the conclusion that workers spend what they get and capitalists get what they spend, is maintained. Third, even in a situation of full employment, it is demand that is driving the activity in Kaldor's system—just a level of demand that is assumed to be always right, as implied by the above equations.

5 THE INCOME DISTRIBUTION BUSINESS CYCLE MODEL OF RICHARD GOODWIN

Goodwin's (1967) model addresses some of the shortcomings of Kaldor's model. Full employment is no longer assumed; the framework is not long-term growth, and income distribution is no longer passive. Instead, Goodwin develops a class struggle model in which workers and capitalists clash over income distribution. This leads to an income distribution cycle generated and endogenously maintained by employment and growth.

5.1 The Model

Goodwin's model is based on the following causal chain. At high levels of employment, upward-wage pressure starts to appear; the profit share is compressed which limits investment and therefore employment. But at that point the scarcity of jobs creates *de facto* the conditions of the restoration of the share of profits and the restoration of growth and employment.

Goodwin begins his presentation by specifying the limits and assumptions of his analysis: "*the model presented here is completely diagrammed and [is] as a rather unrealistic model of growth cycles*" (p.54). Similar to Kaldor (1956), Goodwin provides precise assumptions "*made for reasoning practices*":

1. Technical progress changes at a constant rate. Or;
2. Labor grows at a constant rate
3. Only two factors of production exist: labor and "capital"
4. All amounts are expressed in real and net terms
5. All wages are consumed
6. Productivity of capital is constant: $A_K = \frac{Q}{K} = \frac{1}{\bar{\sigma}}$
7. The real wage rate increases near full employment.

The first equation in this context captures the increase in the capital stock of the investment (which is the savings by identity). The author assumes that all profits are invested:

$$\frac{\partial K}{\partial t} = I = S = \Pi = \left(1 - \frac{w_g}{A_L}\right)Q \tag{27}$$

where w_g/A_L is the wage share prevailing at full employment. Dividing through by K, we simplify the previous equation:

$$\dot{K} = \frac{\frac{\partial K}{\partial t}}{K} = \left(1 - \frac{w_g}{A_L}\right)\frac{Q}{K} \tag{28}$$

where a dot above a variable indicates the rate of change of that variable from time t to $t+1$. As before, we rename $\frac{Q}{K} = \frac{1}{\overline{\sigma}}$, which is constant following assumption $H1$, so that

$$\dot{K} = \left(1 - \frac{w_g}{A_L}\right)/\overline{\sigma} \tag{29}$$

The rate of productivity growth is the gap between the growth rate of output and the growth rate of employment. Since the growth rate of labor productivity is constant (as a result of H1 and H6).

$$\dot{Q} - \dot{N} = \overline{\dot{A}}_L \tag{30}$$

Since in the current framework any supplemental growth can only be achieved by extra investment, $\dot{Q} = \dot{K}$, then (30) may be rewritten as

$$\dot{K} - \overline{\dot{A}}_L = \dot{N} \tag{31}$$

Combining (29) and (31), we find that

$$\dot{N} = \left(1 - \frac{w_g}{A_L}\right)/\overline{\sigma} - \overline{\dot{A}}_L \tag{32}$$

Since both capital and labor feature constant productivity, equation (32) implies that the growth rate of employment is a decreasing linear function of the labor share in total income, $\alpha = \frac{w_g}{A_L}$.

Denoting the labor force L, the rate of employment variable μ is introduced as $\mu \equiv N/L$, $\dot{\mu} \equiv \dot{N} - \bar{\dot{L}}$. Combining this last identity with (32), it follows that

$$\dot{\mu} = \frac{1-\alpha}{\bar{\sigma}} - \left(\bar{\dot{A}}_L + \bar{\dot{L}}\right) \tag{33}$$

Goodwin's model assumes that the real wage rate increases in the neighborhood of full employment. Hypothesis $H7$ is interpreted with reference to Marx's theory of a reserve army and the empirical work of A.W. Phillips. Goodwin assumes an approximate growth rate of real wages by a linear function of the rate of employment:

$$\dot{\alpha} = \left(-a + b\mu\right) - \bar{\dot{A}}_L \tag{34}$$

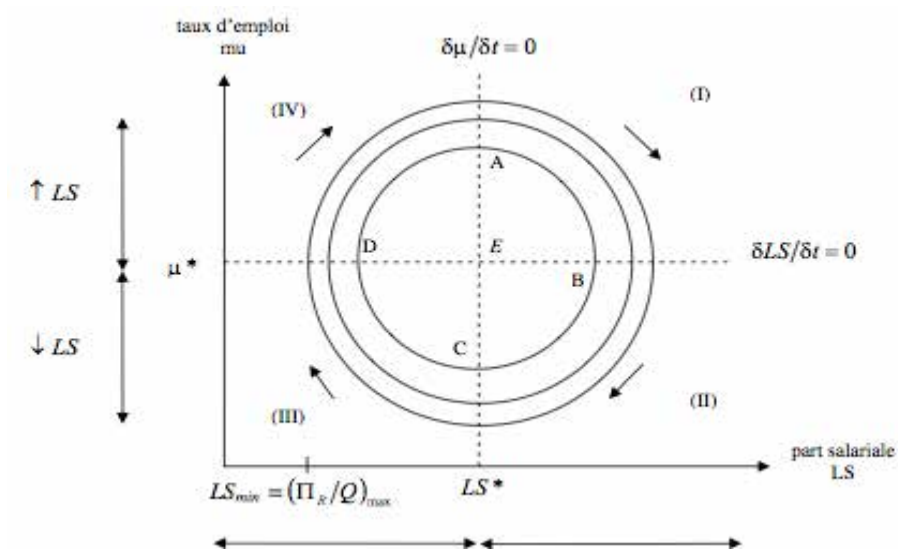
Equations (33) and (34) are two differential equations which explain, respectively, the growth in the employment rate and the growth of the wage share. We can rewrite those relationships in a dynamic systems form:

$$\begin{cases} \dot{\mu} = \frac{1-\alpha}{\bar{\sigma}} - \left(\bar{\dot{A}}_L + \bar{\dot{L}}\right) \\ \dot{\alpha} = \left(-a + b\mu\right) - \bar{\dot{A}}_L \end{cases} \tag{35}$$

$$\Leftrightarrow \begin{cases} \frac{\partial \mu}{\partial t} = \left[\frac{1-\alpha}{\bar{\sigma}} - \left(\bar{\dot{A}}_L + \bar{\dot{L}}\right)\right]\mu \\ \frac{\partial \alpha}{\partial t} = \left[\left(-a + b\mu\right) - \bar{\dot{A}}_L\right]\alpha \end{cases} \tag{36}$$

Goodwin notes that the last rewriting is of a most common type of differential equations called Lotka-Volterra also known as predator-prey models. Such system is represented by a phase diagram characterized by a cycle and an equilibrium point (see Figure 2).

Figure 2 The Goodwin Cycle



5.2 Solution and Interpretation

The equilibrium point E is the solution that simultaneously cancels the LHS of equations (36):

$$\begin{cases} \dfrac{\partial \mu}{\partial t} = 0 \\ \dfrac{\partial \alpha}{\partial t} = 0 \end{cases} \Leftrightarrow \begin{cases} \alpha^* = 1 - \left(\bar{\dot{A}}_L + \bar{\dot{L}}\right)\bar{\sigma} \\ \mu^* = \left(a + \bar{\dot{A}}_L\right)/b \end{cases} \tag{37}$$

The models' features are that

• The solution, or equilibrium, is never reached but there is a constant movement around it. The equilibrium point $E = (\alpha^*, \mu^*)$ is better seen as an "average"; the average of the labor share and the employment rate over the business cycle. What is remarkable is that this equilibrium is stable and independent of initial conditions, as pointed out by Goodwin (p.58). The direction of rotation $A \to B \to C \to D \to A$ on Figure 2is given by the sign of the model parameters.

• Contrary to the equilibrium, the amplitude of the cycle does depend on the initial conditions, so that starting from a very high wage share will make the cycle last longer. Whereas there is only one equilibrium point, there may be several cycles for different initial conditions.

• The circular shape of the trajectories is due to the fact that we have assumed (or made it in such a way) that the relationships between the (α, μ) variables are linear. For nonlinear relationships we would have led to concentric oval or ellipsoidal shapes. Finally, the cycle is a closed cycle in Goodwin's model: the model has the particular feature that, whatever the initial conditions (α_0, μ_0), we return to the starting point.

The usual interpretation of the equations of Volterra type is that of predator-prey model, which is in line with a Darwinian interpretation of the evolution and the preservation of species. A classic illustration of this type of model is two populations of shark and fish living in balance in a closed environment. Both populations have a common dynamic in the sense that if there is plenty of prey (fish), then predators (sharks) are increasing in numbers, whereas scarcity of prey implies a dwindling predator population. The converse is true for prey: the fish population increases when there are few predators and decreases if they are abundant. Both populations tend to over-react (overshoot) insufficient / excess of the other population.

5.3 Analysis and Contribution

We can describe the economics of Goodwin's model using this analogy between fish and sharks. The employment rate represents the fish population, or prey, and the wage share represents the shark population, the predator. When the wage share is too high between A and C (i.e., superior to its equilibrium or average value), the employment rate decreases: the abundance of sharks is reducing the number of fish. Similarly, when the wage share is lower than average, such as between points B and D, the employment rate increases: due to the small number of fish, the shark population increases).

Goodwin's model may also be interpreted in reference to economic conditions. From point A to point C, the employment rate goes down from its maximum to its minimum (point A can be seen as a peak of the cycle and point C as the lowest point). This continued deterioration in the employment rate occurs when the wage share is superior to its equilibrium value α^*; that is to say when the profit share is below its average. According to Goodwin (p. 58), downturns are due to the loss of profits. Conversely between point A and C, the employment rate rises as the profit share rises.

In economic terms, the main features of the model can be summarized in five points:

1. By assumption, profits are assumed to be fully invested and wages entirely consumed. Goodwin does not raise the question of market outlets and eventual leakage out of the system, and their contractionary implications.
2. By assumption, labor productivity grows at a fixed rate. This assumption is similar to the one in Kaldor's model (1957), but since Goodwin does not assume a constant growth rate of production, then we must have cyclical fluctuations —see equation (30).
3. Corollary: cyclical fluctuations are a source of under-employment (in labor), because the growth rate of labor is constant.
4. Conclusion 1: The share of wages and the employment rate are interrelated: at times in a positive way (quadrants II and IV, second equation in (37)); at times in a negative way (quadrants I and III, first equation in (37)). According to Goodwin, the increase in employment can only occur when businesses become more profitable, that is to say, have a lower payroll / wages bill.
5. Conclusion 2: These two opposite effects compensate in time to form a dynamic, closed system. Whatever the set of initial conditions, it always returns to the starting point through

rotation around the point of equilibrium.

In Goodwin's model, the distribution of income is endogenous, deeply embedded, and appears to function harmoniously with the economic system. It is not just accompanying the business cycle: income distribution *is* (a part of) the business cycle, since it is able to restore or deteriorate the level of production and employment.

Finally, we note that model is constructed so that there are closed trajectories around equilibrium. Employment growth is automatically restored by income distribution (i.e. an increase in the share of profits). This calls for three comments:

• If the equilibrium point $E = (\alpha^*, \mu^*)$ is unchanged, we should expect the distribution of income to be oscillating around a long-run constant. Goodwin's model cannot account for a permanent economic situation of underemployment. It could nevertheless be extended in that way by assuming that profits are not entirely re-invested, wages are not entirely consumed or any other kind of leakage.

• If the equilibrium point $E = (\alpha^*, \mu^*)$ could also be assumed changing due to changes in technology or other exogenously-defined variables.

• Finally, it is important to discuss the adequacy of applying the economic-biological model. The theory of the evolution of species is a naturalist theory. In the real biological world, there are also cases where species have disappeared even without human intervention. Not all economic models need to have closed dynamics.

6 TECHNOLOGY AND THE SHAPE OF THE PRODUCTION FUNCTION

Until the laws of thermodynamics are repealed, I shall continue to relate outputs to inputs — i.e. to believe in production functions.

– Paul A. Samuelson (1972), p.174.

Technological progress has often been viewed as a central element of economic growth. In the most general sense, technological progress is based on the "yield" of the factors of production, i.e., the marginal products of capital and labor. And since marginal products can differ, technological progress can be biased towards either factor of production, and the relative shares will change. To understand how and in what direction, we need to discuss different types of technological progress and different types of production function.

Consider the most general aggregate production function:

$$Y = F(L, Z, A) \tag{38}$$

with two inputs: labor L, and a nondescript input Z which could be capital, skilled labor or land. Parameter A is a technology index featuring $\partial F / \partial A > 0$: a greater level of A corresponds to "better technology" or "technological progress." The following definitions apply:

1. **Factor augmentation:** Technical change is said to be L*-augmenting* if the production function takes the more special form $Y = F(AL, Z)$, or Z*-augmenting* when $Y = F(L, AZ)$. We have factor augmentation when only one factor is affected by technological change.

2. **Factor bias:** L*-biased* technical change is different from being L-augmenting. We say that technological progress is L-biased when

$$\frac{\partial}{\partial A} \frac{F_L'}{F_Z'} > 0 \tag{39}$$

that is, if technical progress increases the marginal productivity of labor at a higher rate than it increases the marginal productivity of Z (Acemoglu, 2002).

Technological progress can be factor-biased:

• Technical progress is defined as **Hicks-neutral** if it does not affect the balance of labor and capital in the production function (Hicks, 1932). Since Hicksian neutrality implies that the marginal products of all factors increase at the same proportion, the production function can be written by factoring out technical progress such as $Y = A.F(L, Z)$.

• An innovation is **Solow-neutral** (Solow, 1969) if it only affects the productivity of capital: $Y = F(L, AZ)$.

• An innovation is **Harrod-neutral** (Harrod, 1942) if technology is labor augmenting: $Y = F(AL, Z)$.

6.1 Production Functions: Cobb-Douglas vs. CES

Two types of production functions stand out in the present context: the classic Cobb-Douglas (1928) and the Constant Elasticity of Substitution (CES). By modeling the growth of the American economy from 1899 to 1922, Cobb and Douglas (1928) proposed a simplified view of the economy where the level of output is determined by the amount of labor and capital involved in the production process. In the case of two factors and technical progress (later added in the function by Solow 1956), the standard Cobb-Douglas form is:

$$Y = F(L, K) = AL^{\alpha} K^{\beta} \tag{40}$$

where Y represents total production, L is the labor input, measured by the total number of person-hours worked in a year; K is the capital input, measured by the monetary worth of all machinery, equipment and buildings; A represents total factor productivity, and (which can be intangible as it can range from technology to human capital).

Finally, α and β are the output elasticities of labor and capital, respectively, i.e., they measure the responsiveness of output to a change in the levels of either the labor or the capital input, *ceteris paribus*. For instance, if α equals 0.64, a 1% increase in labor usage would lead to a 0.64% increase in output. In the case of an economy in perfect competition, the factors are paid at their marginal product, so that

$$\begin{cases} \dfrac{W}{Y} = \dfrac{w}{Y} L = \dfrac{F_L^{'}}{Y} L = \dfrac{\alpha A L^{\alpha-1} K^{\beta}}{A L^{\alpha} K^{\beta}} L = \alpha \\ \dfrac{\Pi}{Y} = \dfrac{r}{Y} K = \dfrac{F_K^{'}}{Y} K = \dfrac{\beta A L^{\alpha} K^{\beta-1}}{A L^{\alpha} K^{\beta}} K = \beta \end{cases} \tag{41}$$

The Cobb-Douglas production function is particularly interesting in the case of perfect competition, in which case the function has the following features:

• The factor shares are directly readable on the production function itself as the capital and labor exponents,

• α and β must be constant, or else the derivation above does not hold,

• Since aggregate income is composed of wages and profits and nothing else, it must be that $\alpha + \beta = 1$,

• As a consequence, a perfectly competitive economy characterized by a Cobb-Douglas production function features constant returns to scale.[9]

Another way of proving this result is to call upon the so-called Euler theorem (one of many) stating that for a continuous function $y = f(x_1, \ldots, x_n)$ homogenous of degree one, i.e., featuring constant returns to scale, we have

$$Y = \sum \frac{\partial y}{\partial x_i} x_i \tag{42}$$

On one hand we can apply this theorem on a production function such as $Y = F(K, L)$ to get

$$Y = \frac{\partial Y}{\partial L} L + \frac{\partial Y}{\partial K} K \tag{43}$$

[9] A production function $Y = F(K, L)$ whose inputs are each multiplied by a scalar λ implies, in the case of a Cobnb-Douglas case, that

$F(\lambda K, KL) = (\lambda K\_)^{\beta}(\lambda L)^{\alpha} = \lambda^{\alpha+\beta} .K^{\beta} L^{\alpha} = \lambda^{\alpha+\beta} .F(K, L)$

If $\alpha + \beta = 1$, doubling the amount of capital and labor used in the production process will result in a doubled output and the production function displays constant returns to scale; if $\alpha + \beta < 1$, the function has decreasing returns to sale; if $\alpha + \beta > 1$, increasing returns to scale takes place.

On the other hand, and by definition, we have

$$Y = w.L + r.K \tag{44}$$

By identification, it must be that $\frac{\partial Y}{\partial L} = w$ and that $\frac{\partial Y}{\partial K} = r$ or, in other words, it must be that factors are paid at their marginal product.

Summarizing: the Cobb-Douglas production function has such a particular form that the factor shares are constant in perfect competition, i.e., factors are paid at their marginal product and we have constant returns to scale. If more capital is used in the production process, the rate of profit Π/K falls just enough to maintain a constant capital share.

Cobb-Douglas + perfect competition = constant labor share

Another way to arrive at a constant distribution of income (see Gollin, 2007) is to use a production function with Harrod-neutral technical progress $Y = F(AL, K)$ in the Solow (1957) growth model. The production function $F(\cdot)$ need not be Cobb-Douglas. It is well-known that along the balanced growth path

$$k^* = \frac{s}{\delta + g_A} f(k^*) \tag{45}$$

where there is population growth, s is the exogenous savings rate, capital depreciation is δ, technical progress grows at a rate of g_A, f features constant returns, and $k = K/AL$ is the capital stock per effective worker. Multiplying through by r and rearranging we get the capital, or profit, share as

$$\frac{rk^*}{f(k^*)} = \frac{sr}{\delta + g_A} \tag{46}$$

which is necessarily constant on the balanced growth path because s and r are assumed constant. Thus, two very commonly used economic models, the Cobb-Douglas production function and the Solow growth model, feature a constant distribution of income. Factor shares are exogenous and have no driving role.

Another often-used production function is the Constant Elasticity of Substitution (CES) type. In the following pages we focus our attention on the classic CES production function; see Klump et al. (2011) for a survey of variations on the CES theme.

Pioneered by Arrow, Chenery, Minhas and Solow (1961), the classic CES production function is a "generalized Cobb-Douglas production function" as it encompasses the Cobb-Douglas as a special case. Mukerji (1963) considered a CES function for constant ratios of elasticity of substitution and Bruno (1962) suggested a generalization of CES production function to permit the elasticity substitution to vary. Thus, one of the most important differences between the Cobb-Douglas and CES production functions is that the former has a unit elasticity of substitution between labor and capital while the latter allows for non-unity elasticity.

The general two-factor CES production function takes the form of

$$Y = A\left[\theta K^{\gamma} + (1-\theta)L^{\gamma}\right]^{1/\gamma} \tag{47}$$

Here $0 < \theta < 1$ is the relative share of capital and γ captures the degree of substitutability of the inputs. Parameter A depends upon the units in which the output and inputs are measured and is therefore not directly interpretable as technology. The value of γ is equal to or less than 1. Note that if unit elasticity of substitution prevails $\gamma = 1$, the CES function collapses to the Cobb-Douglas form $Y = AK^{\beta}L^{1-\beta}$.

"Neoclassical" growth theory and the aggregate CES production function have a long common history, starting with Solow's (1956) seminal contribution (Klump et al., 2007). However, the workhorse of growth theory has tended to be the Cobb-Douglas. One reason for this general interest may reside in the long-held belief in a "stylized fact" of long-term economic growth: the approximate constancy of factor shares. We have already proved that an elasticity of substitution equal to unity, as suggested in the Cobb-Douglas production function, implies a constant factor share and a constant capital-to-labor ratio. Any changes in factor proportions will be exactly offset by changes in the marginal product of the factor inputs (Miller, 2008). In the case

of a CES production function, since the elasticity of substitution need not be unity, a constant factor income share can only be achieved if technological progress is purely Harrod-neutral (Klump et al., 2007).

6.2 Technical Change in the CES Production Function

Consider the previous CES production function with $\gamma = \frac{\sigma - 1}{\sigma}$

$$Y = A\left[\theta\left(A_L L\right)^{\frac{\sigma-1}{\sigma}} + (1-\theta)\left(A_Z Z\right)^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}} \tag{48}$$

By construction, A_L and A_Z are two separate technology terms, and A_L is L -augmenting, while A_Z is Z -augmenting.[10] Parameter θ captures the relative importance of the two factors and $\sigma \in [0,+\infty[$ is the elasticity of substitution between labor and variable Z. This quantity measures the extent to which firms can substitute capital for labor as the relative productivity or the relative cost of the two factors changes.

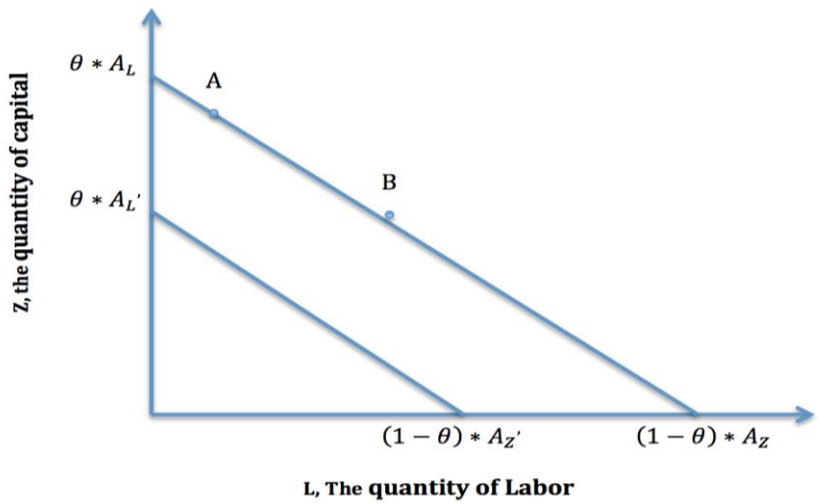
The elasticity of substitution is defined as

$$\sigma = \frac{\partial ln \frac{Z}{L}}{\partial ln \frac{MP_L}{MP_Z}} \tag{49}$$

• When the two factors are perfect substitutes, $\sigma = +\infty$, the production function becomes linear: $Y = \theta A_L L + (1-\theta) A_Z Z$ and the isoquants are straight (see Figure 3. The marginal rate of substitution of labor for capital at any point on an isoquant is a constant. The movement of the isoquants depends on the values of A_L and A_Z.

[10] A_L is also L -complementary and A_L is Z -complementary.

Figure 3 CES Production Function and Perfect Factor Substitution



• When $\sigma = 0$, there is no substitution between two factors.

• When $\sigma = 1$, the production function is Cobb-Douglas.

The direction of the bias of technical change depends on the elasticity of substitution. To understand this, calculate the relative marginal product of the two factors (Acemoglu, 2002):

$$\frac{MP_Z}{MP_L} = \frac{1-\theta}{\theta}\left(\frac{A_Z}{A_L}\right)^{\frac{\sigma-1}{\sigma}}\left(\frac{Z}{L}\right)^{-\frac{1}{\sigma}} \tag{50}$$

As the relative quantity of factor Z is increasing, Z/L increases and its relative marginal product is decreasing (*ceteris paribus*). This is the usual substitution effect, leading to a downward sloping relative demand curve. The effect of A_Z on the relative marginal product depends on σ:

• When the two factors are gross substitutes (σ > 1), an increase in A_Z relative to A_L increases the relative marginal product of Z, so that a Z-augmenting technical change is also Z-biased.

• When the two factors are gross complements (σ < 1), which is usually the case (see Giovannoni [2013b] for an overview), the reverse holds: a Z-augmenting technical change is actually L-biased. Intuitively, in this case of complementarity, an increase in the productivity of Z increases the demand for the other factor—labor—by more than the demand for Z, which

creates "excess demand" for labor. As a result, the marginal product of labor increases by more the marginal product of Z (Acemoglu, 2002).

The value of the elasticity of substitution has been shown to play a critical role in influencing economic growth and the movements of the labor share (Irmen, 2011; Choi and Rios-Rull, 2009). Both non-competitive factor prices and a non-unit elasticity of substitution can explain the dynamics of the labor share, and the latter seems more important. Raurich et al. (2012) derive the equation of the labor share when there is imperfect competition, and labor-augmenting technology, so that the production function is

$$Y = A\left[\theta L^{\frac{\sigma-1}{\sigma}} + (1-\theta)\left(A_L Z\right)^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}} \tag{51}$$

Following Galí (1996) we obtain the labor share α_t as

$$\alpha_t = \frac{w_t L}{Y_t} = \frac{1-\theta}{m_t}\left(\frac{Y_t}{A_L L}\right)^{\frac{1-\sigma}{\sigma}} \tag{52}$$

This equation clearly shows that the labor share depends on:

- The evolution of the markup m_t
- The average labor productivity in efficiency units, $Y_t/(A_L L)$, when $\sigma \neq 1$

Further, the average productivity can be written as

$$\left(\frac{Y_t}{A_L L}\right)^{\frac{1-\sigma}{\sigma}} = \frac{1}{\theta\left(\frac{Z_t}{A_L L_t}\right)^{\frac{\sigma-1}{\sigma}} + (1-\theta)} \tag{53}$$

so that the labor share can be rewritten as

$$\alpha_t = \frac{1}{m_t} \frac{1-\theta}{\theta\left(\frac{Z_t}{A_L L_t}\right)^{\frac{\sigma-1}{\sigma}} + (1-\theta)} \tag{54}$$

The last equation indicates a relationship between the labor share and capital deepening that depends on the value of σ. Capital deepening, or capital intensity, refers to the accumulation of capital per *effective* worker. If $\sigma > 1$, capital deepening reduces the labor share, and if $\sigma < 1$, capital deepening increases the labor share.

Table 2 summarizes the movement of labor and the direction of technical bias given the value of σ for the case of a capital-augmenting technology.

Table 2 The Elasticity of Substitution and the Labor Share of Income

	$\boldsymbol{\sigma > 1}$ Factors are substitutes	$\boldsymbol{\sigma = 1}$	$\boldsymbol{\sigma < 1}$ Factors are complements
Capital deepening leads to …	Capital-biased Technology, lower labor share	Neutral Technology, constant labor share	Labor-biased Technology, higher labor share

6.3 Criticisms of the Cobb-Douglas Form

I personally have faith that there is a fundamental unity in economic as in physical life [...] There is law and relative regularity everywhere else - why not in production and distribution?

– Paul Douglas (1967), p. 22

There are reasons to be skeptical that the Cobb-Douglas production function provides an entirely satisfactory approximation to reality, however. First, most estimates suggest that the aggregate elasticity of substitution is significantly less than 1. Second, a production function with an elasticity of substitution of 1 does not provide a framework for analyzing fluctuations in factor shares, such as those [observed in reality]

– Daron Acemoglu (2003), p. 3

Even though the Cobb-Douglas form was supported by the data from 1899–1922, its accuracy in different industries and time periods has been called into question. It is clear that the model lacks micro-foundations. The function assumes that the labor and capital shares of total output are constant over time, which is not always true and has not always been true in every circumstance that the function was taken to the data (see Giovannoni 2014c). Neither Cobb nor Douglas provided any theoretical reason why the coefficients α and β should be constant over time or be the same among different sectors of the economy. Those are mathematical imperatives, not economic imperatives.

The use of macroeconomic production functions spread following Solow's (1957) classic growth model was introduced. It is rarely noticed that shortly afterwards Solow (1958) qualified the constancy of relative shares as "*a mirage*" and was implicitly skeptical about the use of such aggregated production functions.

Numerous studies have tried to assess whether the Cobb-Douglas or the CES production function was more appropriate to macroeconomic forecasting. Miller (2008) finds that the strength of the Cobb-Douglas is its ease of use and its seemingly good empirical fit across many data sets. Unfortunately, the fact that the Cobb-Douglas model also fits the data well in cases where some of its fundamental assumptions are violated suggests that many empirical tests of the Cobb-Douglas model are picking up a statistical artifact rather than an underlying production function.

Similar results can be traced back to Shaikh (1974), who criticized the Cobb-Douglas production function for having a weak theoretical basis—it is an identity, really. Shaikh shows that the empirical results do not in fact have much to do with production conditions at all. Instead, Shaikh shows that when factor shares are constant, there are broad classes of production data (output, capital, and labor) which can always be related to each other through a functional form mathematically identical to a Cobb-Douglas function with "constant returns to scale," "neutral technical change," and "marginal products equal to factor rewards."

Fraser (2002) paid attention to the issue of whether the data provides deductive support for the "laws of production" as claimed by Cobb and Douglas (1928). Only the New South Wales data and, to a lesser extent, the New Zealand data produce supportive results. Moreover, Fraser ran collinearity diagnostics to reexamine the original series studied, and the result shows all data are subject to collinearity and that the time series properties raise questions as to the statistical robustness of the estimates presented by Douglas.

Another criticism of the Cobb-Douglas production function rests in his possible misinterpretation of technical progress (Miller, 2008). The majority of production functions assume that technical progress is Hicks-neutral, which does not change the marginal products of capital or labor given a certain ratio of inputs. Because of such a strong assumption, it can be shown that Cobb-Douglas is the only functional form that is able to explain the U.S. experience of constant factor shares and a rising capital-labor ratio (Antràs 2004). However, this is simply because Cobb-Douglas is the only functional form where Hicks-neutrality can be equivalently expressed as labor-augmenting technical change. Antràs (2004) also suggests that the finding of the constant shares in many older econometric investigations may be due to an omitted-variable bias caused by the assumption of Hicks neutral technical change.

Furthermore, Raval (2011) found that the Cobb-Douglas production function has two empirical implications that do not hold in the data: a constant cost share of capital and a strong co-movement in average revenue product of capital and average revenue product of labor. Raval finds that the cost shares of capital are different within four-digit-SIC (standard industry code) industries, so simply assuming that they are constant can lead to an estimation bias. Also, the average revenue product of labor is found to increase much more with revenue than the revenue product of capital.

Finally, there is the concern of short-run versus long-run breadth of analysis. Did the empirical investigations into the Cobb-Douglas form and into factor share feature enough datapoints? Surely the Cobb-Douglas results hold only in the long run, but how long is the long run?

Swimming against the current, Jones (2003) presents a defense of the Cobb-Douglas production function by presenting readers with four stylized facts:

- The growth rate in U.S. GDP per capita has not shown a considerable trend for the last 125 years.
- The capital share shows a significant trend in many countries and in many U.S industries over time.
- The estimates of the elasticity of substitution between capital and labor are often below unity.
- The price of capital goods in the "equipment" category, such as computers, machine tools, has been falling relative to the price of nondurable consumption goods, where the falling price is taken to indicate that technical progress is being embodies in capital goods at a faster rate than in consumption goods.

Jones (2003) then attempts to reconcile the above facts with a Cobb-Douglas function despite these facts not being compatible with it. However, this attempt is cut short by Chirinko (2002) which finds the value of the elasticity is still significantly below unity in the short run and in the long run. Thus, capital and labor are found to be complements, and capital deepening leads to a higher labor share because technological progress is labor-biased.

Comparatively, the CES production function has less restrictive assumptions about the interaction of capital and labor in production, but its data fit is inferior. One possible reason may be that various studies are not all measuring the same thing. The CES production function contains a number of variants that can be tested with either cross-sectional or time-series data. Klump and de La Grandville (2000) suggest that cross-study results would be much more meaningful when they are within the same CES family.

Moreover, the inefficiency of CES results can be attributed to the fact that time series estimates of the elasticity of substitution are not well measured by least squares regression. Klump and Preissler (2000) found that not all variants of CES functions commonly used are consistently specified. Therefore, there is no compelling evidence suggesting one should prefer CES to the Cobb-Douglas for forecasting GDP and income shares. However, since the seemingly perfect data fit of Cobb-Douglas is likely due to an accounting identity and mathematical feature rather than an underlying production function, the CES specification is probably getting better because of its allowance for a changing labor share and non-unitary elasticity of substitution, in a word, for being more *general*.

7 WHAT HAVE WE LEARNED? (NON)ERGODICITY AND THE ROLE OF ECONOMIC POLICY

At the end of our inquiry it appears that there is no single model of income distribution that has emerged as a mainstream model (Kregel, 1973). The expression "model of income distribution" is an expression more true in plural form than in singular form. Consider the factors that each author introduces to explain factor shares:

- **Keynes:** capitalist propensity to consume
- **Kalecki:** degree of monopoly, ratio of raw materials prices to aggregate prices, capitalist consumption and investment
- **Kaldor, Pasinetti:** investment share of GDP, saving propensities
- **Goodwin:** employment ratio (itself a negative function of labor productivity, of labor supply, and of the productivity of capital, all three assumed constant)
- **Technology:** degree of substitution between factors, type of technological change

In addition, recall that the models are cast in either full-employment or imperfectly competitive frameworks, and that income distribution is alternatively constant, drifting or cyclical around full employment. How can we reconcile such different frameworks and models?

The present survey and summary can leave the reader feeling one of several ways. An avid reader is probably happy to learn about the many facets of the economics of factor shares. However, it is easy to get lost, overwhelmed or exasperated by the diversity and cacophony of the main theoretical models. A critical reader will note, despairingly, that the theoretical approaches detailed above are just that: theoretical. In practice there is no clear-cut division between aggregate labor income and aggregate profits. Economic theories have nothing to say about the apportionment of proprietors' income or the classification of interest income or the reason why the labor share seems to have fallen precipitously since the early 2000s. There is no consensus for this in the theoretical literature, when it even addresses such specific questions (Giovannoni 2014b).

Thus, it is hard to escape the conclusion that, in matters of factor shares, economic theories are useful but are not enough. The theory of international trade is more precise, the theory of economic growth is more developed, and so it goes with many other branches of economics. But we must go beyond those limitations. Is there a common thread to income distribution theories?

As stated in the introduction, the ambition of this paper is to shed light on various theories, and then try to discern a pathway. Some decisive progress can be made by using a taxonomy based on the answers to the following two questions:

1. "Is income distribution assumed to be constant?" and
2. "Is income distribution treated as an exogenous factor (in the sense of driving the economy) or as an endogenous factor (adjusting to the rest of the economy)?"

Table 3 Suggested Taxonomy of Income Distribution Models

		Is income distribution assumed constant?	
		no	**yes**
The distribution of income is…	**exogenous (driving)**	*Kalecki* *Keynes*	*Goodwin* (cycle around constant)
	endogenous (driven)	*CES prod. function*	*Cobb-Douglas* *Kaldor-Pasinetti*

The justification of the placement of each model is as follows, going clockwise from the top right cell. The Goodwin model presents a cyclical model where income distribution alternates as two driving variables with the employment ratio. The wage share is assumed constant on average. The labor share from either the Cobb-Douglas or CES production functions are driven by technology, which is the real force underlying the changes in income distribution. What income distribution drives, however, is not clear. Kaldor's model and Pasinetti critique make income distribution appear as a result of the investment and saving decisions of the economic agents. Those adjust to the slack on the labor market and devise the distribution of income which is compatible with full-employment. Thus income distribution in Kaldor-Pasinetti is "constant at full-employment" and adjusts ever so slightly to correct for any departure from full employment, as described in Kaldor (1956). Finally, for Kalecki, and seemingly for Keynes, the relative shares need not be constant but they are drivers of the whole economic system through, respectively, the degree of monopoly and the marginal propensity to consume. Note that there is no theory of income distribution in Keynes, but there is enough evidence to place him in the top left cell (see details in section 2).

This taxonomy can be further refined by introducing the concept of (non)ergodicity as exposed, for instance, in Davidson (2003). An ergodic economic system is an economy whose future position is knowable in a deterministic way, possibly allowing for a stochastic error. In such a world, Davidson argues, economic policy and Keynes are irrelevant for there is a natural tendency of economies to self-correct. The future is knowable. Keynesian economics, Davidson continues, is inherently nonergodic—the future is unknowable and economic agents make decisions in radical uncertainty following rules of thumb and crowd movements.

It is the top left cell containing Kalecki and Keynes, and only this cell, which is compatible with the idea of non-ergodicity as in Davidson (2003). Other cells, particularly when income distribution is constant, are not compatible with nonergodicity: if income distribution is constant, or cyclical, or if it is assumed to adjust to maintain full employment, then income distribution in the future is knowable, and equilibrium will prevail. There is no need for economic policies except perhaps insofar as to expedite the process of convergence towards equilibrium. In those cases, income distribution is never "wrong" or inadequate, for it is the correct one that assures full employment of resources.

Income distribution can only be a problem, to the contrary, if one adopts a Keynesian or Kaleckian view of the economy. In those models income distribution can be inappropriate for full employment, and an income distribution policy could be desirable. For Keynes an inadequate distribution of income (outside of moral judgments) is one in which much income is diverted to individuals with a low marginal propensity to consume (MPC); for Kalecki, capitalists can confiscate much income to the detriment of workers. Hence the need of third actor, the State, which can institute redistribution policies, industrial organization policies such as introducing more competition, or introduce and support collective bargaining -among other possibilities.

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Working Paper No. 804

What Do We Know About the Labor Share and the Profit Share? Part II: Empirical Studies

by

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Abstract

In this second part of our study we survey the rapidly expanding empirical literature on the determinants of the functional distribution of income. Three major strands emerge: technological change, international trade, and financialization. All contribute to the fluctuations of the labor share, and there is a significant amount of self-reinforcement among these factors. For the case of the United States, it seems that the factors listed above are by order of increasing importance. We conclude by noting that the falling US wage shares cointegrates with rising inequality and a rising top 1 percent income share. Thus, all measures of income distribution provide the same picture. Liberalization and financialization worsen economic inequality by raising top incomes, unless institutions are strongly redistributive.

The labor share has also fallen, for structural reasons and for reasons related to economic policy. Such explanations are left to parts III and IV of our study, respectively. Part I investigated the theories of income distribution.

Keywords: Wage Share; Labor Share; Profit Share; Technology; International Trade; Finance; Bargaining Power

JEL Classifications: D33, E24, E25

CONTENTS

1 TECHNOLOGY DID IT

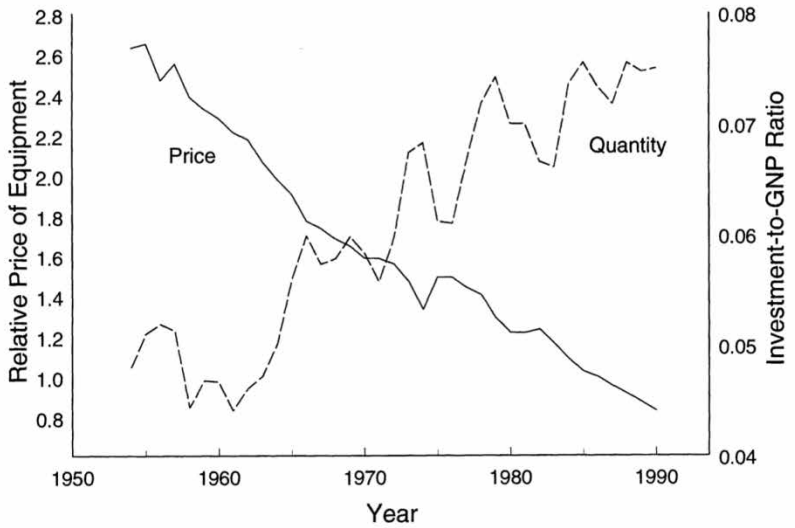
The decline of the labor share of income in many countries has led many researchers to turn to technological progress as an explanation (IMF, 2007a; Bentolila and Saint-Paul, 2003; Arpaia et al., 2009; Driver and Muñoz-Bugarin, 2010; Jones, 2003, Ellis and Smith, 2007; Hutchinson and Persyn, 2009). Specifically, economists draw attention to the ratio between capital and labor measured in efficiency units, which has been steadily increasing since the 1980s (Bental and Demougin, 2010). One of the most common explanations for this phenomenon is the emergence of capital-augmenting technical change (Jacobson and Occhino, 2012a,b; Berman et al., 1994; IMF 2007a).

The mechanism through which capital-augmenting technological change could affect the labor share is multifaceted. The recent shift away from labor-augmenting toward capital-augmenting technology –primarily due to major improvements in information and communication or ICT– largely increased the marginal productivity of labor. However this rise in marginal productivity has surpassed the growth in workers' compensation over the last four decades (Giovannoni, 2013a,b). In effect, slower growth in labor income compared to the growth in total income has pushed the wage share downwards.

1.1 The Debate on the Nature of Technological Progress

Whether recent technological advances are capital-augmenting, labor-augmenting, or Hicks-neutral change is at the core of the debate when one examines the role of technology in the evolution of the labor share. Greenwood et al. (1997) study the role of investment-specific technological change for economic growth in the U.S. and find that capital-embodied technological change is a key determinant of long-run productivity movements. Specifically, the remarkable decline of the relative price of equipment (see Figure 1) amidst a rising equipment-to-GNP ratio during 1950-1990 suggests that investment-specific technical change may be a contributing factor to economic growth.

Figure 1 Investment in Equipment



Source: Greenwood et al. (1997)

Greenwood et al. (1997) identify a negative correlation between equipment prices and equipment investment or GNP. This, in turn, indicates that investment-specific technologies may serve as a driving force behind economic fluctuations. According to the authors, approximately 60 percent of postwar productivity growth can be attributed to technnological change. Karabarbounis and Neiman (2012, 2013) relate the lower labor share to the global decline of the cost of capital beginning around 1980, which induced firms to shift away from labor and toward capital. The greater investment is realized thanks to both the rise of corporate savings and the fall of interest rates. Thus, both studies justify the fall in the labor share as a market price phenomenon, where the lower capital price pushes the capital share up and consequently the wage share down.

But technnological progress need not always be capital-biased (see Giovannoni 2013a). Dupuy and Marey (2004), and Catro and Coen-Pirani (2008), for instance, show that the production function has shifted in a non-neutral way over the last few decades, in large part due to the impact of technological change on the marginal rate of substitution. Dupuy (2006) investigates the dual nature of technological progress in the US using structural parameters allowing technical progress to be simultaneously both neutral and non-neutral, in the Hicksian sense. He finds that (1) both neutral and non-neutral technological changes occurred in the US in the period of 1948 to 1999, and (2) that three-fourths of the productivity slowdown observed in the 70s and 80s was due to the deceleration of non-neutral technical changes. Put differently,

Dupuy underlines that over the last few decades, technology has increasingly become less neutral. He also points out that the major investments in computer and information-processing equipment in the post–1973 period changed the marginal rate of substitution between factors of production and resulted in lower productivity.

In all, empirical evidence supports the assertion that technological change in the US is not purely neutral and points to the fact that the Solow residual may capture the effect of technological change on the marginal rate of substitution.

1.2 Capital-augmenting Technology and the Labor Share

Several empirical studies support the claim that technological change became increasingly capital-augmenting rather than labor-augmenting (Jacobson and Occhino, 2012a,b; Berman at el., 1994; IMF 2007a). This hypothesis of capital-augmenting technological change in turn motivated a substantial number of empirical studies to investigate the relationship between technological change and the labor share (IMF 2007a; European Commission, 2007).

The IMF (2007a) World Economic Outlook finds that technological progress is the largest contributor to the fall in the aggregate labor share of income. In particular, this study examines to what extent the recent trend in labor shares in advanced economies may be explained by the changing global labor supply relative to other factors such as technological change and/or labor market reform.

On theoretical grounds, the reduction of barriers to cross-border trade and capital flows—combined with technological progress—has made it easier for firms to produce merchandise in foreign locations that exhibit lower costs of production. Due to offshore outsourcing, firms are able to boost their profits by lowering costs. Thus, because capital equipment and foreign workers are increasingly substituted for domestic workers, the wage income of domestic workers is likely to drop.

In order to find empirical evidence, the IMF uses a basic international trade model (Feenstra, 2003; Harrigan, 2000; and Kohli, 1991) to analyze the relationship between labor compensation and labor globalization. The model is then taken to the data with controls for technological progress and changes in labor market policies (but not financialization and not welfare retrenchment policies). This model is estimated on a panel of 18 advanced OECD economies over the period 1982–2002. The result shows that both the globalization of labor and technological progress contributed to the fall in the labor share. The IMF (2007a) concludes that

the effect of technological progress on the labor share is considerably large, while changes in labor market policies have a relatively smaller but positive impact on the labor share.

Empirical results in IMF (2007b) show that technological change reduced the labor share in both Anglo-Saxon and European countries, but less so in Anglo-Saxon countries. This may explain why the labor share in Anglo-Saxon countries are more stable than its continental Europe (Giovannoni 2013b). Of note, IMF (2007b) finds that ICT (information and communication technologies) capital contributed to raising the labor share in the US as it is the most advanced country in ICT use. Thus, technological change need not be unfavorable to labor. The authors of the World Economic Outlook report also find that, at the early stages, the adverse labor demand effects of ICT appear to be stronger; this can be explained by the fact that ICT adoption takes place prior to the needed adjustments in workers' education level (IMF, 2007a). However, and contrary to the conclusions of IMF (2007a), Stockhammer (2013) finds that technological change has a positive effect on wage shares in developing countries and a negative effect in developed countries.[2]

Two additional features stand out in the IMF (2007b). First, the WEO model is estimated separately for the income shares of labor in skilled and in unskilled sectors. It is found that the main factor that affects the income share of unskilled labor over the sample period is technological progress. This result is consistent with the belief that ICT equipment and computers complement skilled labor, while acting as substitutes for unskilled labor. Second, the IMF (2007b) finds that labor globalization contributed to the fall in the labor share in the skilled sector, which is congruent with the conclusions of earlier findings that most of the increase in offshoring was driven by the offshoring of skilled rather than unskilled inputs (IMF, 2007a).

Bental and Demougin (2010) propose an alternative channel through which ICT could affect the labor share in the majority of OECD countries. The authors advance a model in which firms are assumed to face two problems. First: a moral hazard problem. Generally, firms and workers bargain over wage contracts and, since the workers' effort is not contractible, firms need to incentivize the agreements. In the actual situation, workers get paid regularly regardless of their productivity since their wages have already been contracted. However, it is possible that there exists deficient incentive for workers to contribute their best effort, so the extra incentive

[2] One reason for the result discordance may be that Stockhammer (2013) controls for financialization (see section 3) whereas the IMF does not, and that the IMF study purports to the case of the US alone while Stockhammer's results are for the group of developed countries.

is needed, which will cost firms extra money and cut their budgets for investment. Second is the investment irreversibility issue. Firms have to meticulously assign their limited budget, deciding whether to provide incentives to labor or to invest in capital.

The emergence of ICT technologies during the past two or three decades affects the two abovementioned assumptions presented by Bental and Demougin (2010). First, now that the workers can be better monitored, the need for incentivized contracts is reduced. Consequently, with higher monitoring precision coming from ICT advances, a certain level of effort can be achieved by lowering workers' bargaining power. Second, with greater bargaining position of firms, investment decisions are more efficient and firms receive a higher share of quasi-rents.

In addition, Bental and Demougin (2010) find that labor market reforms during the same period—including reduced unemployment benefits and the introduction of stricter eligibility criteria—reduced the bargaining power of labor in many countries. As a result, the labor share, as well as wage income, decrease relative to productivity. And more profitable capital investments divert firms to invest in more capital stock rather than labor.

Schneider (2011) provides an empirical assessment of Bental and Demougin's (2010) claim that the downward trend of the labor share was caused by improved monitoring precision allowed by the advances in ICT. Allowing the user cost of capital to change over time, Schneider (2011) concludes that the model by Bental and Demougin (2010) is also consistent with the observed trends in the US, Norway, Spain, and Japan.

Autor et al. (2003) argue that computer capital both substitutes for workers (in performing cognitive and manual tasks that can be accomplished by explicit rules) and complements workers (in performing non-routine problem-solving and complex communications tasks). The routine tasks become easier to monitor through ICT for several reasons: they are easily replaced by a computer, easier to learn, and more mobile. Thus, given improved monitoring precision brought by ICT, Oldenski (2010) finds that firms relocate rather routine tasks through foreign direct investments while non-routine tasks are performed within firms since communication is more important for these tasks.

This implies two possible effects of improved monitoring technology on the declining labor share. First, improved monitoring precision leads to a reduction in bargaining power of labor, and thereby implies a decline in wages. Second, it increases the offshoring possibilities of firms as a result of improved supervision of the production process abroad (Schneider, 2011).

1.3 Criticisms of the Capital-augmenting Theories

So far, the works presented in this paper embrace the capital-augmenting argument and conclude that technical progress has a negative impact on wage shares, except, perhaps, in the US. Corroborating this story are Elsby et al. (2013) who find limited support for the "neoclassical explanations based on the substitution of capital for labor."

ILO (2013) shares this circumspection about the capital-augmenting hypothesis and denotes that technology has a limited effect on labor shares. Unlike other studies that consider solely the relationship between technological progress and the labor share, Stockhammer, the author of the study, also controls for other variables such as globalization, financialization, and welfare state retrenchment. Stockhammer finds that the impact of financialization on the wage share is much greater than the partial effects of other variables, including technological progress.

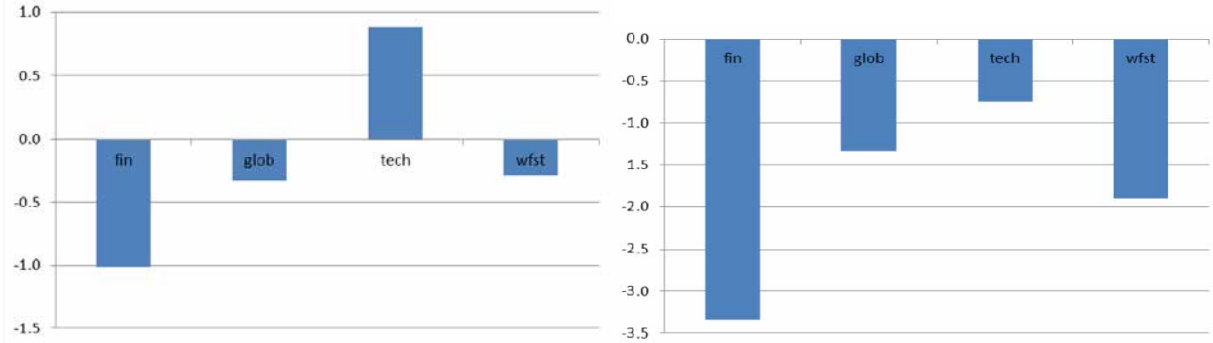
The ILO (2013) inquiry is based on a panel of 71 countries (28 advanced and 43 developing and emerging economies) during the period 1970–2007. The endogenous variable is chosen to be the wage share in the private sector (adjusted for self-employment), and alternative specifications of the labor share are considered, using different data sources. Independent variables in the model include growth, financial globalization, trade openness, government consumption as percentage of GDP, the logarithm of the PPP (purchasing power parity)-converted GDP per worker at constant prices (as a measure of technological change), the share of agriculture, and the share of industry (included to operationalize structural change in developing countries). The results for technological change show that all of the capital-labor ratio variables have statistically significant negative effects. This implies that either technology does not follow the features of the Cobb-Douglas model or that there has been biased technological change (ILO, 2013).

All in all, the ILO (2013) finds econometric evidence that challenges the widely-held view that the functional distribution of income in advanced economies has mainly been driven by technological change. Instead, Stockhammer (2013) finds that income distribution depends mostly on financialization—and this is regardless of the estimation method. Furthermore, by splitting the panel into developed and developing countries, Stockhammer finds that the effects of technological change is unequal: technological progress has positive effects on the labor share in developing countries but negative effects on advanced economies (see Figure 2).

A number of studies which investigate the effect of technological change on labor share confirm the negative correlation. The value of the elasticity of substitution between capital and labor motivated many studies (Acemoglu 2002; Acemoglu 2003; Klump et al., 2007; Chirinko, 2002). This is due to the central importance of the question in both the Cobb-Douglas and CES production functions framework (Giovannoni 2013a).

Vilmunen (2001), for instance, finds evidence in the Finnish economy that the elasticity of substitution between capital and labor is less than 1. This suggests that capital-augmentation is essentially labor-biased (Giovannoni 2013a). To be consistent with a constant factor share in the long-term, either the production function has to be of the Cobb-Douglas type or technology needs to be labor augmenting (Klump at al., 2007). Based on the argument that the long-run elasticity of substitution equals 1 because capital and labor can be easily replaced with each other in the long-run, Jones (2003) states that the direction of technical change is irrelevant for income distribution in the long-term Cobb-Douglas framework.

Figure 2 Contribution to the Change in the Wage Share for Advanced Countries and Developing Countries



Source: Stockhammer (2013) for ILO.

Notes: Top: Developed countries, 1980/84 - 2000/04; Bottom: Developing and emerging countries, 1990/94 to 2000/04. The graphs to the right present the variability of the estimates to the left for different estimation methods.

Some literature from the 1960s tries to identify the economic forces that lead technological change to being entirely labor-augmenting in the long-term. This approach was initiated by Kennedy (1964), Samuelson (1965), Drandakis and Phelps (1966), and recently re-examined by Acemoglu (2002) using new growth theory.

Acemoglu (2003) underlines the coexistence of labor- and capital-augmenting technological change, but with asymmetric long-term properties. Based on the model proposed

by Acemoglu (2002), the direction of the bias of technological change is determined by the factor that is more profitable. There are two competing forces that determine the relative profitability of different types of innovation: (1) the price effect, which creates incentives for the development of technologies used in the production of more expensive goods (technology improvements that favor scarce resources), (2) the market size effect, which encourages the technologies that have a larger market; more specifically, technologies that use the more abundant factor. Since the elasticity of substitution between the factors of production determines the relative strengths of these two effects, an estimation of the elasticity of substitution is central in determining the direction of technological change.

Acemoglu (2002) notes that the rough stability of the labor share in the US while the capital-labor ratio has been increasing steady suggests that technological change has been mostly labor-augmenting—unless the elasticity of substitution between capital and labor happens to be exactly equal to 1, but this has not been found to be the case. In a subsequent work, Acemoglu (2003) confirms that, along the long-run balanced growth path, the economy will have a steadily increasing wage rate and a constant interest rate. Long-run technical change will be purely labor-augmenting (Giovannoni 2013a). Only under the circumstance when the economy goes astray from the balanced growth path, will there be capital-augmenting technological change.

Klump et al. (2007) provide empirical evidence for Acemoglu's theoretical view. The authors apply a normalized CES production function with factor-augmenting technical progress, and estimate a supply-side system for the U.S. economy during the period 1953–1998. They found the elasticity of substitution to be significantly below 1, typically between 0.5 and 0.7. This result confirms previous results summarized in many places in the literature (see survey in Klump et al. (2011), and for details refer to Nadiri (1970), Nerlove (1967), Hamermesh (1993), David and Van de Klundert (1965), Griffin and Gregory (1976), Eisner and Nadiri (1968), Krusell et al. (2000) and Antras (2001), Chirinko, Fazzari, and Mayer (1999, 2001), and Klump et al. (2007).

In the case when the production function is not Cobb-Douglas and the elasticity of substitution is non-unity, to generate perpetual growth, the Solow model introduces labor augmentation. The production function has the form $Y = F(K, AL)$, where A is labor-augmenting technology that grows at an exogenous rate. Perpetual growth is feasible because

the endowment of effective labor AL grows over time and drives up the marginal product of capital, sustaining incentives for accumulation. Another solution has been proposed recently by Peretto and Seater (2013): rather than augmenting the non-reproducible factors (e.g., unskilled labor), firms learn to produce efficiently by eliminating some of the non-reproducible factors. In this model, firms "eliminate" the use of non-reproducible factors by devoting resources to R&D and changing the factor output elasticities (α in the case of a Cobb-Douglas production function).

Figure 3 Technology and the Wage Share: Summary Diagram

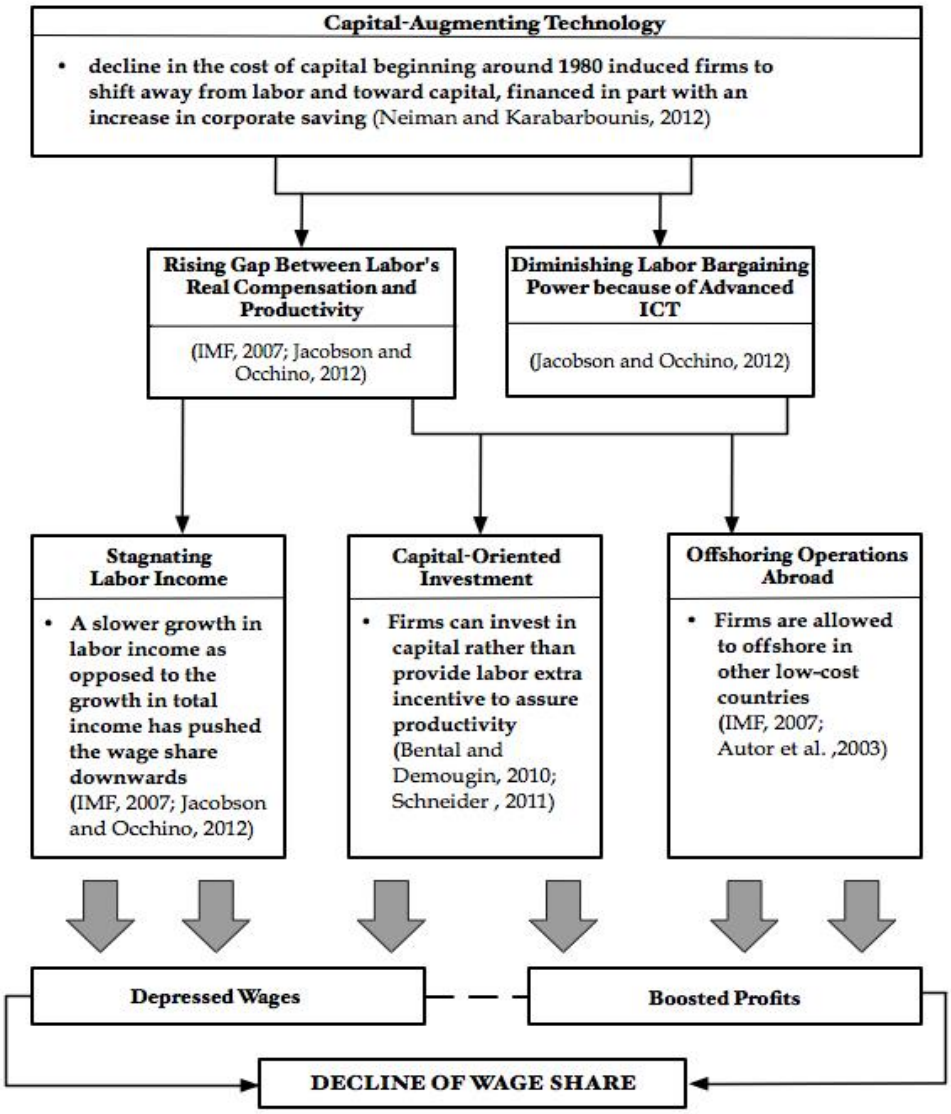
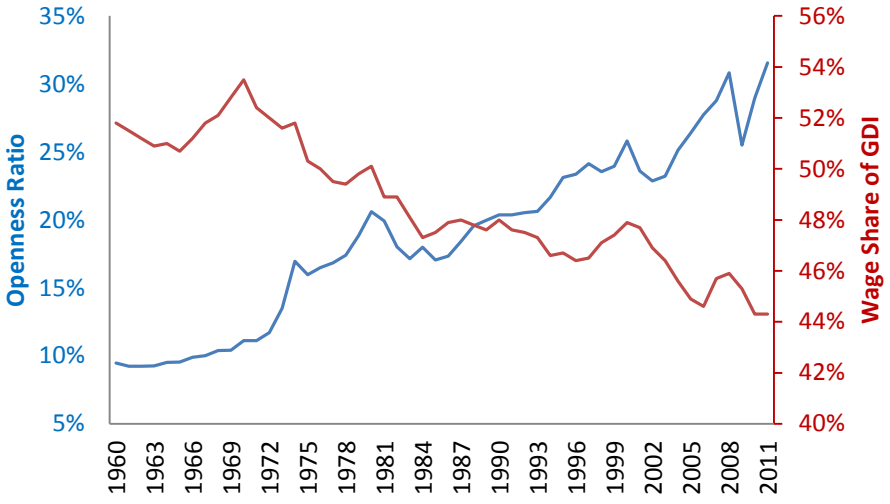


Figure 4 Opennes Ratio and the Wage Share



Source: Krugman (2008)

2 INTERNATIONAL TRADE DID IT

The literature studying the effects of international trade on income distribution is vast; however much of it addresses the personal distribution of income, not the functional distribution (Harrison, 2002). Yet several facts point toward a possible trade effect on the functional distribution of income.

First, the classic trade models predict such an effect. Both the comparative advantage model and factor proportions model predict that wages in developed countries will be depressed, *ceteris paribus*, when those countries trade with lower wages, developing, countries. Second, the past 30 years have seen a tremendous increase in trade volumes between developed and developing countries, while at the same time, the labor share in developed countries has declined; the negative correlation is striking (see Figure 4). Are we to believe, following theoretical guidelines and empirical evidence, that international trade has dragged down developed countries' labor shares? Does correlation imply causality?

2.1 Rising Trade

The past three decades have been marked by significant changes to the international trade landscape. The US exposure to international trade, as measured by the openess ratio, has tripled (see Figure 4). The combination of barriers to trade decliing (both natural and political), accelerating US aggregate labor productivity growth, and surging global GDP growth, have led to a significant increase in flows of international trade and investment, and a change in the composition of trading partners of the US (Haskel, et al., 2012).

During the same period, the global labor supply has increased fourfold (Jaumotte and Tytell, 2007). Developing countries have transformed from being primary product exporters before the late 1970s to becoming, increasingly, major exporters of manufactured goods, and more recently, exporters of selected services (Krugman, 2008).

By 2005, the value of US imports from non-oil developing countries surpassed that of developed countries (Haskel et al., 2012). Trade with developing countries, measured as the average of exports and imports, has grown at a slightly less dramatic rate, but like imports, by 2006 the US's total trade in manufactured goods with developing countries has become greater than in developed countries (Krugman, 2008). The trend of rising average hourly compensation in the US's 10 largest trading partners was commonly cited in the 1990s to allay fears about the

effect of trade on wages. However this trend has reversed recently, as the trade volume between the US and developing countries increases (see Table 1).

How has this changing landscape affected the U.S. distribution of income?

2.2 The HOSS Model: Implications and Limitations

The vast majority of studies on the effects of international trade on factor shares has been built within the classic Heckscher-Ohlin framework (Stockhammer, 2013).

The original Heckscher-Ohlin trade model (Heckscher and Ohlin, 1933) states that a country's comparative advantage is determined, among other things, by its factor endowment. The model predicts that countries will specialize in producing the good that uses their abundant factor intensively. Thus, capital-abundant (usually developed) countries are expected to specialize in producing and exporting capital-intensive goods, while labor abundant (usually developing) countries will specialize in the production and export of labor-intensive goods (Guscina, 2006).

Table 1 Average Hourly Compensation in the Top Ten U.S. Trading Partners, 1975, 1990, and 2005

Year	Top ten trading partners (largest first)	Average Hourly Compensation (percent of U.S. average)
1975	Canada, Japan, Germany, United Kingdom, Mexico, France, Italy, Brazil, the Netherlands, Belgium	76
1990	Canada, Japan, Mexico, Germany, United Kingdom, Taiwan, South Korea, France, Italy, China	81
2005	Canada, Mexico, China, Japan, Germany, United Kingdom, South Korea, Taiwan, France, Malaysia	65

Source: Krugman (2008)

The Stolper-Samuelson theorem (Stolper and Samuelson, 1941) further predicts that the owners of the abundant factor will gain from trade while the owners of the scarce factor will lose. The HOSS model therefore predicts that the relative reward of labor compared to that of capital should go up ($\Delta \frac{w}{r} > 1$) in labor-abundant countries and down in relatively labor-scarce countries.

If labor grows at the same rate as capital such that the capital stock per worker is constant in steady-state (Solow, 1957), international trade leads to $\Delta \frac{wL}{rK} > 1$. Assuming perfect competition and full employment ($L = N$), as both Solow and Heckscher-Ohlin models do, the last expression implies that along the long-run equilibrium path, labor-abundant countries experience $\Delta W > \Delta \Pi$. Thus, classical international trade models imply that the labor share grows in labor-intensive countries and shrinks in capital-intensive countries. Part of this result rests on the price elasticity of the labor supply curve, which is an issue addressed elsewhere (see section 1 above). So from a theoretical point of view, greater international trade is expected to lead to factor price equalization (Samuelson 1948, 1949) but arguably as well to factor *share* equalization. But how do those theoretical claims hold up in practice?

The answer is: not very well. First comes the observation that the relative price of labor is not equal, nor does it tend to be equal (see Table 1). Then comes the evidence provided by empirical studies. Stockhammer (2013) finds that globalization had the *same* effect on the wage share in developed and developing counties. Indeed wage shares have followed the same downward pattern worldwide, in developed and developing countries, and among net exporters and net importers. Moreover, a number of studies based on the Stolper-Samuelson trade logic have been unable to find a relationship between trade and the recent trend of labor's declining share in the US (Haskel et al., 2012). Finally, Krugman (2008) acknowledges that trade with developing countries has probably depressed wages in the U.S. but with a magnitude hard to quantify.

The only channel through which international trade could explain worldwide falling shares is through a beggar-thy-neighbor, or race-to-the-bottom, phenomenon, whereby every country tries to out-export every other by boosting export competitiveness through internal devaluation and productivity exhortation. This channel may be at work, and would probably be even more important in trade-intensive regions whose currency cannot adjust, i.e. in the eurozone. Regardless of the channel, the effect of international trade on labor shares is ultimately an empirical question, and on that matter, Stockhammer (2013) provides estimates indicating that the effect is significant, but limited.

The legitimacy of classical trade theories rests on the limitations of their assumptions. The assumption of full employment is at odds with the popular perception that unemployment is created by the export of jobs abroad (Stockhammer, 2013). The assumption of perfect

competition has also become increasingly discordant with empirical evidence as the share of US national income going to owners of capital through corporate profits has surged (Harrison, 2002), which points more in the direction of increasing returns and imperfect competition (Krugman, 2008). The assumption of identical technology across borders does not hold in practice.

The increase in capital mobility relative to labor mobility that has characterized the most recent period of trade (Haskel, et al., 2012) confronts the classic trade models' assumption that factors are immobile. This, in itself, weakens the implications of the Stolper-Samuelson model substantially, making it unclear whether this approach is an effective guide to the current situation (European Commission 2007, Stockhammer 2013). On the other hand, Guscina (2006) argues that greater factor mobility would only amplify the equalization of factor returns implied by the Heckscher-Ohlin model. Yet even if it is the case, the previous limitations of full employment and perfect competition remain.

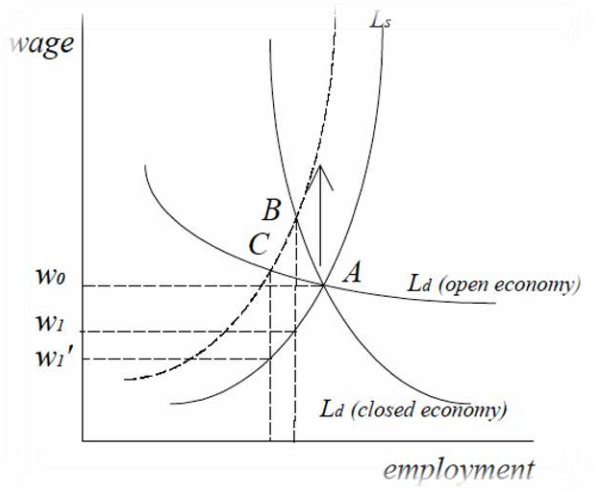
As a result of those limitations, a number of heterodox frameworks and numerous extensions of the Heckscher-Ohlin model have been developed to account for the recent developments in international trade. The introduction of heterogeneous firms and workers, and the allowance of intermediate goods have been major features of these extensions (Stockhammer, 2013). But the applications for such extensions are primarily focused on illustrating the influence of trade on the personal distribution of income within factors, rather than across factors (Harrison, 2002). Therefore, progress in expanding existing models based on factor endowment and relative prices have limited interest for our purpose. However, some studies have focused on the functional distribution of income. Progress has been made by outlining the effects trade has on factor mobility and its effect on the bargaining power of labor and capital.[3]

[3] Models for factor mobility and bargaining power also overcome another classic limitation. A natural consequence of studying trade and its effect on functional distribution of income is the tendency to focus solely on trade between developed and developing countries, but the majority of trade conducted by most developed countries is with other developed countries (Rodrik, 1998).

2.3 Labor Mobility and Bargaining Power

Labor is either seen as (1) mobile, at least in the long-run, or (2) relatively immobile compared to capital, or compared to previous waves of immigration. In the case of (1) we have factor price equalization, and assuming full employment and falling wages in developed countries, the wage share should fall. In case (2) labor is losing bargaining power to capital and one expects the labor share to fall. So from a theoretical perspective, the labor share falls in both cases.

Figure 5 Capital Mobility Incidence



Source: Rodrick (1998)

Labor Mobility

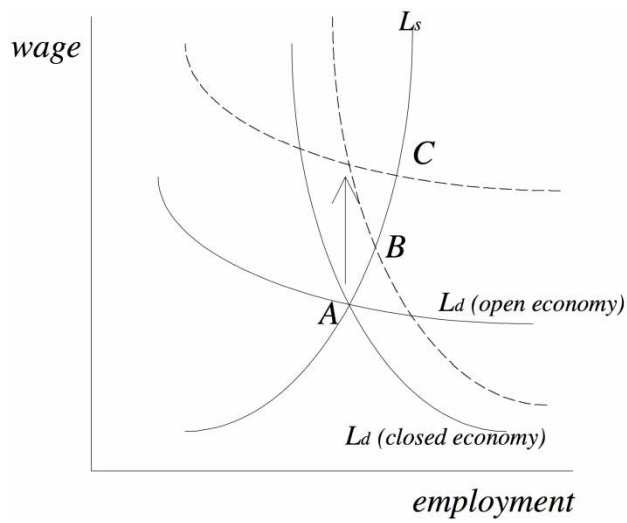
The economics of labor mobility are well understood. Rodrik (1998) for instance notes that the globalization of the 1990s bears a striking resemblance to the globalization of the early 20th century: trade flows in relation to national output are at similar levels, and capital flows are smaller than they were during the height of the gold standard. The notable difference between the two periods of globalization is the mobility of factors. While the mobility of capital has increased, the mobility of labor has declined significantly with increasing regulation of immigration. This trend has led to the cross-border mobility of capital, and the relative immobility of labor being a critical characterization of recent globalization, with the consequences of increased elasticity of demand for labor, and decreased labor bargaining power (Rodrik, 1998).

Capital mobility means that there are more trade and investment opportunities for employers (capital owners). This makes achieving high labor standards and benefits more costly

for workers as the elasticity of demand for labor increases. The implications of a more elastic demand for labor can be represented on a graph such as Figure 5.

The original equilibrium is at point A, with wages being w_0. An increase in employment standards can be viewed as a leftward shift of the labor supply curve. In a closed economy where the demand for labor is relatively inelastic, the burden of the increase in employment standards is shared relatively equally between employers and workers, with workers bearing w_1 to w_0. In an open economy the demand for labor is relatively elastic, the same rise in employment standards sees workers taking on w'_1 to w_0. Therefore, in an open economy, increases in employment standards lead to greater decreases in wages compared to a closed economy. Note also that another implication of Figure 5 is that a more elastic labor demand (open economy) will result in greater employment loss (Rodrik, 1998). Lower wages and lower employment lead to an expected lower wage share.

Figure 6 Capital Mobility and Labor Market Volatility



International Trade and Bargaining Power

Another implication of greater capital mobility in an open economy is that labor becomes easier to substitute, and hence a decline in the bargaining power of labor (Rodrik, 1998). In this scenario it is easier for capital to travel across borders toward countries with the cheapest labor. In order to retain capital and employers, workers may have to accept lower wages. When there is a decline in labor's bargaining power it becomes harder for workers to fight for higher wages while maintaining employment levels. Guscina (2006) finds evidence of increased openness to

trade, decreasing the power of labor unions. Harrisson (2002) finds that greater capital controls benefit labor share while greater foreign direct investment (FDI) flows reduce the labor share (see below). Kristal (2013) finds that the decline in the labor share came mostly from sectors that were once more unionized.

Yet, more interestingly, Diwan (2001) finds that bargaining systematically causes a decline in the labor share during financial crises. Diwan considers financial crises as periods of intense bargaining and redistribution; and while physical capital is relatively immobile, financial capital will flee abroad if the country's short-term returns fall below international rates. Thus, labor is forced to bear a larger share of the losses during these intense bargaining periods.

The Political Economy of Trade Approach

A heterodox approach to trade's effect on the functional distribution of income through the political economy angle has been developed from Rodrik's notion of factor mobility and bargaining power (Rodrik 1998, Onaran 2011, Stockhammer 2013). This approach abandons the factor endowment model and uses factor bargaining power and factor mobility instead. Set in a bargaining framework, this approach argues that trade liberalization will benefit the more mobile factor by increasing its bargaining power. This implies that trade leads to a redistribution of *rents* instead of the equalization of factor costs (Rodrik 1998, Stockhammer 2013). The political economy of trade approach also finds that a redistribution of income could take place due to threat effects (Epstein and Burke 2001, Stockhammer 2013), as well as trade among similar countries.

Since the current wave of globalization is marked by an increasing mobility of capital and a relative labor immobility (Diwan 2001), the political economy of trade approach predicts a decline in labor's bargaining power and therefore predicts a decline in labor's share of income. When capital has a higher mobility, there is an implication that labor will have to compete harder to attract capital. Guscina (2006) finds that European employment protection policies, a proxy for labor's bargaining power, have become less effective following globalization, thus representing a decline in the bargaining power of labor. Guscina's (2006) regression results show that for the post-globalization era, the employment share increases with employment protection by about 0.08–0.10 percentage points. While the results do not show globalization having a dampening effect on the bargaining power of labor, as the pre-globalization results showed a 0.03–0.06 percentage point increase, the post-globalization results are not always

significant, whereas pre-globalization results were. The same conclusion can be reached from the perspective that the European Union has been built on the idea of free trade and greater labor market flexibility.

2.4 Offshoring, FDIs and Income Distribution

International trade theory predicts that reduced international barriers that allow workers' services to be more easily substitutable internationally. The greater ease of outsourcing and off-shoring affects the bargaining position of labor adversely. Elsby, Hobijn, and Sahin (2013) find indeed that the offshoring of labor-intensive components is the leading explanation for the decline in the labor share in the US. However, the authors do not control for financialization (see below) or welfare retrenchment, so those channels may be more powerful than the outsourcing channel.

The linkage between capital account openness and the labor share can be understood in the same vein—an increase in capital mobility materializes the threat of relocating production abroad, causing labor to have a weaker bargaining power and an increase in the profit rate-wage rate ratio. This is supported by Jayadev's (2007) finding that a negative correlation exists between the degree of openness and the labor share, although the effect is not present for low-income countries.

Another measure that can be used to measure the effects of globalization on the labor share would be the intensity of FDIs in an economy. FDIs can generate two opposite effects: a positive force from spillover effects, and a negative influence due to the lower bargaining power of labor and depreciating exchange rates. The positive expectation for FDI is that following a rise in the ratio of FDI to GDP, it will not only increase labor demand but also improve the labor share through the transfer of more productive technology. However, if FDIs were to happen only mostly through mergers and acquisitions instead of long-term investments, spillover benefits would be limited and there would not be any major positive effects on economy-wide competitiveness, employment, and wages (Mencinger, 2003; Gallagher and Zarsky, 2004).

Small capital may suffer the most from FDI as it destroys jobs in the small domestic firms which are generally less competitive, further dampening the bargaining power of labor in these firms. Onaran's (2007) study of the wage share in Turkey, Mexico, and Korea revealed that an increased export intensity led to a decline in the manufacturing wage share in both Turkey and Mexico, but no significant effect in Korea. Similarly, FDIs and levels of economic

development have negative effects on the labor share in China; this is believed to have resulted from the regional competition for FDI which has significantly lowered the bargaining power of the labor force (Luo and Zhang 2010).

Another study by Maarek and Decreuse (2011) found a U-shaped relationship between the labor share in the manufacturing sector and the ratio of FDI stock to GDP. Most developing countries are trapped in the decreasing part of the curve. The fall of the labor share may indicate that the overall benefits from FDI did not improve the population's living standards, but have been captured by foreign investors instead. On the other hand, the effects of FDI and international trade on wages in the manufacturing industry in Central and Eastern European Countries yield different results for different time frames. In the short run, international trade shows no effect while FDI has a positive effect that is driven mostly by the capital-intensive and skilled sectors. In the medium run, the effect of FDI becomes negative; meanwhile, exports affect wages negatively but imports provide a positive effect (Onaran and Stockhammer 2007).

2.5 Overview of Recent Studies

Harrison (2002) combined national account data from the United Nations with measures of trade openness, capital account restrictions, and capital flows, and found that globalization places negative pressure on labor shares in both poor and rich countries. Unlike the classical models of trade, her results indicate that changes in relative factor endowments, represented by the ratio of labor to capital, have a prominent impact on changes in the labor share, having found a significant negative coefficient for relative factor endowments.

This implies that the elasticity of factor substitution is relatively low. Therefore, a rise in the labor supply would lead to a more-than-proportional decrease in the return to labor relative to capital, and consequently reflect a fall in the labor share. If true, the quadrupling of the effective global labor supply between 1980 and 2005 (Jaumotte and Tytell 2007) may have an even greater importance than is currently believed. However, it is unknown whether the implications of Harrison's finding are confined to the within border labor force or if they could be expanded to encompass the effective global labor supply presented by Jaumotte and Tytell (2007).

Harrison's (2002) analysis also asserts that, in addition to relative factor endowments, flow of foreign direct investment (FDI), relative GDP per capita, large exchange rate depreciations, and increasing trade shares impact the labor share negatively. She assumes that

FDI flows indicate the ease with which capital is able to enter and leave a country; the more freely capital is able to cross borders, the lower the laborers' bargaining power will be. A higher relative GDP per capita would therefore decrease laborers' bargaining power as well, because capital is expected to flow toward regions where unit labor costs are lower (Diwan 2001). On the other hand, Harrison (2002) finds that capital controls and government spending have positive effects on labor's share. By using capital controls as a proxy for higher fixed costs of relocating capital, the significant positive result indicates that greater capital controls decrease the bargaining power of capital, and consequently raise the labor share.

Guscina (2006) studies the question of how trade has impacted the functional distribution through the classic Heckscher-Ohlin framework using the following equation:

$$Y_{it} = \beta_{0i} + \beta_1 X_{it} + \mu_{it}$$
$$i = 1, \ldots, N, \; and \; t = 1, \ldots, T$$

where Y is a measure of labor's share, X is a matrix of explanatory variables and μ_i is the error term.

Guscina (2006) looks at three dependent variables: the compensation share in national income, employment share in national income, and the Gini coefficient. She uses labor productivity for the whole economy and productivity per worker as proxies for productivity and technology; ratio of trade to GDP, trade share with developing countries, FDI to GDP ratio, ratio of capital flows to GDP, and ratio of capital flows to GDP as proxies for openness to trade; and union density, and employment protection as proxies for labor bargaining power.

Focusing on two periods, pre-globalization / pre-IT revolution and post-globalization / post-IT revolution, Giscina's study finds that both compensation and the employment share decrease with trade openness, but the effect is not as significant during the pre-globalization era for the compensation share. Guscina's results also show that a higher degree of employment protection benefits labor more than capital, but in the post-globalization era the degree of significance of employment protection fell. For every percentage point increase in openness, the compensation share falls by 0.13–0.15 of a percentage point, while the employment share falls by about 0.16 of a percentage point (the results are significant at the 99 percent confidence level and are robust to alternative specifications). Also, while a regression of the labor share on trade

share with developing countries showed a positive relation to compensation in the pre-globalization era, the same regression showed a negative relation to the compensation share in the post-globalization era.

Guscina (2006) theorizes that high trade barriers, high trade costs, and big differences in technology between countries caused the implications of the HOSS model to be weakened. When using FDI to GDP ratio as a proxy for openness and international capital mobility, results show that there is again a variation between the results for pre- and post-globalization. In the post-globalization period employment share fell by 0.10 to 0.15 percentage points for every percentage point increase in the ratio, implying that globalization seems to have heightened the effect of the ratio on inequality. This suggests that higher capital mobility tends to raise the average standard of living but is biased towards benefiting skilled labor.

Based on her findings, Guscina (2006) suggests that the decline in OECD member countries may have been mostly an equilibrium, rather than a cyclical, phenomenon. This implication is based on her finding that while technology in the pre-globalization era appears to be labor-augmenting, with labor's share increasing with faster productivity, technology after the IT revolution has been capital-augmenting. This finding, along with her other results, has led her to believe that the decline in the labor's share in OECD member countries may have been mostly at equilibrium rather than a cyclical phenomenon. Therefore, the declining labor share is in the process of adjusting to capital-augmenting technological progress and a more globalized world economy. Guscina further suggests that, despite declining wages and salaries, the effect on wealth may be smaller as increasing direct and indirect ownership of equities holding by households may be counterbalancing the effects of falling wages and salaries on wealth. For example, Jaumotte and Tytell (2007) used a microfounded model:

$$R_L = \beta_L + Y_{EL} ln \frac{P_E}{P_A} + Y_{ML} ln \frac{P_M}{P_A} + \beta_{LL} ln \frac{L}{K} + \phi_{LK} X$$

$$+ \phi_{LM} \frac{L_M}{L} + \phi_{LC} \frac{K_{ICT}}{K} + \phi_{LC2} \left(\frac{K_{ICT}}{K} \right)^2 + \phi_{LP} LMP + \varepsilon_L$$

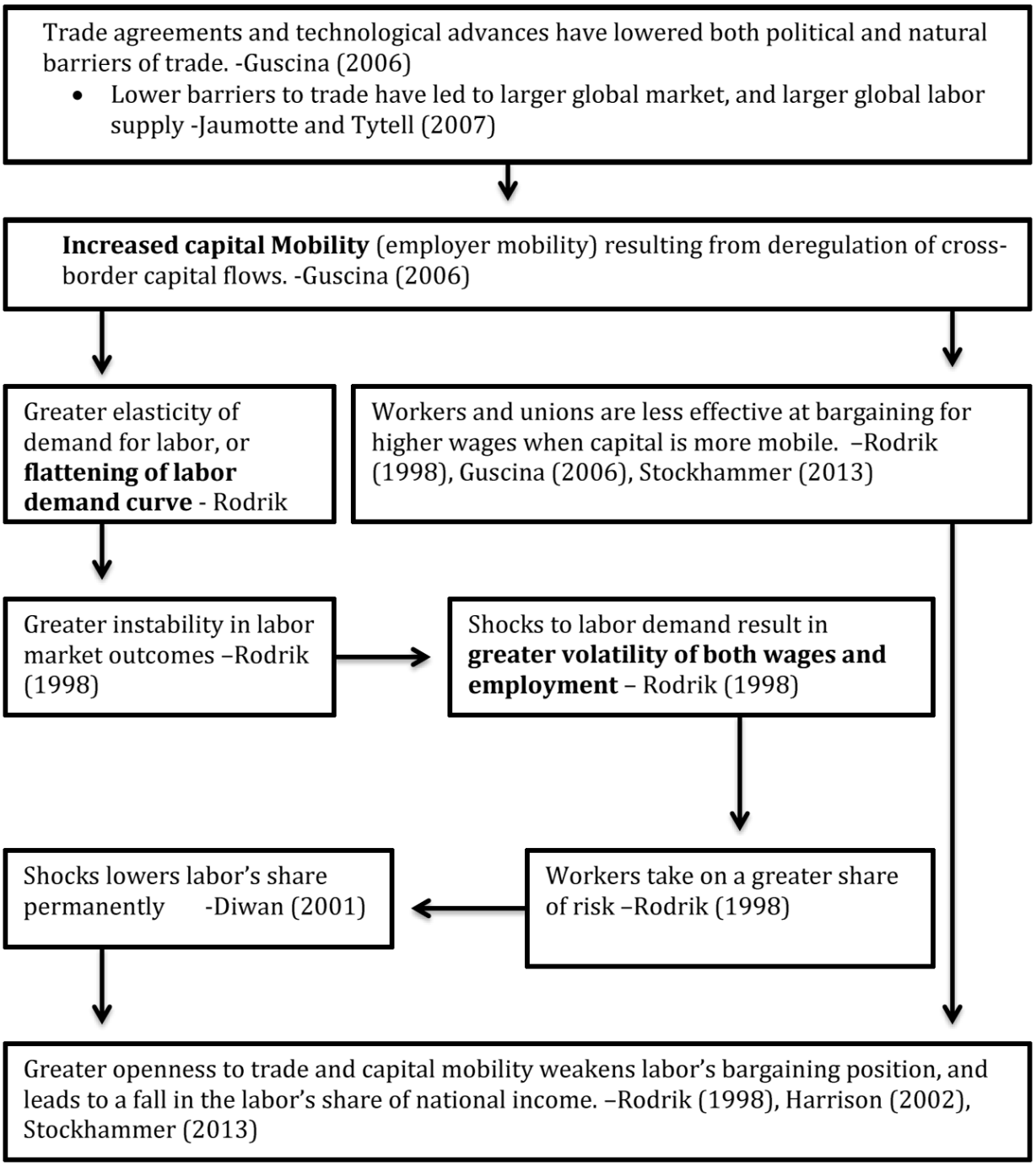
where R_L is labor share P_E, P_M, and P_A are prices of exports, imports, and absorption, respectively L is labor, K is capital X is the intensity of offshoring L_M is immigrant

employment K_{ICT} is information-and-communication technology capital and LMP are labor market policies.

They estimated that, on an imbalanced panel of 18 advanced OECD economies over 1982–2002, higher relative export prices and lower relative import prices are associated with lower labor share (consistent with advanced countries exports being capital intensive and exports being labor intensive). More specifically, they find that offshoring and immigration are negatively related to the labor share, technology appears to have a nonlinear effect on the labor share, and that higher tax wedges and unemployment benefit replacement rates are associated with a lower labor share. From their study, Jaumotte and Tytell conclude that both globalization and technological progress have acted to reduce the labor share but argue that technology has played a larger role than globalization in reducing labor's share in developed countries. One criticism for Jaumotte and Tytell's study is that they only consider physical capital and do not include financial globalization in their analysis, reasoning that while the regression between financial globalization and labor shows significance, it is not as significant as the other variables. Furthermore Stockhammer (2013) argues that studies, such as the one by Jaumotte and Tytell (2007), that conclude that technological change has been the main driver of changes in income distribution are not correct. While technological changes have presented a negative effect on wage shares in developed economies, the effect is smaller and less robust compared to that of other factors.

Other empirical studies have also found a statistically significant relationship between globalization and functional income distribution. Jayadev (2007) found that for a pool of developed and developing countries, increased trade has a negative effect on the wage share. The IMF (2007a) offers several measurements of globalization such as trade openness, terms of trade, and measures of offshoring and immigration. Furceri et al. (2014) find that one important channel through which globalization affects inequality is the functional distribution of income. Using a panel of 149 countries the authors found that capital account liberalizations lead to persistent increases in inequality and persistent decreases in labor shares, changes which are particularly strong in advanced countries. Both Jayadev (2007) and Furceri et al. (2014) found that current account liberalization decreases the labor share by at least 0.7 percentage points, which is statistically significant, but not very.

Figure 6 International Trade and the Wage Share: Summary Diagram



3 FINANCIALIZATION DID IT

A burgeoning piece of literature has recently linked the decline of the labor share to a process loosely coined as "financialization" (Stockhammer, 2013; ILO-ILLS, 2012; Duenhaupt, 2011; Lee and Jayadev, 2005; Diwan, 2001; Lübker, 2007, Hein, 2013). The term chiefly denotes the weight of the financial sector, which has been increasing worldwide, particularly in the US, since the 1980s (Epstein, 2001, 2005, Palley 2007). This accelerated shift towards finance in the last three decades can be seen, among other things, through:

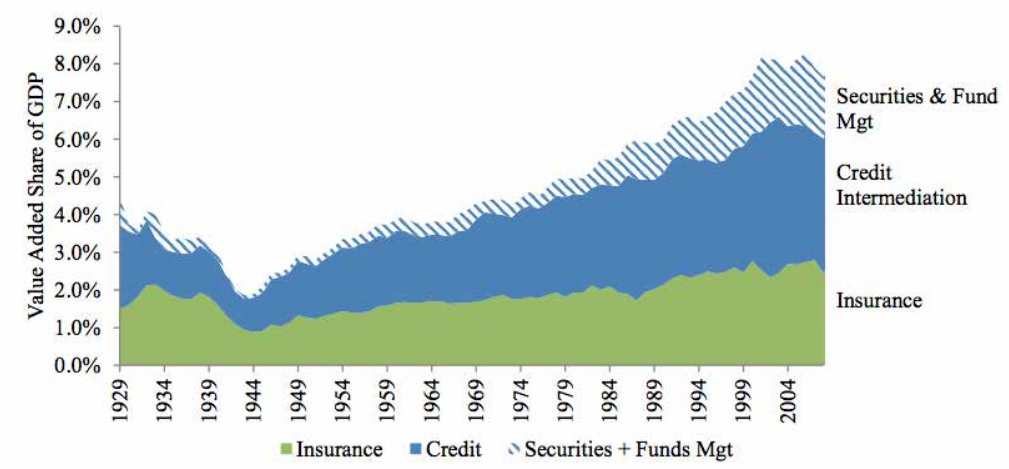
- the prominence of financial markets and financial institutions (Epstein, 2001, 2005)
- the greater participation of non-financial businesses in financial activities (Stockhammer, 2005)
- the increased level of household debt, the higher volatility of asset prices and exchange rates, and a bias towards short-term goals and shareholder value (Erturk et al., 2008; Stockhammer, 2010)
- the growth of mergers and acquisitions, globalization of trade and international finance, the rise of dividend and interest payments, and increased top management compensation (Hein, 2013)

Such changes affect the functional distribution of income through a number of channels, with the common effect of depressing wages and boosting profits. Thus, financialization leads to a fall in the wage share mostly, but not only by profits pushing it down. Before we get into the channels through which this happens it may be good to present evidence allowing us to grasp the extraordinary financial developments of the last thirty years.

3.1 Stylized Facts: The Development of Finance

Financial services—consisting of insurance, securities and funds management, and credit intermediation—have nearly doubled as a proportion of US GDP over the last three decades, increasing from 4.9 percent in 1980 to 8.3 percent in 2006 (see Figure 7). On a global scale, Greenwood and Scharfstein (2013) identify the rise of financial services in a number of other countries (Belgium, Denmark, Switzerland Great Britain, Japan, Korea, Netherlands) in the period 1990–2006 (see Figure 8).

Figure 7 The Growth of Financial Services

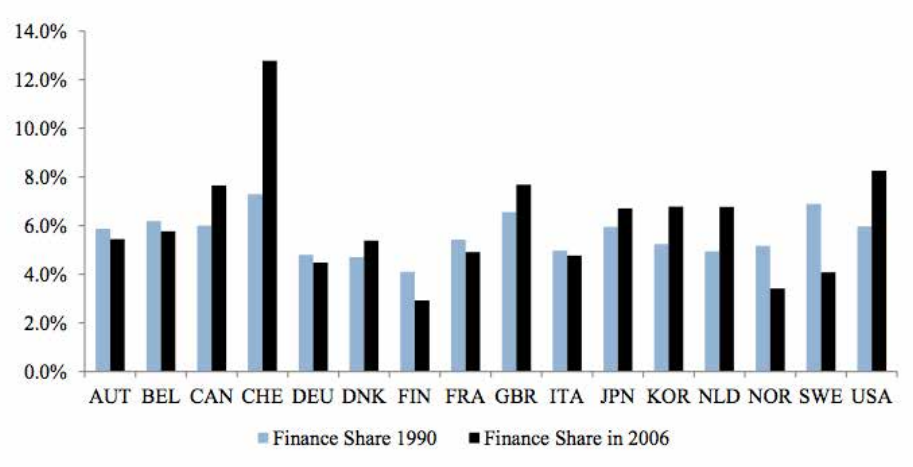


Source: Greenwood and Scharfstein (2013).
Notes: Data from the National Income and Product Accounts (1947-2009) and the National Economic Accounts (1929-1947)

Moreover, in the period between 1980 and 2006, compensation in the financial services industry rose by 70 percent, an increase partly driven by a greater use of highly specialized skilled workers (Phillipon and Reschef, 2009) but is out of line with the rest of the economy. As of 2013 the average wage in the financial services sector is about twice that in the rest of the economy (see Figure 9), a ratio only last seen in the 1930s in the US. This increase is tightly linked to the growth of IPOs, credit risk activities and greater financial deregulation (Phillipon and Reschef, 2009).

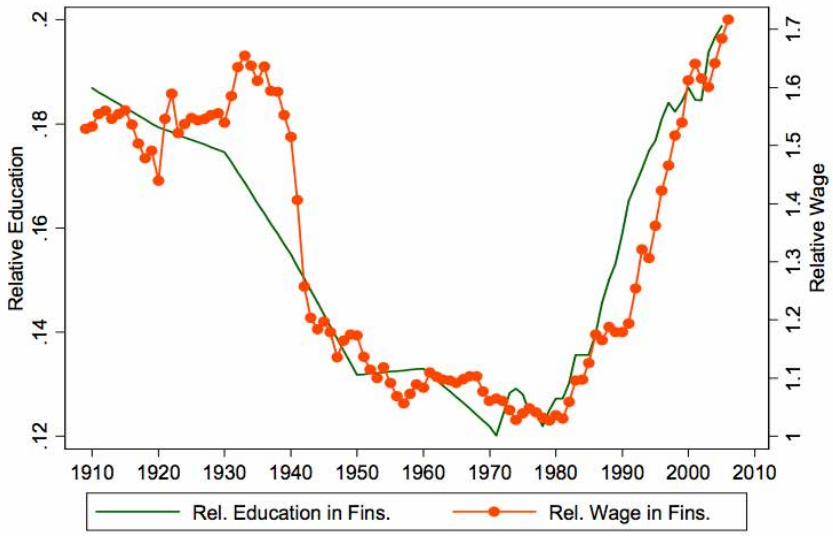
This surge in financial incomes and profits has been widely reported (Hein and Schoder, 2011; Onaran et al., 2011; DeAngelo and Skinner, 2002; Duenhaupt, 2011). The trend is primarily identified for interest payments, dividend payout and stock buybacks; however, rapid hikes in capital gains must also be added for certain periods (Power et al., 2003). DeAngelo and Skinner (2002), for example, point to the increase in aggregate dividends since 1978 due to a greater concentration of market power in a few large corporations.

Figure 8 The Growth of Financial Services as a Share of the GDP by Selected Countries



Source: Greenwood and Scharfstein (2013) using OECD data

Figure 9 Relative Wages and Education in the US Financial Sector



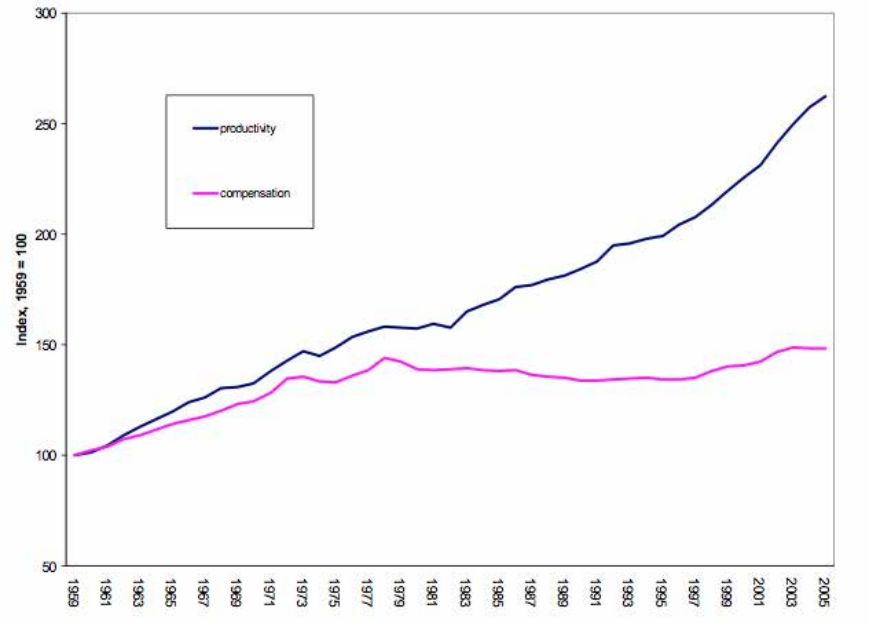
Source: Phillipon and Reschef (2009)

Alternatively, Duenhaupt (2011) draws attention to the growth in stock buyouts. The author cites the work of Jensen et al., (2004), who investigate the level and composition of CEO pay in S&P 500 firms in the period 1992-2002. Jensen, Murphy and Wruck (2004) find that, in 1992, base CEO salaries accounted for 38 percent of total CEO compensation, while stock options contributed 24 percent to the total income. By 2000, the share of base salary declined to 17 percent, while stock buyouts increased to 50 percent of the total CEO income. Despite a general fall of income in 2002, they find that stock options still represented 50 percent of CEO

salaries. Duenhaupt (2011) further cites Holmstrom and Kaplan (2011), who trace the source of the rise of interest payments. Homstrom and Kaplan (2011) find that the trend of increasing interest payments is due to the aforementioned growth in stock options, leveraged acquisitions and takeovers.

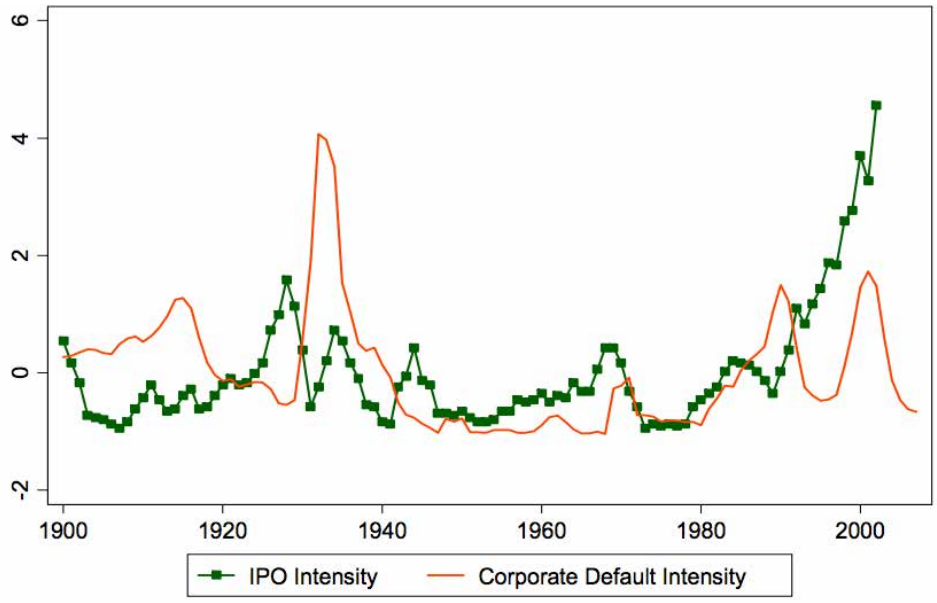
This spike in financial income and profits took place amidst faltering wages (Palley, 2007). Building on data published by the Economic Policy Institute, Palley (2007) observes that in the period 1959–1979, the growth in median wages followed the trend of rising labor productivity. However, in the post-1980 period, Palley (2007) underlines the divergence of the two: with wages stagnating and productivity continuing to rise (see Figure 10). The divergence would have been even greater, and therefore the wage share would have fallen even more, if one excludes the compensation of the top 1 percent, which is mostly due to skyrocketing financial incomes (Giovannoni 2013b).

Figure 10 Index of Productivity and Median Hourly Compensation of Production and Non-supervisory Workers in the US, 1959–2005.



Source: Palley (2007) from Economic Policy Institute data.

Figure 11 Non-Financial Corporate Activities



Notes: IPO is IPO value over Market Capitalization. Defaults is the 3-year moving average default rate on all corporations. Both series are normalized (mean 0, std dev 1) over the sample. Data from Jovanovic and Rousseau (2005).

Source: Phillipon and Reschef (2009)

A number of economists have also called attention to an increased focus of non-financial corporations on financial investments (see Figure 11; Phillipon and Reschef, 2009; Krippner, 2005; Stockhammer, 2004). According to the World of Work Report (ILO-ILLS, 2011), non-financial firms in advanced economies increased their total financial assets from 81.2 percent of GDP to 132.2 percent of GDP in 2007. This can be partly explained by the extraordinary profitability of the financial sector, which increased from 14.2 percent in 1990 to 36 percent in 2006. A similar trend is identified in emerging economies where non-financial firms increased their total financial assets from 56.4 percent of GDP in 2000 to 87.4 percent in 2007, with a profitability of 32.1 percent that year (ILO-ILLS, 2011).

This increase in profitability may be partly explained by deregulation, financial innovations, and financial bubbles during the 1990s and 2000s. Financial returns should ultimately mirror the (expected, real) returns in the economy. However, much of those returns are now made in financial sectors, with the creation of bubbles over the past 15 years. In addition, it is difficult to find real investment projects providing rates of return greater than those provided by the financial sector, which makes the case of financial investment over real investment that much stronger. Thus, the development of finance has diverted investment flows

from the real economy in to financial markets.

In all, statistical evidence suggests a simultaneous slowdown of wages and accelerated growth in profits and financial incomes (Giovannoni, 2013b). The combination of the two puts greater pressure on the wage share and drives the profit share upwards.

3.2 Theoretical Inquiries

Financialization could affect the wage share through several theoretical channels.

First, the deregulation and globalization of financial activities has altered the bargaining power of labor (Stockhammer, 2013; ILO, 2012). Stockhammer (2013) finds that due to a greater access to financial markets, firms face many investment options: investment in real or financial assets and domestic or foreign investment. As a direct effect of the widened capital- and geographic-investment scope, domestic firms are less dependent on real national investment and domestic hiring. Consequently, while companies attain larger investment and employment flexibility, workers face a weakening of their bargaining power; hence, a greater bargaining position of firms relative to that of labor.

Second, financialization coupled with a general stagnation of wages and the growth in income inequality has likely amplified the erosion of the wage share (Palley, 2007). The effect of structural changes over the last few decades—trade, globalization, deuniozation, minimum wage stagnation, immigration, skill-biased technological change and higher CEO compensation—highly contributed both to the wage growth slowdown and the widening of the income gap (Palley, 1998a; Gordon and Dew-Becker, 2007; Levy and Temin, 2007). According to Palley (2007), the process of financialization intensifies the deterioration in labor power further modifies the functional distribution of income, primarily by shifting the focus from wage payments (workers' and managers' wages) to capital income (profit and interest payments).

Third, the rise of the shareholder-oriented corporate governance has aligned management interests with shareholder interests, thereby turning firms' objectives away from the fundamental goal of growth creation, and toward the goals of shareholder satisfaction and profit-maximization (Lazonick and O'Sullivan, 2000; Stockhammer, 2005). In order to present the impact of this new orientation, Stockhammer (2005) underlines the differing interest of firms' social groups; in particular, the separation of control (management) and ownership (shareholders) based on a nonaxiomatic (but institutional) post-Keynesian model. According to this model, shareholders, workers and managers follow contrasting utility functions:

shareholders are primarily occupied by profits, workers are concerned with higher wages and employment, and managers hold an intermediate position. Based on the simple model adopted by Stockhammer (2004) that assumes sole preoccupation of managers with growth and exclusive concern of shareholders on profits, the utility functions of management (U_M) and shareholders (U_O) are:

$$U_M = U(g) \tag{1}$$

$$U_O = U(r) \tag{2}$$

where g is investment or growth of the firm and r is the profit rate. Hence the firm's objective function $u(.)$, expressed as Nash bargaining event:

$$u = u(g,r) = I^{1-\beta} R^{\beta} \tag{3}$$

where: I is investment, R is profit and β is an index of shareholder power.

Next, Stockhammer (2005) expands the model by considering the growth-profit trade-off that firms face in the post-Keynesian model. This trade-off is implied by default from the separation of ownership argument, and, an inverse relationship between current distributed profits (paid-out earnings) and current investment expenditures (retained earnings). According to the model, since, by assumption, both growth and profits are components of the objective function of a firm, then the firm will tend to "overinvest" beyond the profit-maximizing level of investment. Assuming a simplified linear growth-profit trade-off, profit is determined by:

$$R = I_R - tI \tag{4}$$

where I_R is the profit-maximizing investment level and t is a constant.

Next, maximizing Equation (3) subject (4), Stockhammer (2005) arrives at the optimal investment and profit levels:

$$\begin{cases} I^* = \dfrac{(1-\beta)I_R(Y)}{t} \\ \\ R^* = \beta I_R \end{cases}$$

and concludes that the effect of an increase in shareholder empowerment on real investment is negative at the microeconomic level:

$$\frac{\partial I^*}{\partial \beta} = -\frac{I_R}{t} < 0 \tag{5}$$

Translating these findings to the macroeconomic level, Stockhammer (2005) finds that the development of a shareholder-oriented corporate governance has shifted firms' priorities toward profits at the cost of "real economy" investment. The rise of profits as a result of institutional changes further implies the suppression of wages and, hence, a drop in wage share.

The ILO (2012) examines the means through which these new institutional changes have likely led to the depletion of real, productive investment. The two primary channels are: increased dividend payments that lift stock prices (increase in shareholder value) and risky financial investment (delivery of short-term returns). The combined effect of increased financial activities on the real economy's capital stock in advanced economies is assumed to be negative. The macroeconomic result: a rise in financial investment and a relative drop in real investment.

Fourth, based on the Kaleckian theory of functional income distribution, Hein (Hein and Mundt, 2012; Hein, 2012, 2013) distinguishes between three determinants of the price mark-up —the degree of competition in the goods market, the bargaining power of trade unions, and the overhead costs and gross profit targets—which indirectly influence the wage and profit shares of income as follows:

$$\omega = \frac{W}{W + \Pi} = \frac{1}{(1+z)\mu + 1} \tag{6}$$

$$h = \frac{\Pi}{W + \Pi} = \frac{(1+z)\mu}{(1+z)\mu + 1} \tag{7}$$

and by definition: $\omega = 1 - h$.

where ω: wage share, h: gross profit share, Π: gross profits, W: wages for direct labor, μ: mark-up, z: relationship between unit material costs and unit labor costs, defined as, $z_j = \frac{p_f e \mu_j}{w a_j}$, p_f: unit price of imported material or semi-finished products in foreign currency, μ_j: imported materials or semi-finished inputs per unit of output, e: exchange rate, a: labor-output ratio, w: nominal wage rate.

In the Kaleckian framework adopted by Hein (2012, 2013) and Hein and Mundt (2012), financialization alters the wage share through the mark-up μ. The shift in sectorial composition away from public and non-financial business sectors toward the financial business sector is associated with an increased concentration and monopoly power of the corporate financial industry. To put it differently, higher labor income share of the financial sector causes a rise in the mark-up μ. This happens through tacit agreements, implicit cartels, and growth of other forms of competition such as marketing or product differentiation relative to price competition. The aggregate microeconomic result of financialization leads to an increase in the mark-up and causes an overall drop in the labor share of income for the whole economy, at the macroeconomic level.

Hein and Mundt (ILO, 2012) also consider the theoretical effect of the level of unionization and labor-bargaining power on the wage share in the context of the Kaleckian equations 7 and 8. The authors acknowledge the deterioration of labor power as a significant factor leading to a decline of the labor share (caused by weakened bargaining power of trade unions); this confirms the argument in Kristal (2013). Building on the model of strategic behavior between firms and workers, the authors note that stronger trade unions imply higher wages demanded for the purpose of offsetting the effects of the excesses of market power determined by the mark-up. This property, in turn, creates incentives for firms to constrain their

mark-ups. Based on these theoretical assumptions of the Kaleckian model, the recent de-uniozation trend has weakened the bargaining position of labor, thereby allowing firms to sustain mark-ups with a depressed wage share.

Last, Hein and Mundt (ILO, 2012) emphasize the role of increased management compensation and the growth of overhead costs—including depreciation of fixed capital, salaries of overhead labor, and profit claims of the rentiers in the form of dividend and interest payments of the corporate sector—in influencing the degree of monopolization; hence, the labor share. According to Kalecki's equation (1954), the growth in overhead costs reduces gross profits.

$$\Pi = \mu(W + M) - S \tag{8}$$

where Π: gross profits, W : wages (variable), S : salaries (fixed), M : cost of raw materials (fixed), μ : average mark-up for the whole economy.

This, in turn, potentially leads to the emergence of tacit collusive agreements with the purpose of preserving favorable profit margins. Building on the idea of interest rate (or interest payments) and dividend payments elastic to the mark-up adopted in the Kaleckian framework, Hein and Mundt (ILO, 2012) assert that prolonged period of increased interest rates (or payments) triggers firms, on average, to raise their mark-up prices in order to remain operational, thereby lower the wage share. In addition, the authors argue that the sustained increase in dividend payments (a type of overhead obligation that emerged alongside recent financial developments) creates incentive for managers to transfer the opportunity cost of refraining from real investment (through retained earnings) into higher mark-up. This is achieved by means of raising prices or pushing down unit labor costs. Financialization has made this process more feasible due to the aforementioned effects of reduced bargaining power of labor.

In summary, the theoretical models above promote the idea that financialization leads to a slump in wages (weakening of workers' bargaining position, shift away from labor toward capital) and a leap in profits (empowerment of shareholder interests, greater stress on financial activities). Both trends individually and jointly participate in the deterioration of the wage share and the rise in the profit share.

3.3 Recent Empirical Studies

What can be learned from empirical investigations? The empirical literature on the labor share has flourished in recent years. This is despite the scarcity of theoretical contributions and the difficulty in measuring "financialization" other than by recourse to proxy variables.

The proxy variables used in the literature include, but are not limited to: capital controls and capital mobility (Rodrik, 1998; Harrison, 2002); foreign direct investment inflows (FDI, Onaran, 2009); FDI stocks (IMF, 2007b); dummy variables that isolate exchange rate crises (ILO, 2011); rentier income of non-financial business as a measure of shareholder value orientation (Stockhammer, 2004); financial globalization, measured as the sum of foreign assets and liabilities as a share of GDP; and financial reform variables such as credit controls, interest rate controls, entry barriers, privatization, international capital flows, security markets, and financial reform indices (ILO and ILLS, 2011; ILO, 2013).

Regardless of the variable or combination of variables chosen, the empirical literature overwhelmingly finds that the primary force behind the decline in the wage share has been financialization, even after controlling for changing institutions and increased international trade.

For instance, the ILO and the International Institute for Labour Studies (ILO-ILLS, 2011) find that the global integration of financial markets is the main contributor to the decrease in the wage share. The study takes AMECO wage share data for European countries, uses a generalized least squares technique in a panel regression and finds that the effect of financial globalization on the wage share is significantly negative for the majority of the examined high-, middle- and low-income countries.

Likewise, Lee and Jayadev (2005) use capital account openness to show that financial openness depressed the labor share in developed and developing countries during the period 1973–95. Applying a simple OLS cross-section regression (with the labor share estimated by the United Nations' system of national accounts, Table 103) and more advanced robustness tests (Jayadev, 2003, 2007), the authors conclude with the unambiguous, negative effect of capital account openness on the labor share. Put differently, financial liberalization is related to a lowered share of productive income passed on to labor. Lee and Jayadev (2005) explain their empirical outcome by singling out one argument: the liberalization of the capital account leads to a weakening of labor's bargaining power with the consequence of a declining labor share—both in developing and developed countries.

Similarly, Diwan (2001) applies simple least squares panel-data techniques and finds that the labor share falls by 5.0 percent points of GDP during each financial crisis, with a partial rebound afterwards. The author notes that the estimated decline in the labor share during a crisis may be explained by a country's leverage, its financial structure, trade openness, and capital openness and control regimes. Altogether, Diwan (2001) estimates that the cumulative effect of financial crises during the last three decades led to an overall fall in the labor share by 4.1 percent of GDP.

Lübker (2007) summarizes the conclusions of critical literature by emphasizing an empirical consistency of the negative effect of financial openness and financial crises on the labor share.

Other studies focus on the influence of the institutional changes that emerged along, or perhaps caused, the rise of financialization, such as shareholder-oriented corporate governance, intensified short-term profit-driven practices, and hedge funds (Lazonick and O'Sullivan, 2002; Stockhammer, 2002; Hein and Schoder, 2011; Argitis and Pitelis, 2001).

Stockhammer (2004) provides empirical support for the effects of the "shareholder revolution"—emergence of a market for corporate control that realigned management interests with shareholder interests—on real investment. The results of the study, based on a time series analysis of aggregate business investment, show evidence that financialization resulted in a slowdown of real capital goods accumulation in the US, the UK and France.

Similarly, Orhangazi (2008) presents additional empirical affirmation to the claim that the orientation toward profit maximization of financial institutions has a negative effect on capital accumulation. This is based on the results of a dynamic Arellano-Bond Generalized Method of Moments (GMM) model applied to US firm-level data during the period 1973–2003. To explain the connection, Orhangazi notes that the process of financialization alters the behavior of non-financial corporations (NFC) by placing a greater focus on financial investment over real investment; thus, lifting up financial profits. This new trend in the behavior of NFCs—in the face of greater pressures from financial markets to deliver short-term returns—triggers additional transfers to financial markets such as dividends, interest payments and stock buybacks. In short, rising financial profit opportunities and higher financial payments result in a decline (or slowdown) in real sector investment and capital accumulation. Thus, building on the theoretical claims, a greater focus on financial profit may explain the decline in the wage share.

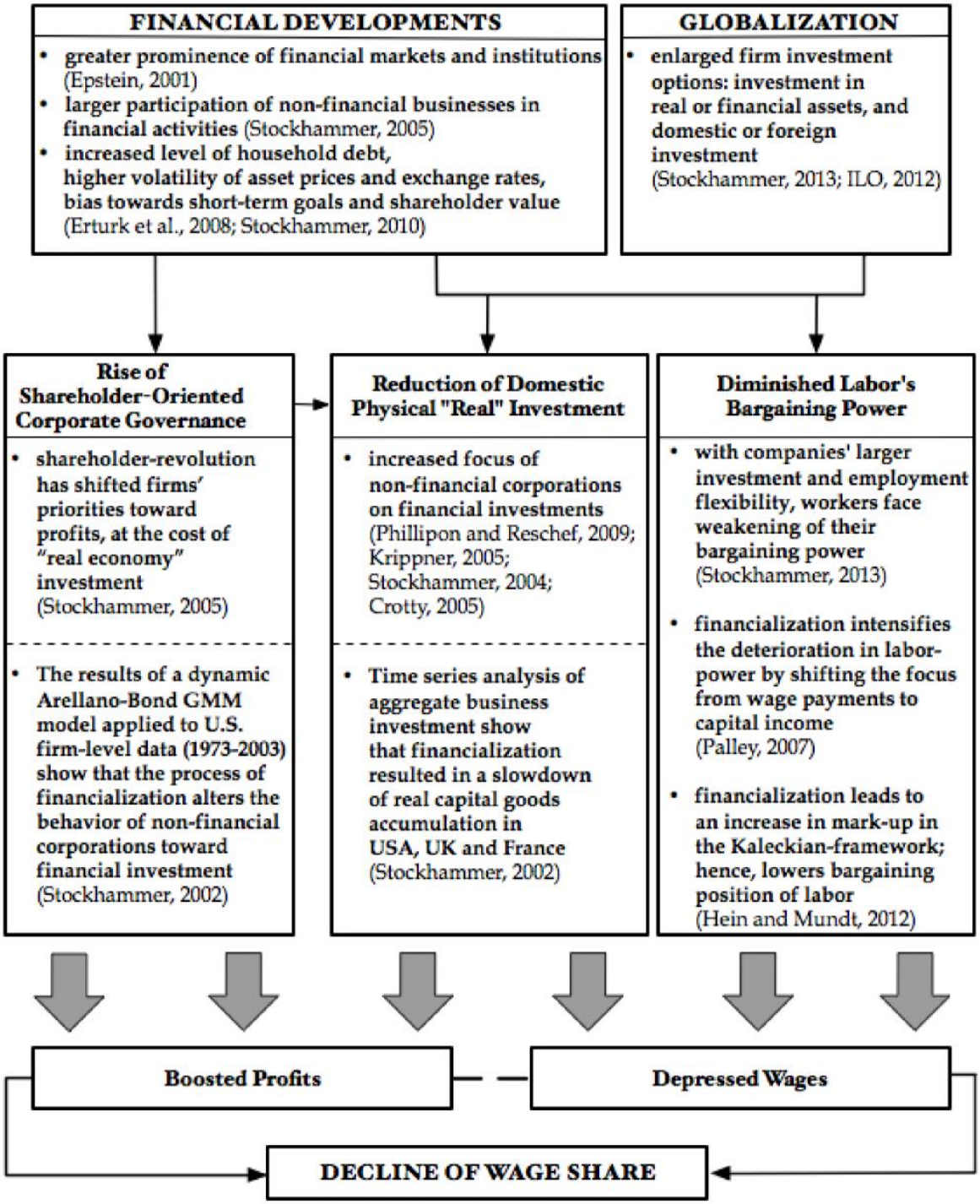
Lin and Tomaskovic-Devey (2013), too, present empirical results for the negative

relationship between financialization and labor's share of income. Using cross-section data of the US non-financial sector, the authors find that, in the long-run, increased reliance on financial income is related to a decline in labor share, higher top executives' share of compensation and greater polarization of workers' earnings. Drawing on the outcome of their counterfactual analysis, Lin and Tomaskovic-Devey (2013) conclude that financialization may have contributed to more than half of the fall in the labor share of income.

The most recent study conducted by the ILO (ILO, 2013) adopts four econometric methods—Parks estimator (cross-section fixed effects), first-difference (FE) estimator, non-overlapping 5-year average data methods, and GMM estimator—to measure the effect of technology, globalization, welfare state retrenchment and financialization on the wage share. The sample size consists of 71 countries (28 of which are OECD high-income economies). The results of the ILO's (2013) study consolidate the conclusions of the primary economic literature by ascribing 46 percent of the global fall in the wage share to financialization alone, 25 percent to institutional factors, 19 percent to globalization, and 10 percent to technological change.

Overall, empirical investigations tend to agree with those theoretical and statistical insights: in most of the countries studied, there exists a negative relationship between financialization and the wage share (see Figure 12). This result has been strongly confirmed in advanced economies while the relationship for emerging and developing countries is less robust. The difficulty empirical studies face, as well as possibly the weak results for developing countries, lies in the choice of variable to represent the development of finance.

Figure 12 Financialization and the Wage Share: Summary Diagram



4 CONCLUDING REMARKS: FACTOR SHARES AND INEQUITABLE GROWTH

The quartet of causes frequently mentioned for factor shares' behavior are: technology, international trade, financialization and welfare retrenchment (i.e., policy). We have detailed the literature on each one except for the last, which we leave for a subsequent and more detailed study. A few stylized facts have emerged:

- Technology or capital-for-labor substitution appears to have played a relatively minor role in the evolution of labor shares. If anything, technology has actually raised the labor share in the US, and many studies have found that capital and labor are complements, not substitutes, at least over the long run. According to the IMF (2007b) and Stockhammer (2013), technology has had a positive impact on the US's labor share. Only continental Europe can be isolated as a place where technology may have had a significantly depressing effect on wage shares. There are many studies confirming this overall picture, and little dissent.
- Market liberalizations and welfare state retrenchment have had more negative effects, especially in Europe. In particular, de-unionization seems to receive weak- to moderate support. There is a limited number of studies of those phenomena and more are needed.
- International trade, capital mobility, FDIs and "globalization" all have had negative effects on the labor share both in developed and developing countries, taken as groups. Whether some individual countries have been "winners from trade" in the Heckscher-Ohlin sense, is left to another inquiry. It is important to note, however, that even net exporting countries like Japan, Germany, and China have experienced declining, not rising, labor shares, so that the HOSS model might not be the most appropriate. Many studies confirm this fact, and often place trade and globalization as the number one reason labor shares have fallen (Elsby et al. 2013).[4] Those studies, however, do not control for financialization.

[4] This is mostly true over the past two decades, not so much before that (see Krugman 1995)

- Financialization is found to be the single most depressing force underlying the fall in labor shares worldwide. This is true in a fair amount of studies which account for the phenomenon —which they often fail to do. The evidence appears convincing; however, given the predominance of financialization over all other determinants of the labor share, more studies would be welcome.

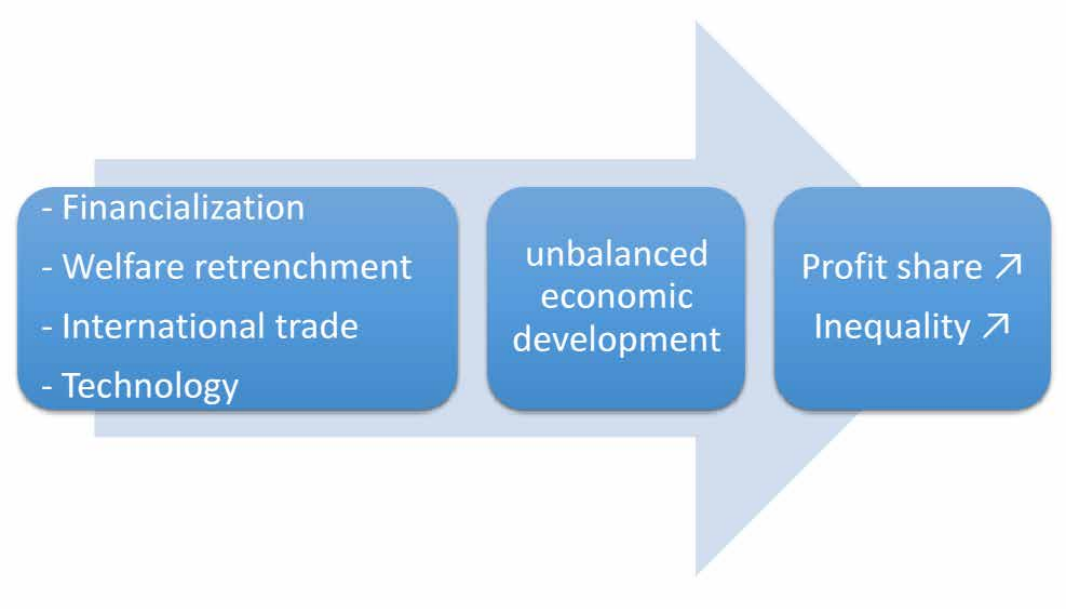
All in all, it seems that labor shares have fallen as much because they are dragged down by globalization and welfare retrenchment, as they are pushed down by the rise of financialization and the rise of the profits / property share.

Top Incomes, Factor Shares and Inequality

Finally, one may go a step further by noting that technology, trade, welfare retrenchment and financialization not only affect the labor shares. They all have in common to lead to biased growth in the sense that they will not affect the whole population *equally*. Welfare retrenchment hurts the poor the most; technological change hurts the unskilled; international trade creates winners and losers; and financialization benefits those who are finance-savvy, connected, and already wealthy. Because of this, technology, trade, welfare retrenchment, and financialization are at the root of another phenomenon: inequality. The link between the relative factor shares and inequality has been suggested recently in ILO (2012), Elsby et al.(2013) as well as in Furceri et al. (2014).

On one hand we have the poor, the unlucky, the welfare-dependent and the unskilled, whose relative positions have worsened; on the other hand we have the skilled, wealthy, lucky and independent individuals, whose relative positions have improved. In practice the middle class falls in the former group, with only top incomes gaining ground recently. The income gap between those two groups has widened and inequality has risen. Thus, the fall of the labor shares and the rise of inequality are but two manifestations of one and the same cause: unbalanced economic growth. The process is described in Figure 13; if this hypothesis is correct, one should see a parallel increase in the property share and inequality. Figure 14 presents the evolution of those two series using the Census Gini for the US and a measure of the property share including the top 1 pecent incomes. Implicitly this means that we treat the top 1 percent as economic rents.

Figure 13 The Unbalanced Growth Process

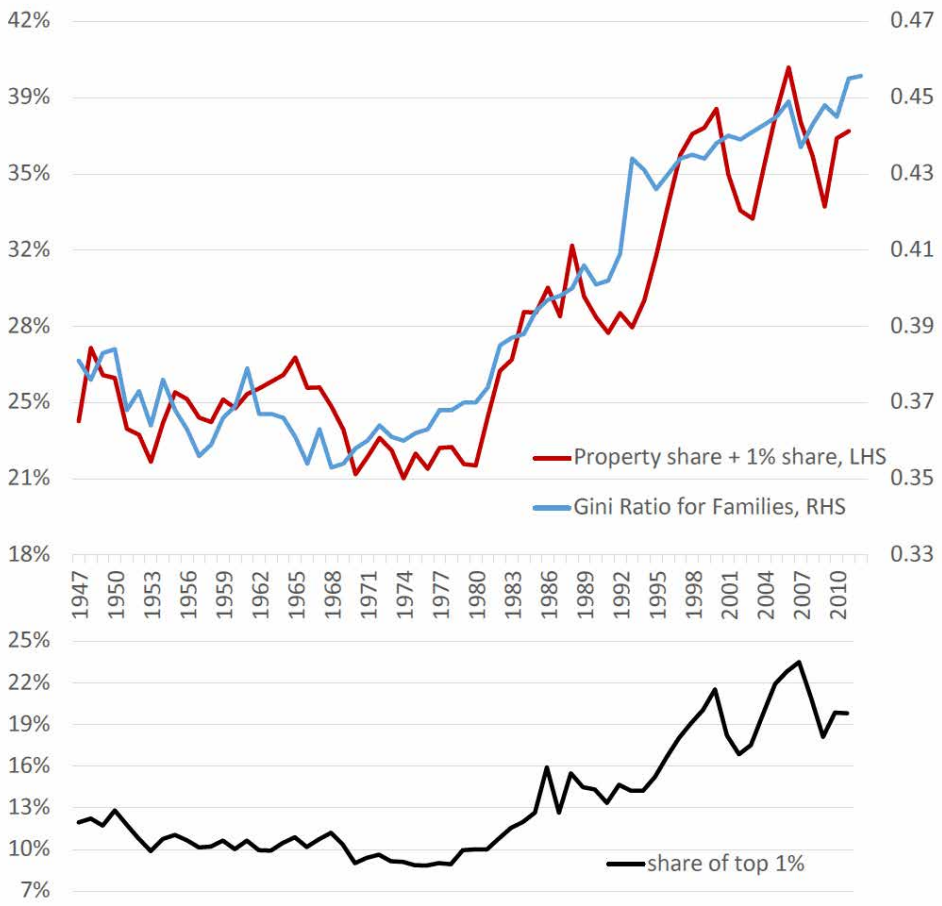


The evolution of the property share and inequality is remarkably parallel. This evolution is best described as period of relative stability from 1947 until the early 1980s, followed by a constant rise thereafter. This is a very peculiar evolution and such cointegration is unlikely to be due to chance. It must be that there is a common driving force, or a set of driving forces. We know what they are:

1. On the one hand, we have the divergence of the top incomes, materialized both in the Gini ratio as well as the property share in Figutr 14; this is the common denominator
2. On the other hand, this study has illustrated the quartet of factors causing inequality and deteriorating factor shares: technology, trade, finance, and welfare retrenchment.

Thus (1) and (2) are the two sides of the same coin. Unbalanced economic growth is mostly manifested through the rise of top incomes, with rising property shares on one side and increasing inequality on the flip-side.

Figure 14 Inequality and the Property Share



Source: Giovannoni (2013b) and Census Bureau Table F4.
Note: a break appears in the inequality series in 1993 due to a change of definitions.

Finally, the finding of the correlation between inequality and property shares allows us to clarify the debate about which channel of inequality is the most potent or likely. The rise of the top 1 percent (and consequently the rise of inequality and the rise of the property share) can be clearly dated to the early 1980s. This date is at odds with the "trade did it" and "technology did it" explanations of inequality, as there is no such corresponding clear-cut date in the evolution of trade and technology. What seems more likely to explain the rise of the property share, the rise of top incomes and the rise of inequality are the other two factors—financialization and welfare retrenchment (the policy channel). And to the extent that financialization was helped, if not created by liberalization policies, it seems that unbalanced economic growth was at least partly the result of a policy choice.

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Working Paper No. 805

What Do We Know About the Labor Share and the Profit Share? Part III: Measures and Structural Factors

by

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Abstract

Economic theory frequently assumes constant factor shares and often treats the topic as secondary. We will show that this is a mistake by deriving the first high-frequency measure of the US labor share for the whole economy. We find that the labor share has held remarkably steady indeed, but that the quasi-stability masks a sizable composition effect that is detrimental to labor. The wage component is falling fast and the stability is achieved by an increasing share of benefits and top incomes. Using NIPA and Piketty-Saez top-income data, we estimate that the US bottom 99 percent labor share has fallen 15 points since 1980. This amounts to a transfer of $1.8 trillion from labor to capital in 2012 alone and brings the US labor share to its 1920s level. The trend is similar in Europe and Japan. The decrease is even larger when the CPI is used instead of the GDP deflator in the calculation of the labor share.

Keywords: Labor Share; Composition Effect; Income Inequality; Top Incomes; Purchasing Power

JEL Classifications: D33, E24, E25

Contents

1 PLUS ÇA CHANGE, PLUS C'EST LA MÊME CHOSE?

> *One of Kaldor's "long-run growth facts" is the relative constancy of labor's share. Indeed, this fact is so ingrained in many macroeconomists that it is almost sacrilege to use an aggregate production function other than Cobb-Douglas, since this production function implies a constant share of income going to labor. That is to say, if labor's share has shown a distinctive trend, it would go against what most macroeconomists store in their bag of facts.*
>
> – Gomme and Rupert (2004), p. 7

In the 1930s, 40s and 50s the topic of the functional distribution of income was frequently debated. Economists were hard at work trying to measure and understand the shares of labor and capital. It is believed that besides measuring the pace of economic activity the question "who gets what" was a proximate reason for the founding of national accounts in the UK and the US (Kuznets 1933, Krueger 1999). Economists were equally as hard at work on theoretical front, trying to find channels that could explain the stability or fluctuations of the observed shares. In particular, the roles of technology, aggregate demand and institutions were highlighted (see Giovannoni 2013a for a survey). The principal problem of political economy was indeed the functional distribution of income (Ricardo, 1817, Atkinson, 2009).

The last landmark contribution from those years of high theory is that of Kaldor (1961), who famously considered the stability of income shares a "stylized fact."[1] For Kaldor, the economy was operating at near full employment, real wages matched labor productivity, and the labor share was constant. For in the 1960s it was clear that economic growth had returned triumphantly, and it was time to move on from distribution to growth theory. The issue of the distribution of income must

[1] Kaldor was hardly the only economist believing in constant relative shares. Before him Keynes (1939) considered the stability "a bit of a miracle... a well-known statistical phenomenon... one of the most surprising, yet best established fact [that] appears to be a long run, and not merely a short period phenomenon". Samuelson (1964) turned this stability into a law, "Bowley's law", referring to the works on aggregate wages and national income of British statistician Arthur Bowley, who first documented the empirical regularity of the labor share c.1900. See Bowley (1900, 1920, 1937).

have felt secondary in those times of broad-based gains and shared prosperity. Income distribution disappeared from the economic discourse for a while before it was "brought in from the cold" (Atkinson, 1997) with a revival of interest for the personal distribution of income in the 1990s.

The *functional* distribution of income didn't experience that revival, and fast forward half a century later after Kaldor (1961), many economists are still considering factor shares constant and the issue secondary. Lucas (2003) finds that "*Of the tendencies that are harmful to sound economics, the most seductive, and in my opinion the most poisonous, is to focus on questions of distribution*." Feldstein (2008), writing as late as 2008, agrees: "*the share of national income going to employees is at approximately the same level now as it was in 1970.*"[2] Greg Mankiw, in his popular introductory textbook Macroeconomics, confirms:

> *Paul Douglas [noticed that] the division of national income between capital and labour had been roughly constant over a long period....More recent US data are also consistent with the Cobb-Douglas production function....Despite the many changes in the economy over the past four decades [the] division of income is easily explained by a Cobb-Douglas production function.*
>
> – Gregory Mankiw (2007), pp. 55-8

Solow (1957) popularized the use of aggregate production functions but also urged caution about their use because the stability of factor shares was "partially a mirage" (Solow 1958). But as the opening quote suggests, the use of the Cobb-Douglas (1928) production functions is widespread these days, and is not the least hindered by the question of whether or not factor shares are constant. For all intents and purposes our theoretical understanding and use of production functions has barely changed during the fifty years that separate us from Kaldor (1961)—on the principle

[2]Kaldor was hardly the only economist believing in constant relative shares. Before him Keynes (1939) considered the stability "a bit of a miracle? a well-known statistical phenomenon? one of the most surprising, yet best established fact [that] appears to be a long run, and not merely a short period phenomenon". Samuelson (1964) turned this stability into a law, "Bowley's law", referring to the works on aggregate wages and national income of British statistician Arthur Bowley, who first documented the empirical regularity of the labor share c.1900. See Bowley (1900, 1920, 1937).

that factor shares are, indeed, constant. It is as if the question of distribution had been divorced from that of production.

However, things are starting to change on the empirical side. This is mostly because of the greater availability, over the past decade, of income share statistics. By now we have accumulated evidence for labor shares exhibiting a worldwide downward trend since the early eighties (see the Stockhammer 2013 ILO report for a survey) –the trend seems to have accelerated for some countries over the past decade. This burgeoning inductive literature seems to provide a consensus that biased technological change, international trade, welfare retrenchment / liberalization and above all, financialization, are responsible for the fall in labor shares (see Giovannoni 2014b for a survey).

Interestingly, the renewed interest in factor shares has not taken place in academic circles as much as it has within international organizations and government institutions. Examples include:

- The International Labor Organization (Lübker 2007, Hein and Mundt 2012, Lavoie and Stockhammer 2012, World of Work Report 2011 and 2012, Global Wage Report 2012)
- The United Nations (Cornia 2005, Boushey and Weller 2006, Van Der Hoeven 2010, Rodriguez and Jayadev 2010, Lindenboim 2011, UNCTAD 2012)
- The IMF (Guscina 2006, Jaumotte and Tytel 2007, World Economic Outlook 2007a,b)
- The Federal Reserve (Gomme and Rupert 2004, Jacobson and Occhino 2012a,b)
- The Council of Economic Advisers (Economic Report of the President 2012 and 2013),
- The European Central Bank (Lawless and Whelan 2007)
- The European Commission (Arpaia et al. 2009)
- The OECD (OECD 2012, Bassanini and Manfredi 2012)
- The Bank for International Settlements (Ellis and Smith, 2007)

The issue of the functional distribution of income has also started to permeate the related field of sociology (Lin and Tomaskovich-Devey 2013, Kristal 2013a,b).

This paper is part of this renewed literature and makes the following contributions. In section 2, we start by crossing various datasets to derive what we believe to be one of the first estimates of the *nationwide national* labor share for the United States. We compare this new measure to alternative datasets and provide international comparisons and conclude that the American labor share is surprisingly nearly constant. I note, however, that this is a statistical illusion and that much is happening within the aggregate—Solow(1958)'s "mirage." Section 3 presents the adjustments for various composition effects, including feminization, purchasing power and top incomes. Section 4 concludes.

Two comments are required before diving into the exposition. First, statistical agencies usually report components of aggregate income such as wages, benefits, proprietors' income, net interest, rents and corporate profits.[3] Thus there is no straightforward counterpart to the wages/profits/rents dichotomy used in economics. In practice not all types of income can easily be ascribed to either capital or labor, and we will spend some time explaining how we can make such difference.

Second: in matters of the functional distribution of income, it is especially important to define the terms precisely. There is a certain vagueness in the discourse—such as calling the "wage share" what is really a labor share—that should be addressed from the outset. To remedy this vagueness let's recall that an income "share" depends upon its numerator and its denominator. The denominator is commonly GDP, GDI, national income, or value added. For comparison's sake we will almost always report the shares in the same aggregate, which we choose to be the net national income (NNI, or "national income at factor cost"): GDP minus indirect taxes, minus capital consumption, minus statistical discrepancy plus net foreign income. The choice of numerator leads to the distinction between:

[3] as well as secondary types of income which are either very small flows, constant through time, do not have an immediate economic meaning, and/or are not the focus of the present study. Incomes of this type are such as business current transfers and payments, taxes on production and imports, taxes on corporate profits, subsidies, and capital consumption.

- The wage share is the share of wages for a chosen measure of income;
- The compensation share includes wages and benefits;
- The labor share consists of wages, benefits and an estimate of the labor component of proprietors' income (see below).

Thus, depending on the choice of numerator and denominator, one can end up with a variety of "shares" that need not tell the same story, hence why this paper tries to provide evidence from different angles and different measures. The first two are generally easy to get; the labor share, less so.

Similarly one should be careful what we call the complement to unity of the labor share. The "capital share" is a misleading term in empirical applications, and the term "profit share" stands for corporate profits only. Following national accounting practices the complement to unity of the labor share will be called the "non-labor share," or better, the "property share."

2 ESTIMATING THE NATIONAL LABOR SHARE

The renewed popularity of the factor shares over the past decade appears to follow the publication of US data by the Bureau of Labor Statistics (BLS) showing a labor share of income falling over the last 30 years (see Figure 1).

Figure 1 which should now be familiar to many, presents the official data for real hourly wages, hourly labor productivity, and the labor share. The latter is the ratio of the former two, at each and every time t:

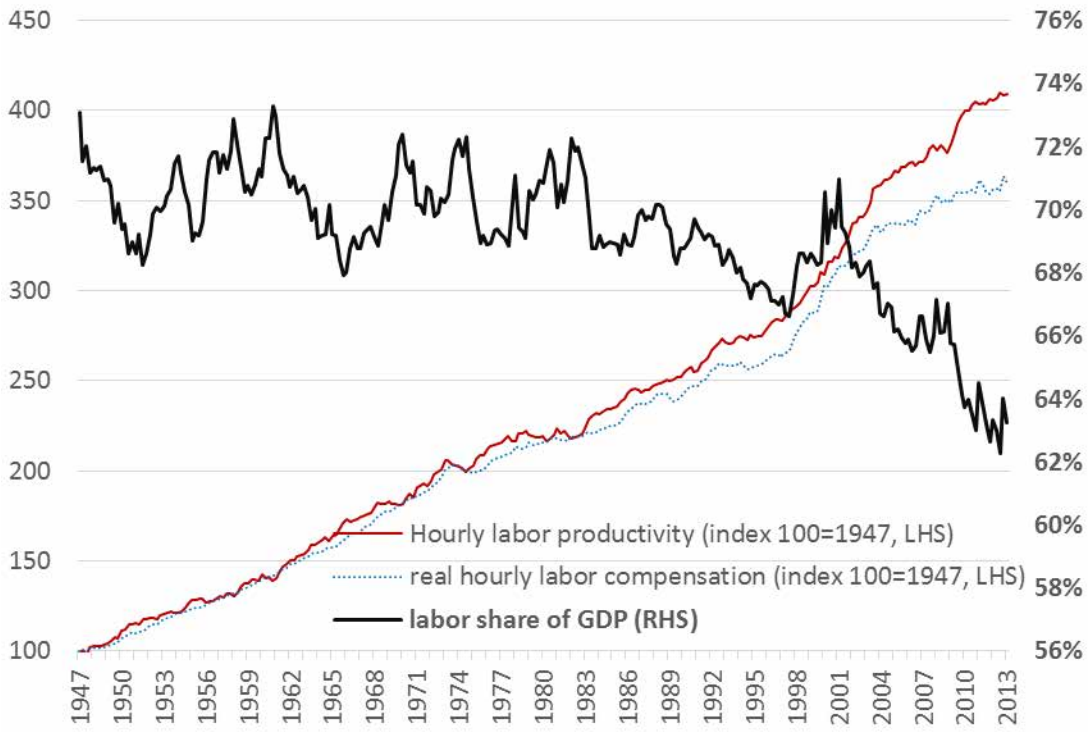
$$\alpha_t := \frac{W_t}{Y_t} = \frac{w_t N_t}{P_t Q_t} = \frac{w_t}{P_t} / \frac{Q_t}{N_t} \text{ so that } \alpha_t = \frac{w_{r,t}}{A_{L,t}} \tag{1}$$

Where α_t is the labor's share, W_t is total labor income, Y_t is a measure of income, w_t is the nominal rate of labor income (i.e. wage rate or nominal compensation), N_t is the level of employment (in Man-hours), P_t is the overall price level, Q_t is a measure of output, $w_{r,t}$ is real labor income and $A_{L,t}$ is the productivity of labor.

The numerator and denominator of the last ratio are presented in Figure 1; this is how the BLS computes the labor share.[4] The hourly basis of compensation and productivity is convenient because any change in work duration is de facto accounted for. Based on this data, the labor share has been roughly constant from 1947 to approximately 1983, and declining since then. But one measure is scarcely enough for a generalization. There is a wealth of information to gain from a deeper empirical investigation, and investigation that has not, to this day, and to our knowledge, been extensively carried out.

[4] The BLS uses published and unpublished data to arrive at these results. In particular the BLS adjusts for proprietors' income by assigning the average compensation in the sector to proprietors. This assumes that the compensation share is the labor share for proprietors. See BLS handbook of Methods, chapter 10, available at http://www.bls.gov/opub/hom/

Figure 1 Productivity, Real Compensation and the Labor Share of GDP in the US Nonfarm Business Sector



Source: Author's calculations based on the Bureau of Labor Statistics, Multifactor Productivity (MP) and Labor Productivity and Costs (LPC) databases.
Note: Compensation and productivity data have been rescaled to indices 100=1947 to facilitate comparison. The labor share values were obtained by scaling the index values of the LPC database (base 100=2005) by the MP database value of the labor share in total cost of .656 for 2005. Those are estimates to the extent that the MP database includes energy costs as a factor of production which is excluded on the basis of being an intermediate good/service in the LPC database.

2.1 Alternative Data Sources

There are three reasons we want to derive a series of alternative labor shares. The first is that the definition of a labor share is not clear-cut. The results will be different depending on the definition of "labor income" and the choice of the denominator, and the choice of the coverage (the whole economy or a subset).

The second reason is the opacity of the BLS measure, which consists of published (but highly aggregated) and unpublished data. The lack of detail makes it impossible to break down the series or to understand how the index has been created, and on what assumptions.

The third and most important reason is that the BLS labor share covers the nonfarm business sector only —a far cry from the whole economy. The BLS data exclude the general government, nonprofit institutions, paid employees of private households, and the rental value of owner-occupied dwellings (Ryan 2011). *Together, those exclusions represent approximately 20% of national income, or $2.6 billion in 2011, which is nontrivial.*[5]

The reasons advanced by the BLS for the exclusion of those sectors is that their value added is not clear—not that the value doesn't exist, just that it's hard to measure. However, the sectors excluded consist mostly of compensation, so including those sectors will affect the labor share positively—to what extent requires the calculations presented below.[6] This is also real money received by a sizeable fraction of the population with real macroeconomic consequences.

Notwithstanding the issue raised by the BLS, one may want to derive a more comprehensive measure of the labor share, at the national level. To my knowledge this is a task that hasn't been tackled so far, at least not in a systematic way (except an attempt in Giovannoni, 2006).

[5] See NIPA tables 1.10 - 1.14 and 7.9 for the magnitude reported.

[6] For instance employee compensation is the only form of income for the whole government sector; there are no interest, rents, proprietors' income or profits reported for this 20% chunk of the economy.

Traditionally, raw US data come from the National Income and Product Accounts (NIPA) and is then treated by the BLS—again, not very transparently—to extract the labor share presented above. In the past five years or so, three new international datasets have been made available by the OECD, the European Commission and the United Nations, increasing data availability. Primary sources:

- **NIPA:** The National Income and Product Accounts, compiled by the Bureau of Economic Analysis—a branch of the Department of Commerce. Several tables present data that are relevant to the analysis of the distribution of income but tables 1.10, 1.11 and 1.12, in particular, stand out. Most of the time the data are available on a quarterly basis since 1947 and beginning in 1929 on an annual basis, making the US one of the countries with the best data coverage.
- **BLS:** The Bureau of Labor Statistics, a branch of the Department of Labor, computes a labor share of income in its two databases "productivity and costs" as well as "multifactor productivity". The data is provided on a quarterly basis from 1947 at best, and for different meta-sectors of the economy.

Secondary sources:[7]

- **AMECO:** The Annual Macro-Economic database of the European Commission's Directorate General for Economic and Financial Affairs (DG ECOFIN), presents labor share series on an annual basis for European countries, groups of European countries, as well as the United States. Starting dates vary but most data starts in 1960.
- **OECD-SULCI:** the System of Unit Labor Costs Indicators of the Organisation for Economic Co-operation and Development. The data is available annually for 46 countries or economic areas. The OECD effort mostly consists in compiling labor share data from participating countries' system of

[7] I exclude databases not covering the US or not providing enough data to derive the whole-economy labor share. Examples include the KLEMS database ("capital, labor, energy, materials and service inputs," European Commission) who presents evidence at the industry level.

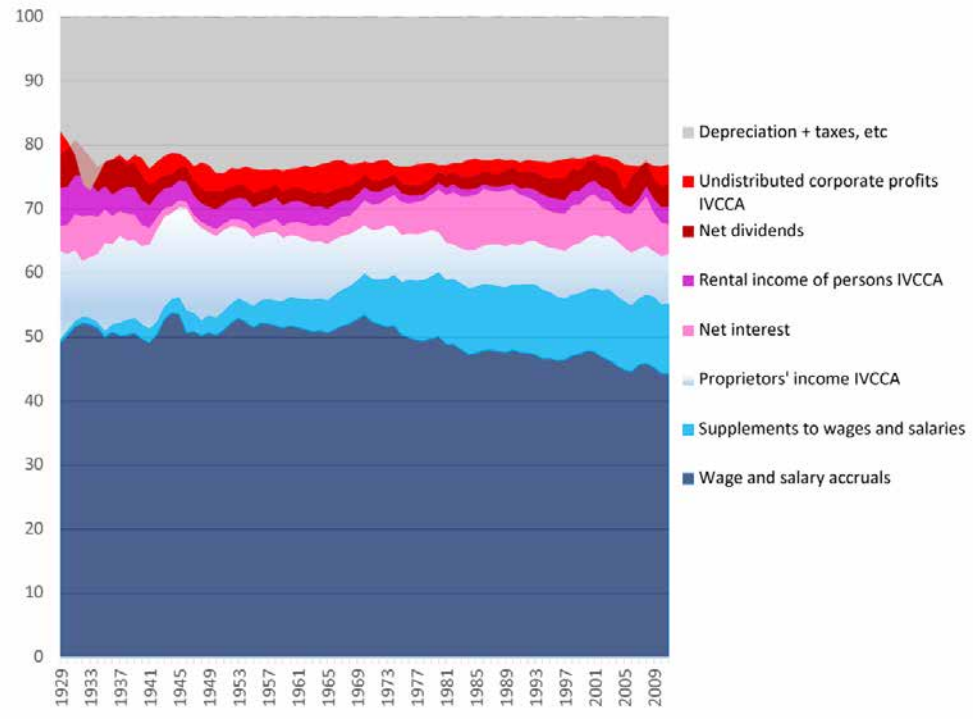
national accounts, and harmonizes it so that data is as internationally comparable as possible.

- **UNSNA:** The United Nations System of National Accounts provides a compilation of data of national accounts from member countries and provides adjustments in order to make the data comparable.

The best *nationwide* data for the US can be found at the source, in NIPA Table 1.11 "Percentage Shares in National Income" and is plotted in Figure 2. We immediately see that the share of depreciation, taxes, business transfer payments and subsidies did not change much over the past 80 years. This is surprising; changes in tax receipts (tax cuts) must have matched the changes in depreciation charges (computers depreciate faster). Given the quasi-absence of movement we are better off talking about the relative shares in net national income, which we do in Figure 3, using a simple technique of mixed income apportionment described below.

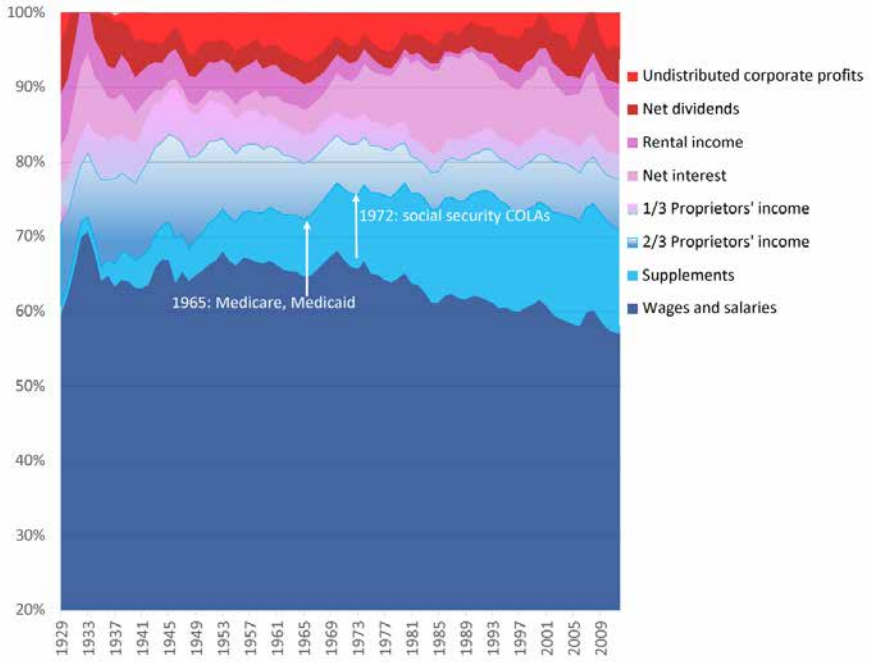
Figure 2 and Figure 3 hint at an important composition effect. The share of wages has been falling since the early 1970s, while the share of benefits has risen since the late 1960s. NIPA Table 7.8 shows that the growth in benefits is almost entirely due to the increase in cost of two benefits (retirement and health care; see Figure 4). The only plausible explanation I find that matches the timing is the expansion of social security.

Figure 2 Percentage Shares of Gross Domestic Income



Source: Annual data from NIPA Table 1.11

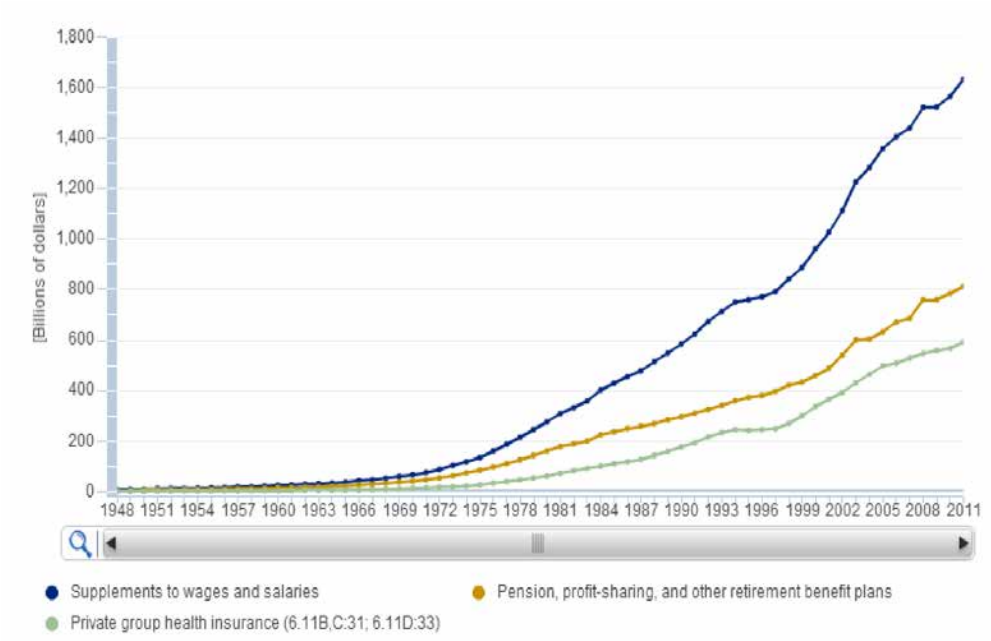
Figure 3 Income Shares of Net National Income, with Proprietor's Income Apportionment



Source: Annual data from NIPA table 1.11 and author's calculations

The fall of the wage share while the benefit share is increasing makes it look as if there has been substitution of one for the other. This does not necessarily mean that employers lowered wages as a result of higher hiring cost due to the creation of Medicare and Medicaid; in fact this question is outside of the scope of the present paper. I will only note that the extension of social security started in 1965 and wages only started to decline starting around 1973. Thus it seems more likely that the oil shocks and resulting inflation led to wage moderation and a fall of the wage share starting in the 1970s. The rise of the share of benefits around this time prevented a fall in the labor share, i.e. existing Federal programs stabilized the distribution of income –which is what those programs were partly intended to do.

Figure 4 Employee Benefits and Two Major Contributors



Source: NIPA Table 7.8

2.2 Apportionment of Proprietors' and Mixed Income

A traditional problem with Figure 2 is that it is an incomplete picture of the labor share unless the labor component of mixed income is extracted and added up. Whereas corporate profits and compensation of employees are unambiguously capital income and labor income, respectively, the case of proprietors' income is less clear-cut (Kuznets 1933, Johnson 1954). Below we present five ways to apportion this "entrepreneurial income."

Johnson (1954): 2/3rds Rule

Figure 3 presents a simple Johnson (1954) solution to this problem: allocate two-thirds of proprietor's income to labor and a third to property. This is a fixed-weight rule of thumb.

Gollin (2002): Assuming Identical Wage Rates

Another apportionment consists in assigning the same average wage to each and every worker regardless of him/her being an employee or self-employed (proprietor). The formula for the labor share becomes (see Gollin 2002).

$$\alpha = \text{employee compensation} \cdot \frac{workforce}{\#employees} / Y \qquad (2)$$

The resulting labor share may be a lower bound, for self-employment covers professions such as doctors, consultants, lawyers and heads of business whose income is more likely to be above the market average than below.

Gomme and Rupert (2004): Assuming Identical Wage Shares

In a famous article Gomme and Ribert (2004) present a way of apportioning "ambiguous income" between "capital" and labor. First the authors recognize that there are incomes which are either unambiguously labor (Y_{UL} = compensation of employees) or unambiguous capital (Y_{UK} = corporate profits, rental income, net interest and depreciation).Second, they assume that the labor share within ambiguous incomes (Y_A = proprietors' income

plus indirect taxes less subsidies) is the same as in the rest of the economy, i.e., ($\alpha = \alpha_A = Y_L / Y$). In that case, total labor income Y_L *is*

$$Y_L = Y_{UL} + \alpha Y_A \tag{3}$$

But Y_L is also

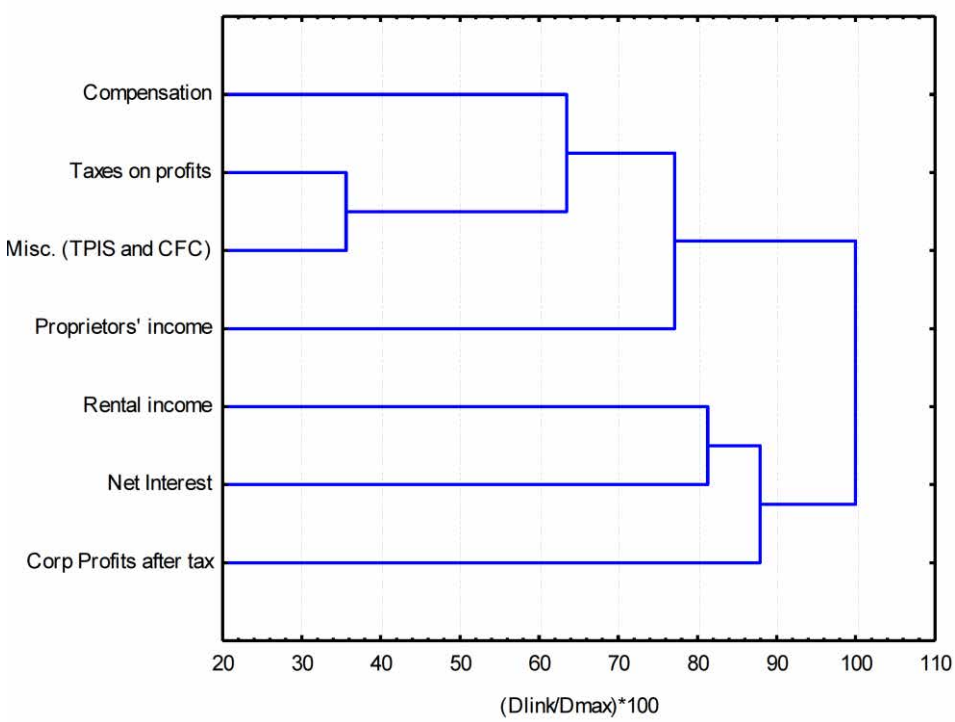
$$Y_L = \alpha Y = \alpha (Y_{UL} + Y_{UK} + Y_A) \tag{4}$$

Subtracting the two equations and solving for the labor share we get

$$\alpha = \frac{Y_{UL}}{Y_{UL} + Y_{UK}} \tag{5}$$

Both the Gollin (2002) and the Gomme and Rupert (2004) are variable-weights apportionment methods.

Figure 5 Tree Diagram for Seven Types of Income, 1953-2013



Source: author's calculations. TPIS and CFC stand for taxes on production and imports less subsidies and consumption of fixed capital

Cluster Analysis

An original method consists of using cluster analysis to split proprietors' income. Consider the fact that at each and every point in time a certain amount of each type of income is generated in the economy. Proprietors' income may be related to those other types of income in a certain way, i.e. it may consist of a certain amount of profits and a certain amount of wages. Thus

$$\text{Propinc} = f\,(\text{comp, net interest, rental, corp profits, } \ldots)$$

Cluster analysis can be applied to the dataset in order to find affinity between variables. The way to proceed is to consider the rate of change of each variable since each variable is *I(1)*, and to standardize each variable (to avoid affinity by standard deviation). Cluster analysis provides the classification tree reported on Figure 5, where shorter distances between variables indicate greater affinity.[8]

Table 1 Apportionment Using Regression

Dependent Variable: DLOG(PROPRIETORS)
Method: Least Squares with Breaks
Sample: 1953Q1 2013Q1
Included observations: 241
Break type: Bai-Perron tests of L+1 vs. L sequentially determined breaks
Break selection: Trimming 0.15, Max. breaks 5, Sig. level 0.05
No breakpoints selected
HAC standard errors & covariance (Bartlett kernel, Andrews bandwidth)
Allow heterogeneous error distributions across breaks

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLOG(COMP)	0.681531	0.242069	2.815446	0.0053
DLOG(PROFAT+RENTAL+NETINT)	0.073194	0.054194	1.350590	0.1781
C	0.002152	0.004042	0.532428	0.5949

R-squared	0.081313	Mean dependent var	0.014067
Adjusted R-squared	0.073593	S.D. dependent var	0.025726
S.E. of regression	0.024761	Akaike info criterion	-4.546692
Sum squared resid	0.145924	Schwarz criterion	-4.503313
Log likelihood	550.8764	Hannan-Quinn criter.	-4.529215
F-statistic	10.53267	Durbin-Watson stat	1.789548
Prob(F-statistic)	0.000041		

[8]The analysis was run using Ward's method of classification with Euclidian distances, and the graph has been normalized by the largest affinity = 100.

Regression Analysis: Constant Elasticities

A regression of proprietors' income on other types of incomes was run and no significant break date could be found, so there is little reason to expect the 77/23% split to have greatly changed across the sample (see Table 1). The regression indicates that proprietors' income is much more related to compensation, with a highly significant and a large coefficient (.68, t-stat 2.82), whereas the property coefficient is small and significant only at 15% confidence (0.07, t-stat 1.35). Those results conform to the results from cluster analysis and to the literature in ascribing a greater share of proprietors' income to labor.

Summary

Figure 6 presents the five labor shares corresponding to the five alternative methods of mixed income apportionment described above, plus the original Gomme and Rupert (2004). All shares are in net national income (or "at factor cost") except for this last measure, which is a labor share in GNP. All methods give very similar results except for the Gollin (2002); this may be due to our use of full employment equivalent measures where employment series should have been used instead. Figure 7 presents the labor share using the average of the top four apportionment methods, i.e. leaving the Gollin (2002) and the original Gomme and Rupert (2004) series aside. This mixture of fixed-weight and flexible-weight methods is our baseline labor share estimate.

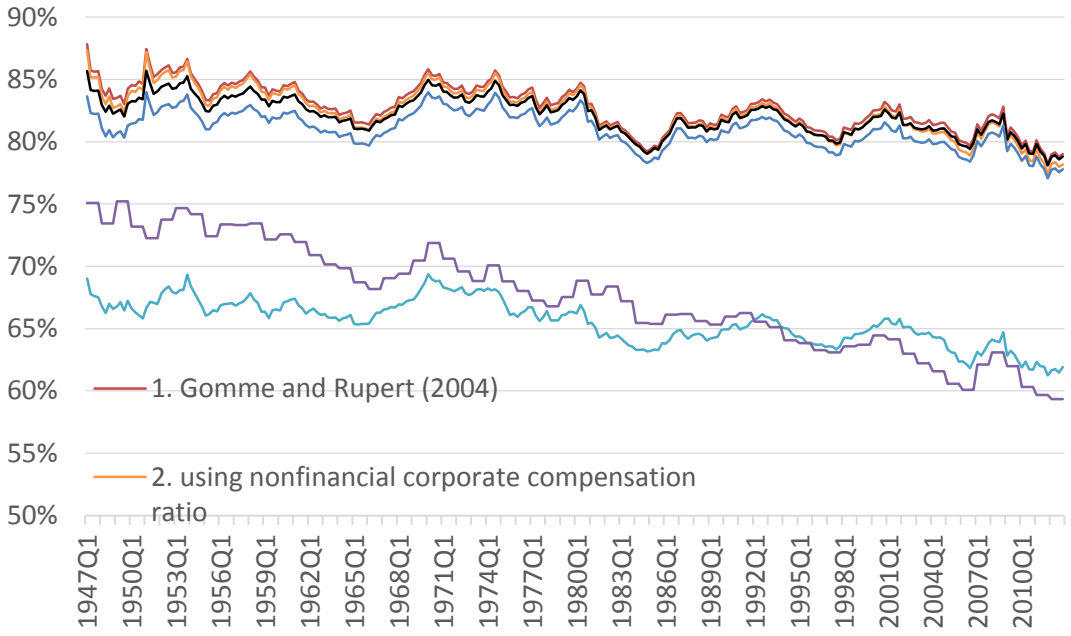
Figure 7 depicts a labor share estimate that has been remarkably constant at about 78–84% of NNI (or 62–69% of GNP). This is most striking because today's economy and structure is vastly different from that which prevailed some 80 years ago; yet the share of income accruing to labor has remained roughly within a 5-point corridor (Keynes 1939, Solow 1958). In terms of a trend, the constancy of the relative shares seems to validate the use of Cobb-Douglas production functions. In terms of the level, also, the rule of thumb in choosing 2/3rd or 3/4th as the exponent to factor "labor" seems to have hit the bull's eye. Were we right all along, and nothing happened since Kaldor (1961)?

Our contention is that much has happened to the *composition* of the labor share.

2.3 Robustness Check and International Comparisons

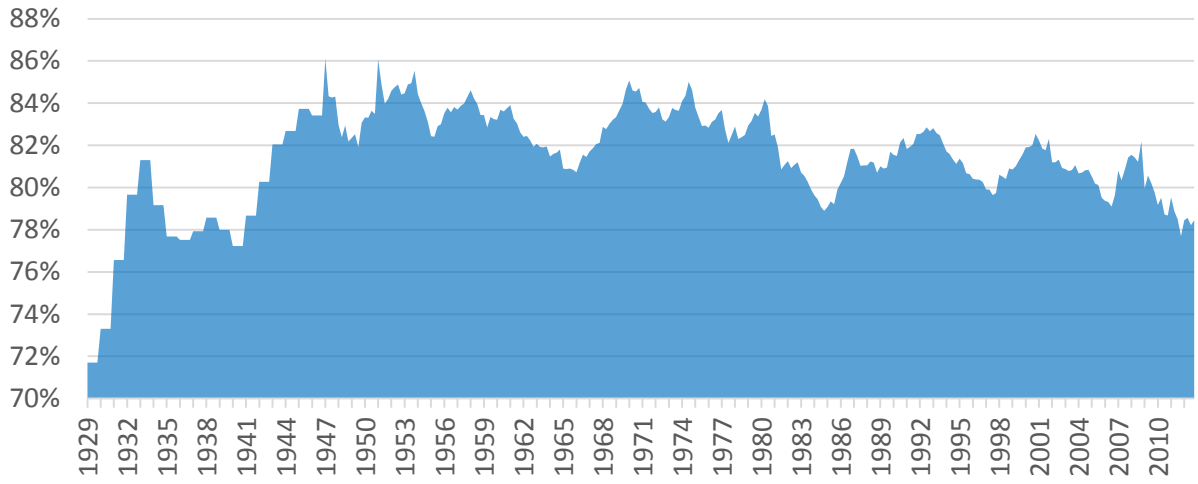
So far, our inquiry has been conducted without placing it into context. Before moving on we need to compare our results to alternative data series (which use a different methodology) and to the experience of other countries (which may have fared differently). In order to provide an apples-to-apples comparison we will make use of the international datasets mentioned in section 2.2. It is worth stressing that comparing the same measure (the labor share) across datasets will invariably introduce small discrepancies—mostly because of different definitions, methods, and scope.

Figure 6 National Labor Shares Estimates Using Alternative Proprietors' Income Apportionments



Source: author's calculations based on NIPA Table 1.10

Figure 7 Estimated US Labor Share Based on NIPA Data



Source: author's calculations

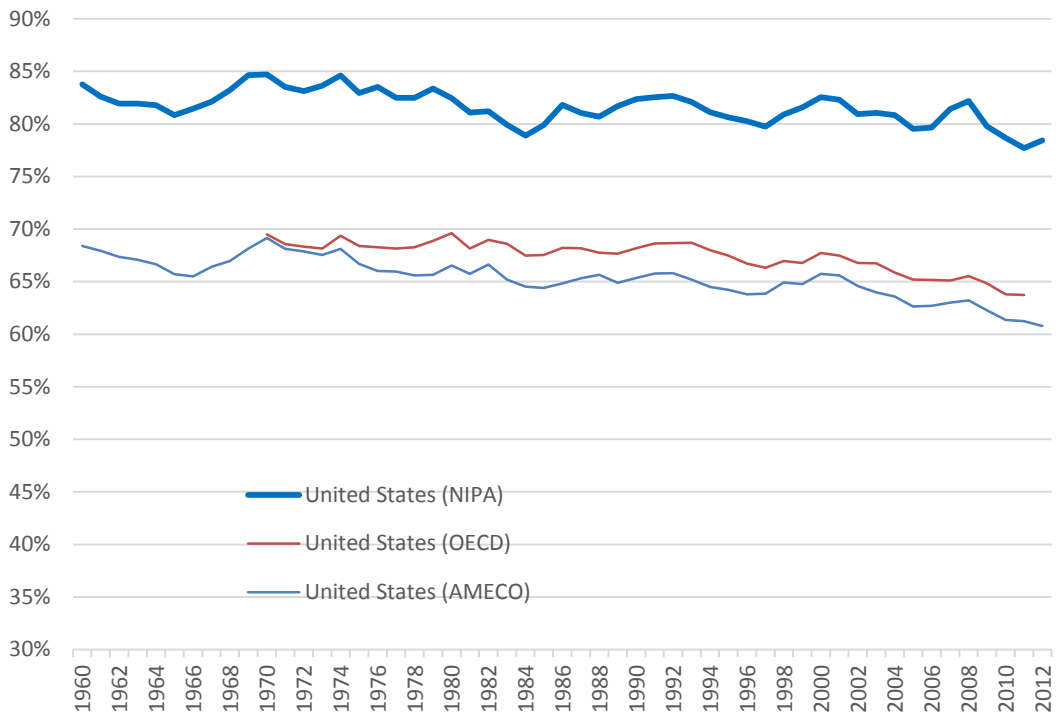
Comparison with Existing Datasets

Figure 8 presents a comparison between our measure of the US labor share and that provided by the OECD and the European Commission. Our measure is in line with those alternative datasets; all paint the same picture of a quasi-constant labor share fluctuating within a 5-point corridor of whatever measure of income is used. The correlation between our measure and existing datasets is high, ranging from 0.72 with the OECD measure, to 0.85 with the AMECO measure with a median correlation of 0.78 with the BLS measure (which considers only the nonfarm business sector, not reproduced here, see Figure 1).

Our labor share estimate has several advantages over existing measures. First, it provides greater coverage than anything else available. Our measure starts in 1929 using annual frequency and in 1947 using quarterly frequency, which is far ahead of the earliest start date (1960, AMECO). Plus, there simply isn't any quarterly data available besides our own except, again, for the BLS measure plotted on Figure 1, valid for the private sector only, and only available beginning in 1947. Second, our measure provides a middle ground in terms of methodology as it comes from the average of four alternative mixed income apportionment methods, while alternative labor share sources only use one method, generally assuming identical wage rates across the board (AMECO, OECD). Third, our measure is more transparent; all the details of our measure were presented in the pages above. Fourth, because our

measure is transparent it is decomposable. It is easy to understand that the complement to unity of our measure is the "property share" and we have shown what the share includes. All in all, our measure of the labor share has very desirable properties and is strongly correlated with the existing data.

Figure 8 Comparison of Alternative Data Sources for the US Labor Share



Sources: as indicated on graph; NIPA compiled by the BEA (author's calculations, see above), AMECO by the European Commission.

International Comparisons

Figure 9 presents a comparison between the US labor share and the labor shares in Mexico, Canada and Japan (top panel) and the UK, France and Germany (bottom panel). The US and Canada present the smoothest evolution and the greatest stability. While most countries experienced a rise in their labor shares in the 1970s following the oil shocks and the growth slowdown, the American and Canadian labor shares remained remarkably constant. Similarly, all other countries' labor shares fell in the 1980s, partly as a compensation for their previous rise, although the fall went further. It is not uncommon to see labor shares 10 points below their pre-1980 levels by 2006. The 2008 crisis elevated European labor shares again by the same mechanism

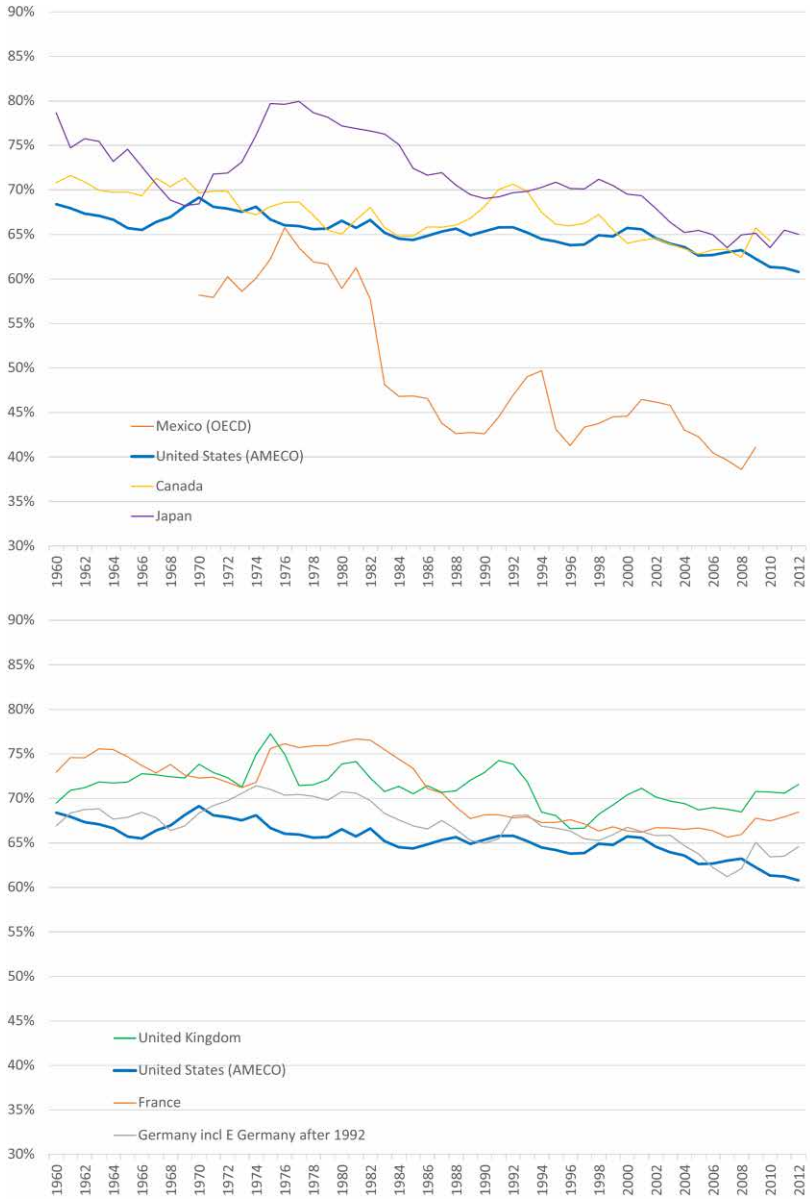
that prevailed in the 1970s, namely that output fell faster than real wages. Overall, therefore, one is presented with the image of labor shares exhibiting substantial variation, especially if one talks in terms of billions of dollars, euros, pounds or yen instead of percentage points. Labor shares, however, are generally not violently unstable. They tend to fluctuate within a 10-15-point range, exceptionally more, as in the case of Mexico in the early 1980s. And within this relative stability the US and Canada presents the most stable labor shares. Why this is the case is beyond the scope of this paper.

Another way to look at the data is to compare the United States to Europe and Japan as separate blocs. This can be done by superimposing our measure of the labor share on data from the AMECO database, as in Figure 10. Again the American labor share stands out as the most stable. However if one deducts the top 1% incomes from the US labor share its evolution becomes similar to that of Japan and Europe (see section 3.3 below). Overall the bottom 99% labor share in the U.S., and the economy-wide labor shares of Japan and the EU-12 have fallen by about 10-15% of net national income.

3 COMPOSITION EFFECTS AND ADJUSTMENTS

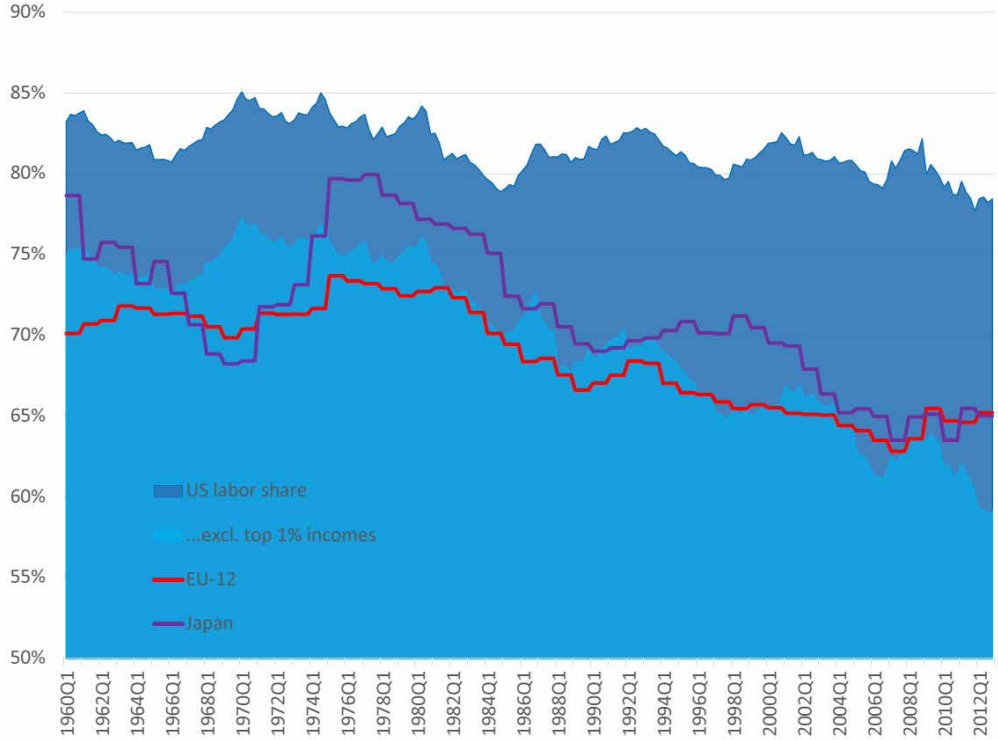
A point which has not been addressed so far in the literature is the effect of structural changes. When the economy's structure changes, the labor share experiences a composition effect and we expect the labor share to change due to structural, as opposed to purely economic, reasons. We are interested in seeing if some of the major structural changes having occurred over the past few decades were of sufficient magnitude to sway our conclusions as to the stability of the labor share.

Figure 9 The US Labor Share in International Perspective



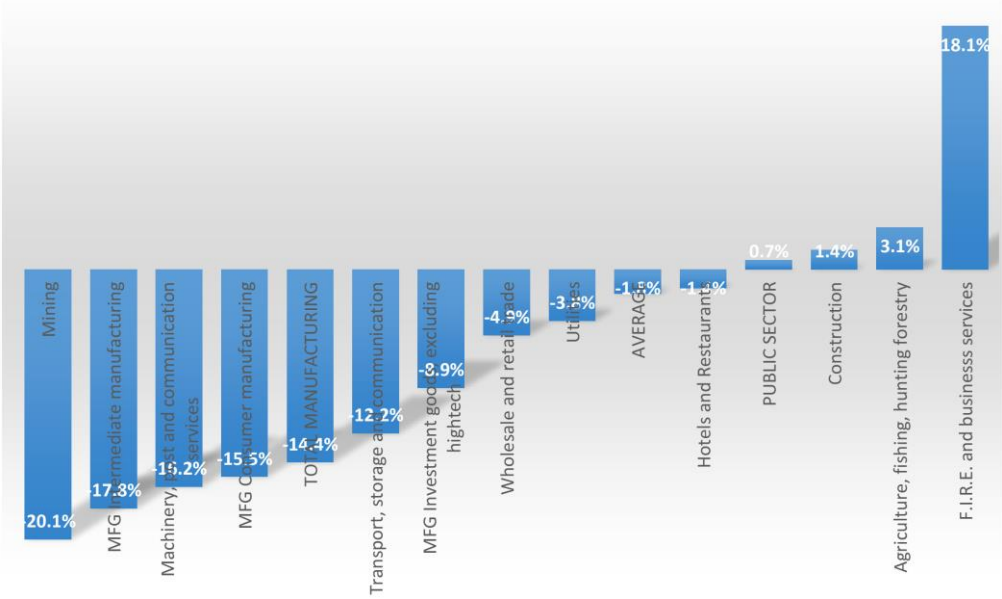
Source: See text

Figure 10 The American Labor Share, Compared



Source: for US data: Bureau of Economic Analysis NIPA and author's calculations; for European and Japanese data: European Commission AMECO (quarterized).

Figure 11 Change in the Compensation Share, 1977–2007



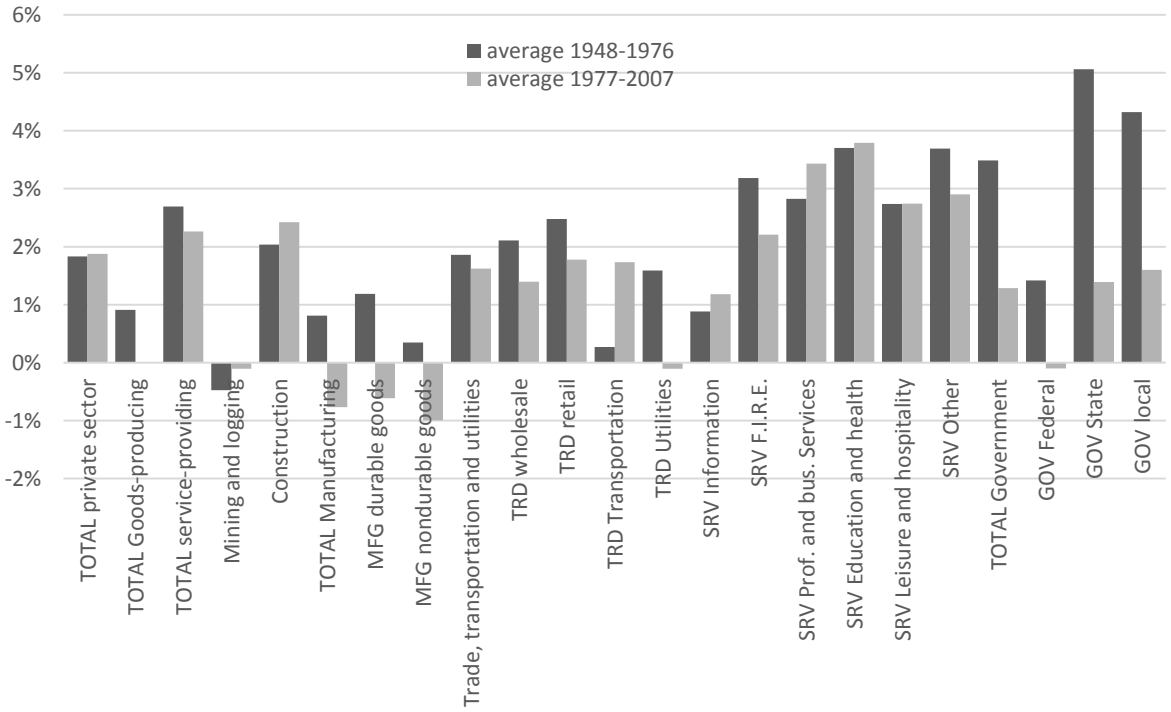
Source: EU-KLEMS and author's calculations. The compensation share is in gross value added.

3.1 Sectoral Changes

The first type of structural change is the generic one which relates to changes in the weight of sectors in the economy. Over time, certain industries lose employment and others gain; the overall labor share will go up if the net job gains occur in sectors with a higher labor share. To assist the reader in grasping this sectoral composition effect, Figure 12 presents average employment changes by sector and Figure 11 presents the changes in the observed compensation shares.

Figure 11 indicates that the compensation shares in trade, utilities, hospitality, construction and agriculture industries remained relatively constant. Besides those sectors, we are left with as polarized a picture as possible, with a large compensation share drop in manufacturing (-14 points) and a large gain in finance (+18 points). Both sectors have about the same average weight in value added over the sample, so gains of one canceled out the losses from the other, on average. Overall the sectoral shares show much variation but they seem to cancel out at the aggregate level (Solow 1958). Indeed the average change of the US compensation share over 1977-2007 has been a mere -1.8 points.

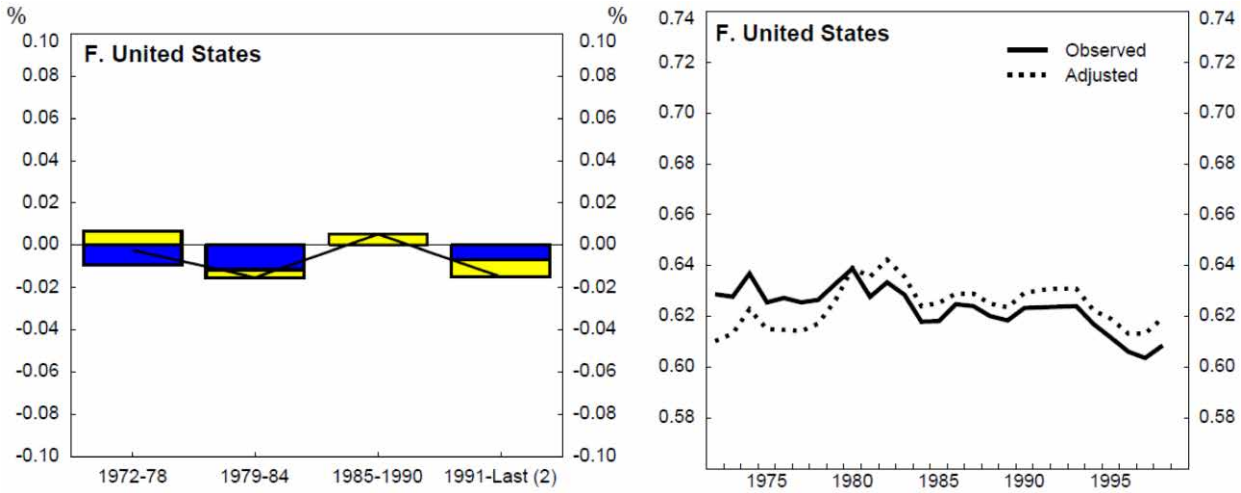
Figure 12 Average Yearly Job Changes, 1979–2012



Source: BLS and author's calculations

There are other points to note beyond this remarkable stability. The first is that the drop in manufacturing's compensation share happened with job losses (Figure 12), while the increase in finance's compensation share took place with average employment growth. Much research is still needed into the causes, but those trends are compatible with a trade / technology-displaced-workers explanation in the manufacturing sector (see Elsby et al., 2013) and a skills-biased technological change, or monopoly power, explanation in the finance industry. The disaggregated data point to the many reasons for the fall in the US labor share. Second, Figure 12 points to the erosion of manufacturing and public sector employment and a reinforcement of the service sector. So overall the employment shift is that from higher wages, higher unionization sectors to lower wages, and lower unionization sectors. The slowdown in government hiring is particularly noticeable.

Figure 13 Estimates of the Composition Effect



Source: de Serres et al. (2002), whole economy estimates. Blue represents the effect of changing sector weights, i.e., the composition effect, while yellow indicates the effect of changing labor shares within sectors.

We may have a better look still at the composition effect by proceeding to a shift-share decomposition (Arpaia et al. 2009, de Serres et al. 2012). By definition, the aggregate labor share α_t is the average of all sectoral labor shares α_{it} weighted by w_{it}, the weight of sector i in total value added:

$$\alpha_t := \frac{W_t}{Y_t} = \frac{\sum W_{it}}{Y} = \frac{\sum \frac{W_{it}}{Y_{it}} Y_{it}}{Y} = \frac{\sum \alpha_{it} Y_{it}}{Y} = \sum w_{it}.\alpha_{it} \tag{6}$$

where W denotes labor income. Differentiating with respect to time, we get the shift-share:

$$\Delta\alpha_t = \underbrace{\sum \bar{w}_{it}.\Delta\alpha_{it}}_{\text{effect of varying shares within sectors}} + \underbrace{\sum \Delta w_{it}.\bar{\alpha}_{it}}_{\text{effect of changing sector weights}} \tag{7}$$

which states that the overall wage share can come from the changes in sectoral labor shares when sector weights remain constant, or from changes in sector weights when labor shares remain constant. In other words, the first summation represents changes in sectoral labor shares, while the second summation represents the effect of a change in sectoral composition.

Arpaia et al. (2009) and de Serres et al. (2002) look at the composition effect for a panel of OECD countries and find that generally the composition effect is dominated by the sectoral shares effect. However, in the case of the US the composition effect has been strong: de Serres et al. (2002) estimate that about 50% of the variation in the labor share is due to changing sector weights, as opposed to falling labor shares within sectors. De Serres et al. (2002) find that when the composition effect is removed, the US labor share becomes even more stable (see Figure 13). Thus there is a sizable composition effect consisting in labor moving across sectors, in particular towards less unionized and more service-oriented, but this is hardly the reason why the labor share fell.

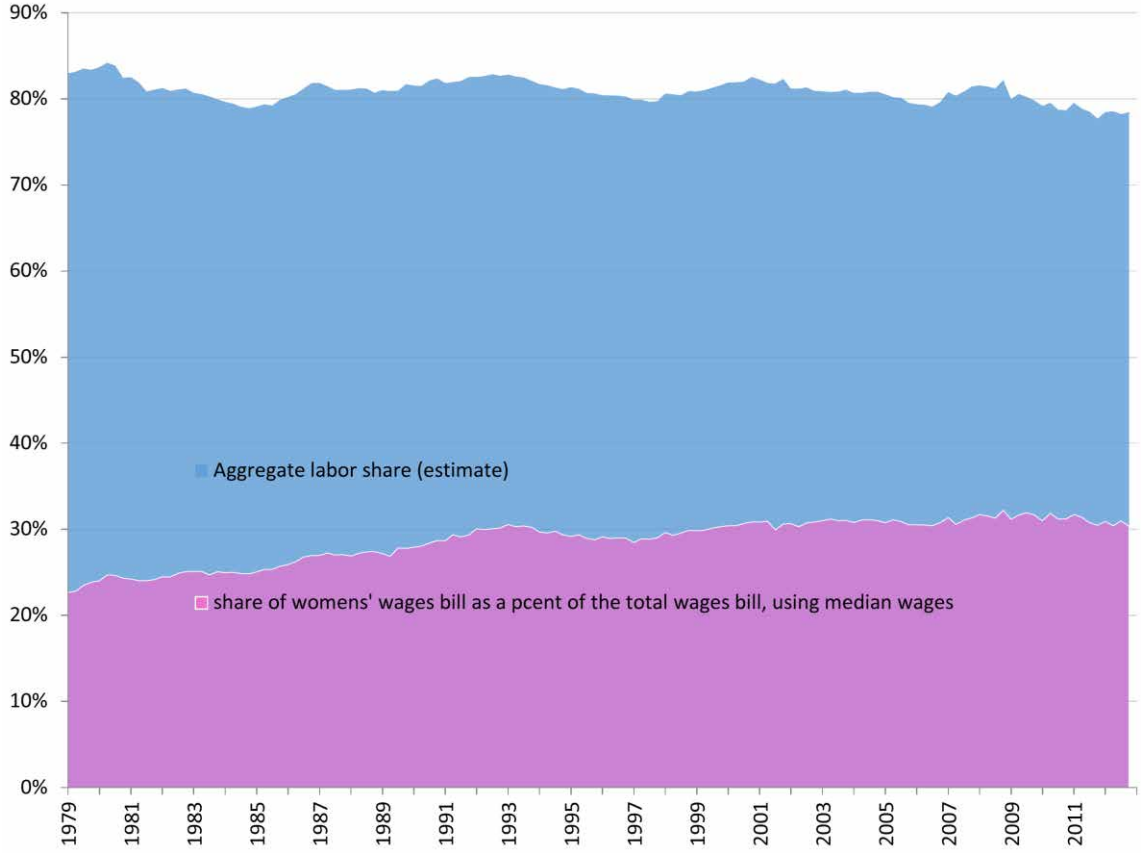
3.2 Feminization

A major structural change of the last half century is the greater participation of women in the labor force. Comparing the labor share of 2013 to that of 1980 is not an apples-to-apples comparison because of this greater participation and because women's incomes are only a fraction of men's. We expect the labor share with greater women participation to be lower.[9]

There is no official data presenting a breakdown of the labor share by gender, so we will have to make do. Figure 14 represents the aggregate labor share together with a measure of feminization of the labor force; the women's share of income is women's employment times women's median wage, all as a percentage of aggregate income. The measure is not perfect but it may still hold clues. Until 1990 the aggregate labor share has remained quasi-constant while women were participating more and women's relative wage was increasing, but after 1990 the overall labor share started to fall while feminization remained constant. Thus in the case of the United States, feminization and labor share are not very much correlated. At most, we can say that women's greater participation stabilized the labor share by preventing it from falling further, which it would have done if the labor force consisted only of men.

[9] A note of caution should be made. An adjusted labor share is purely a thought experiment made under many assumptions, especially that the "alternative scenario" was a possibility. Thus, any gap between the actual and adjusted labor share should not be taken at face value; better use the gap magnitude as an indication of how strong the composition effect, or structural change, has been.

Figure 14 Labor Share Adjusted for Wage Differential



Source: BLS Data and author's calculations

An alternative approach is presented in Finnoff and Jayadev (2006), who use regressions to study the correlation between feminization and the labor share in a panel of countries, using different control variables acting as proxies for welfare retrenchment, trade unionism, protectionism, capital openness, the unemployment level and the degree of labor market flexibility. All variables are statistically significant to the labor share, but the share of women in the labor force is consistently (across specifications) highly significant and with a large estimated coefficient, varying between -0.27 and -0.68. Thus Finnoff and Jayadev prove our expectation correct: there is strong negative correlation between feminization and the share of labor. If the US doesn't seem to exhibit such a strong correlation it may because other variables are left out of the analysis, such as the share of the top 1%. Further examination of the specific case of the US is required, but this is beyond the scope of the present paper.

3.3 Purchasing Power

A third adjustment can be made to measure the purchasing power of labor. We are, after all, not so much interested in what the labor share looks like, but more interested in how much labor can buy. By definition, the labor share $\alpha_t = \frac{w_{r,t}}{A_{L,t}}$ is deflated by the GDP deflator[10] while "purchasing power" is a concept traditionally assessed using the CPI deflator. In normal circumstances both deflators would be growing at the same pace so that which deflator is used wouldn't matter. However, the CPI and the GDP deflators have not evolved jointly in recent decades (see Figure 15). The evolution of the IPD and the CPI was parallel until 1980 but the two measures started to diverge thereafter, with the CPI growing faster –a cointegration break if you will. Thus, the labor share and the purchasing power of labor have diverged since 1980; the purchasing power of labor is actually lower than what the labor share indicates. Another way of looking at this is to consider the decomposition

$$\alpha = \frac{wN}{p_{GDP}Q} = \underbrace{\frac{wN}{p_{CPI}Q}}_{\substack{\text{purchasing}\\ \text{power of}\\ \text{labor}}} \cdot \underbrace{\frac{p_{CPI}}{p_{GDP}}}_{\substack{\text{rel. price}\\ \text{of wage}\\ \text{goods}}} \tag{8}$$

When the two deflators are the same the labor share measures the purchasing power of labor. But when the CPI grows faster the purchasing power of labor is lower than the observed labor share, and part of the observed labor share is driven by the relative price of consumption goods. This finding echoes that of Karabarbounis and Neiman (2013) who find that roughly half of the worldwide fall in corporate labor shares has been due to the fall of the relative price of investment goods.

[10] In what follows I call GDP deflator what is also known as the implicit price deflator or IPD, and more particularly I refer to its consumption component, the personal consumption expenditure (PCE) deflator. The Consumer Price Index (CPI) measures inflation for a basket of consumption goods and is measured for urban households. The CPI tracks actual inflation pretty well (see the MIT's billion price project at http://bpp.mit.edu/usa/).

Where does the CPI and PCE discrepancy come from? For starters, both are computed in different ways by different statistical agencies, as Table 2 illustrates. Then comes the coverage: by construction the CPI does not cover the price of capital, which declined since the 1980s. Another difference seems to come from the higher weights given to housing and gas in the CPI, making it more realistic of a price index for the majority of the (urban) population. The GDP deflator seems more appropriate to higher incomes for whom shelter and gas are smaller fractions of total expenditures, and for whom the price of capital matters most.

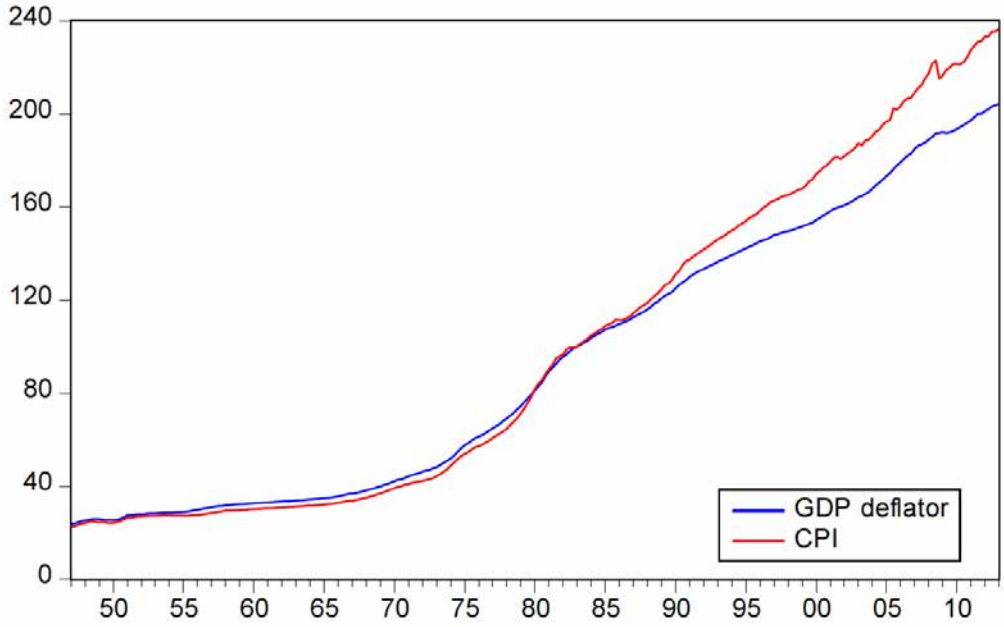
Table 2 Some CPI and PCE Differences

	CPI	**PCE**
Computed by	BLS, Dept of Labor	BEA, Dept of Commerce
Type of index measure	Laspeyres	Fisher superlative. Accounts for product substitutions
Weights	Consumer expenditure survey	Census surveys
Scope	All urban households	All households and nonprofits
Features	• Only household out-of-pocket expenses are counted • Larger shelter and gas weights	• Full cost and price is reflected in the index • Smaller shelter and gas weight

Source: BLS (2011). PCE stands for Personal Consumption Expenditure deflator, which is the "consumption" component of the IPD.

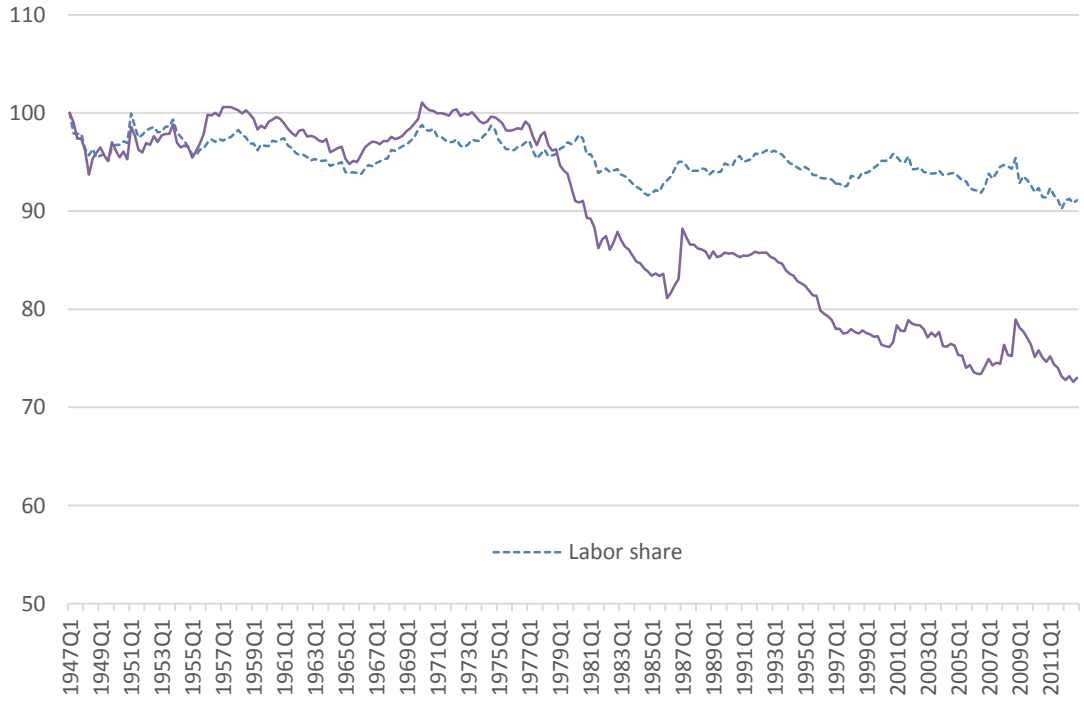
When one takes the labor share of the bottom 99% incomes and deflates this with the CPI instead of the GDP deflator, one gets Figure 16, which indicates a drop of about 20% of purchasing power in 2013 compared to 1980. Half of that drop is due to the rise of the top 1% incomes, and the other half to a higher deflator. Thus, prices and their measurement play a large role, possibly as large as the increase of inequality. The magnitude of the fall of the labor share could as well have been under-reported so far in this paper, and the fall could be as much as 20% when one compares purchasing power.

Figure 15 The CPI and GDP Deflators



Sources: GDP and PCE deflator from the NIPA, CPI-U for all urban consumers from the BLS. Data has been indexed base 100 in 1947 to facilitate comparisons.

Figure 16 Purchasing Power of the Non-top 1% Labor Share



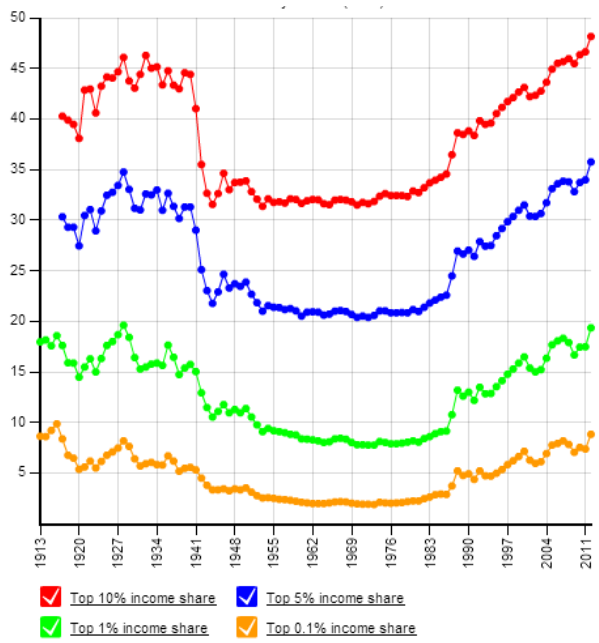
Source: See text

Table 3 Top Income Thresholds and Average Incomes, 2012

	Income threshold, 2012	Average income, 2012
Top 10%	$112,000	$254,000
Top 5%	$158,000	$378,000
Top 1%	$372,000	$1.022m
Top 0.1%	$1.55m	$4.661m
Top 0.01%	$7.205m	$21.269m

Source: World Top Incomes Database of the Paris School of Economics (Piketty and Saez, 2006)

Figure 17 Top Income Threshold Shares



Source: World Top Incomes Database of the Paris School of Economics (Piketty and Saez, 2006)

3.4 Top Incomes

One of the most striking features of the last decades has been the worldwide rise of top incomes. This is a particularly strong feature in the United States and has been well documented in the World Top Incomes Database (Piketty and Saez, 2007)—see Table 3 and Figure 17. The World Top Incomes Database presents annual data, for many top incomes thresholds, for the average income, the income share, as well as the distribution of such income in wages, rents, interest, etc. The National Income and Product Accounts (NIPA), Table 1.10 presents data for aggregate incomes since 1929 on an annual basis and since 1947 on a quarterly basis. Together, NIPA data and the World Top Income Database allow us to devise relative shares for non-top incomes, over the long period.[11]

[11] The correspondence between categories of income between the two datasets has been carried the following way. In the Piketty and Saez (2006) dataset, "wages, salaries and pensions" was

The Labor Share and Top Incomes

It may be interesting to see how the rise in top incomes weighs on our measure of the labor share: what would the labor share be for the bottom incomes? Figure 18 presents the results. What we find is that the income reported as wages by top incomes is a substantial part of aggregate income, and that subtracting those wages from the aggregate labor share significantly alters it. We find that the labor shares for the bottom 90%, 99% and 99.9% have decidedly fallen since the early 1980s, so much so that the labor share is lower today than at any other period since 1930. The fall took place over 1980-2012 and it is substantial, ranging between 8 and 18 points of the net national income, depending on which top income category is retained. This is the equivalent of an annual transfer of $1 to $2.25 trillion from labor to "capital" (using 2012 data). Recall, for comparison, that our best estimate of the aggregate labor share has it falling 5 points of net national income over the same period. Thus, whatever the forces shape the labor share, one of the most powerful is the concentration of incomes at the top.

The Property Share and the Top 1%

Another decomposition can be provided, this time on the property side. What would the property share be if one treats the top 1% of incomes as economic rents? Figure 19 provides the answer, this time using quarterly data to provide more light to the recent era. We find a very similar story—indeed, complementary; the property share was remarkably stable from the postwar period until 1980 and started rising thereafter. The reason for this increase is not to be found in profits (corporate or noncorporate), which have remained constant—though they are currently on their historical upper bound. All in all, about 5% of the increase of the property share can be ascribed to different types of income, to which one must add 10–15% due to the rise of the top 1% and their capital gains.

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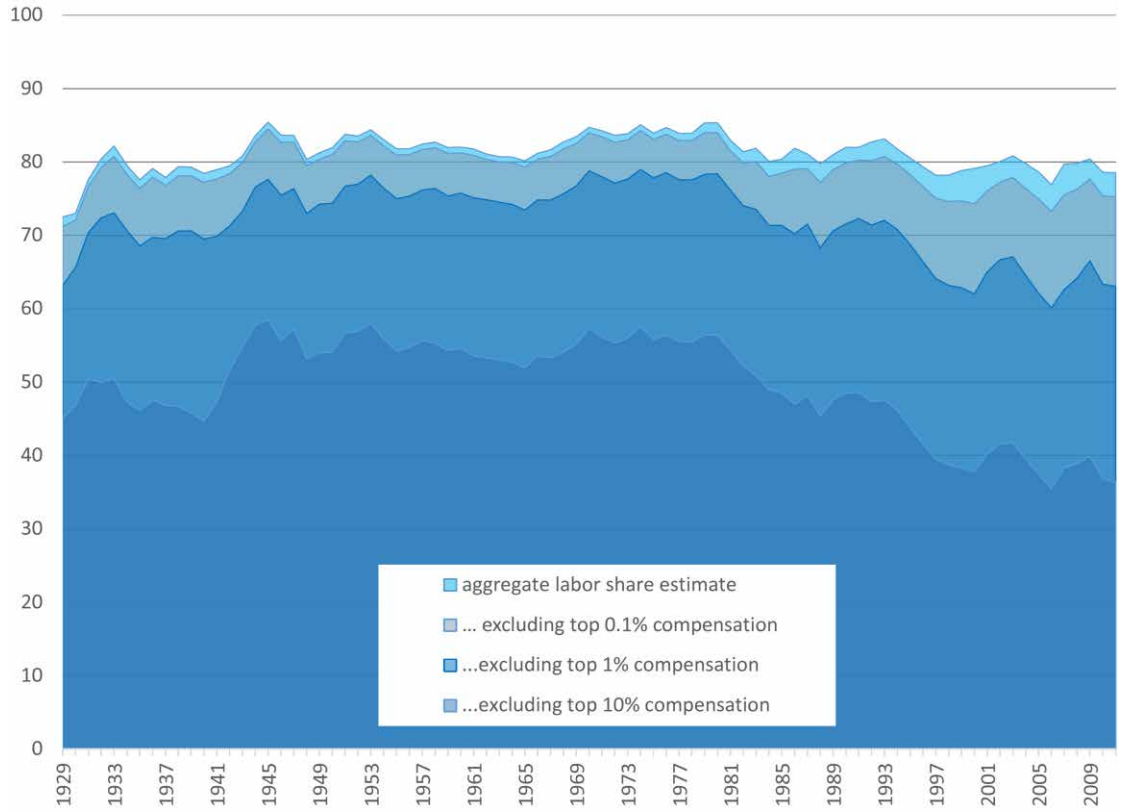
understood as including benefits (=NIPA's "compensation"), while "entrepreneurial income" was understood as being mixed income, hypothesized to generously consist of 2/3 wages and 1/3 profits.

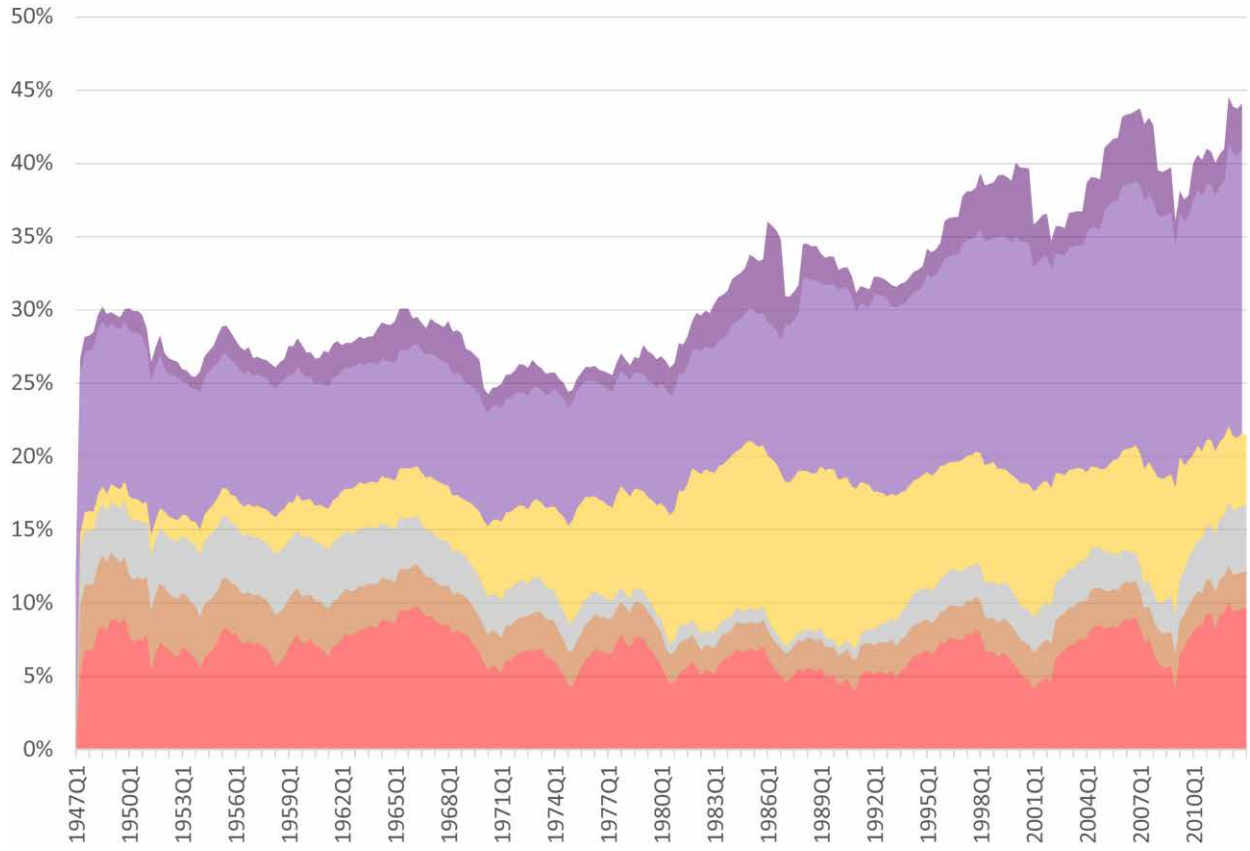
Figure 18 The Aggregate Labor Share and the Contribution of Top Incomes, 1929–2011



Source: Author's calculations based on NIPA data and the World Top Incomes Database of the Paris School of Economics (Piketty and Saez, 2006) available at http://topincomes.parisschoolofeconomics.eu

Note: Each labor share is the ratio [(1) - (2)]/(3) where (1) for the whole economy: employee compensation plus 2/3rd proprietors' income (Johnson 1954 adjustment), (2) is the is the same measure for the top x%, and (3) is the National Income net of taxes, subsidies and depreciation.

Figure 19 The Aggregate Property Share: Contribution of the Profit Share and the Top 1% Income



Source: Author's calculations based on NIPA data and the World Top Incomes Database of the Paris School of Economics (Piketty and Saez, 2006) available at http://topincomes.parisschoolofeconomics.eu
Note: noncorporate profits, or the profit component of self-employment value added, was derived using Johnson (1954) 1/3rd rule. However the whole top 1% income share was added.

4 CONCLUDING REMARKS

In this paper, we used a variety of datasets to derive a dense series of labor shares for the whole US economy. The constancy of the share over the past 70 years is a remarkable feat in itself which deserves the qualification of "a bit of a miracle" (Keynes, 1939). However, the aggregate labor share also suffers from important composition effects so that the miracle is at the same time "a bit of a mirage" (Solow, 1958). Within the aggregate, financial and top incomes grew tremendously at the expense of labor compensation, at the pace of 15 points of net national income or $1.8 trillion in 2012 alone. It is not that labor compensation has fallen in relative terms; all evidence points to most gains going to the top incomes and a muddling through middle-class. As a result, the average American worker has experienced a triple squeeze: (1) overall, there is relatively less money going to labor; (2) of the "labor money," less is going to the bottom 99% as wages; and finally (3) the purchasing power of the bottom 99% wages has gone down due to higher-than-assumed inflation.

Our findings have clear implications for future research. As far as economic theory is concerned the proximate implication is that, while the use of constant-shares production functions may be acceptable, their use with the sole purpose of estimating production is missing the big composition effect and the polarization of incomes at the top. Thus, it is hard to continue to divorce the questions of distribution from those of production. With such a tremendous change in the distribution of factor rewards underlying the function, one might expect income distribution to have implications for production as well. Indeed there seem to be links between income concentration, inequality and instability. This is the realm of "inequitable" or "unbalanced" growth, the implications of which we are only starting to understand (Krugman 2007, Galbraith 2012, Palley 2012, Reich 2013, Stiglitz 2012).

Another contribution simply lies in the data this paper provides, which can be used for various theoretical and empirical inquiries. The data would serve the purpose mentioned above—that is to identify the channels through which inequality, factor shares and instability play out, if at all. The rich dataset presented in this paper can also be used to find determinants and correlates of the factor shares themselves

and, for that purpose, quarterly data is much preferred. The labor share data can also be used for research in international trade, or anywhere (real unit) labor costs matter. That, alone, could be the topic of a separate paper.

Our findings also have clear practical and policy implications beyond the ones suggested above. First, again, presenting the evidence allows for better informed policy. Knowing how much labor has lost to "capital" can be useful. Knowing that government programs such as social security have helped stabilize the labor share can be useful. Knowing that the worsening position of labor is not so much due to corporate profits increasing but rather the top 1% increasing, could be of practical importance for tax design. In those days of political polarization, economic policy decisions have ultimately proven to be as much about politics as economics, if not more; but perhaps better data can lead to a more informed discourse.

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