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Elasticity of substitution and social conflict: a structuralist note on Piketty's *Capital in the Twenty-first Century*

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This paper presents a structuralist analysis of the elasticity of substitution between capital and labour, with an application to the US economy. The paper shows how the elasticity of substitution is an aggregated residual parameter, as well as how fluctuations of it can be explained in terms of technological, distributive, demographic and demand shocks. Then, based on a 2 × 2 dynamical model for the wage share of income and the employment rate, the paper analyses Thomas Piketty's theoretical proposition that the functional distribution of income may not be stationary.

Key words: Income distribution, Structuralist macroeconomics, Goodwin, Piketty
JEL classifications: B50, E11, E12, O51

1. Introduction

The translation of Thomas Piketty's (2013) book into English had an important impact on the US economic media and academia. Even though economists have known the work of Piketty on the World Top Incomes Database (Atkinson *et al.*, 2011) for a while, the style, breadth and policy proposals of Piketty's book caught everyone's attention to the risk of rising income inequality, especially in the USA and other English-speaking economies. It is too early to know the impact of Piketty's book on economics, but so far it has managed to put income distribution at the centre of mainstream economic research, using new data sources and traditional tools of analysis. This is no small feat if we recall that, for a large part of the profession, it is common practice to dismiss questions of income distribution as poisonous (Lucas, 2004).

In terms of the history of economic thought, Piketty's book represents a return to the analytical tradition of political economy, which combines history, theory and policy in one comprehensive study of economic issues. In fact Piketty's main arguments can be divided into three blocks that reinforce each other, but that also stand alone. First, on data, the World Top Incomes Database contains many interesting patterns and information on capital and labour income, which in turn are compatible with alternative

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theoretical explanations, mainstream and non-mainstream. One does not need to agree with Piketty's theoretical or policy propositions to benefit and use his dataset. Second, on theory, Piketty's hypothesis that the functional distribution of income is not necessarily stable as the capital–labour ratio increases is an issue to be debated theoretically and tested empirically. Again, one does not need to agree with Piketty's dataset or policy proposals to test whether or not the elasticity of substitution of capital for labour is equal to one. Third, on policy, Piketty's defence of a global tax on capital does not depend on rising inequality, either from data or from theory. The distribution of income and wealth can be stable and still very unequal, which is usually not compatible with democracy. The crucial justification for Piketty's policy proposal is, actually, that high income inequality increases social tensions and destabilises democratic regimes.

The objective of this paper is to analyse the theoretical part of Piketty's book from a heterodox perspective. As we will see, it is perfectly possible to analyse the changes in the functional distribution of income without assuming perfect competition or that income is determined from the supply side. Piketty's data and policy proposition are also compatible with a theoretical view based on effective demand and social conflict, which are characteristic features of structuralist macroeconomic models.[1] Our first step is to show how one can obtain the elasticity of substitution from the national income and product accounts (NIPA) of any economy.

2. Accounting identities and the elasticity of substitution

Consider an open economy and assume, as usual in the NIPA, that the net domestic income at production prices consists of the compensation of employees and the net operating surplus. For simplicity, assume further that the net operating surplus is private capital income and let Y be the net domestic income, then:

$$Y = \omega L + rK \tag{1}$$

where ω is the real wage, L employment, r the rate of profit and K the capital stock.[2] All real variables are scaled by the price index of Y.

Next, consider the usual mainstream simplifying assumptions that each factor of production receives its marginal product under perfect competition. In this case:

$$\hat{K} - \hat{L} = \sigma(\hat{\omega} - \hat{r}) \tag{2}$$

where σ is the elasticity of substitution of capital for labour and $\hat{X}$ represents the continuous growth rate of X, for any variable X.

Now, to illustrate Piketty's (2013) assumption about the technology of production more easily, equation (2) can be rewritten as follows:

$$\left(\hat{\omega} + \hat{L}\right) - \left(\hat{r} + \hat{K}\right) = \left(\frac{1-\sigma}{\sigma}\right)(\hat{K} - \hat{L}) \tag{3}$$

[1] In the 'family tree' of economic thought, structuralist macroeconomics is a direct descendant of post-Keynesian and development economics. For a survey of its main ideas and methods, see Taylor (2004).

[2] Economists usually assign part of proprietors' income to labour income, but we do not need this for our theoretical considerations. Part of the net operating surplus can also belong to the government, due to government enterprises, but this does not alter our analysis substantially.

In the terminology of mainstream economics, when it is 'easy' to substitute capital for labour ($\sigma > 1$), the increase in the capital stock per worker raises the capital or profit share of income. When the opposite happens ($\sigma < 1$), raising the volume of capital per worker increases the labour or wage share of income. Thus, the change in the functional distribution of income seems to be a purely technological issue from equation (3).[3]

From a heterodox economics point of view, is there an alternative scenario that is consistent with the data? The answer is yes and the starting point is the 'macrofoundation' given by equation (1) instead of the 'microfoundation' assumed by equation (2). To observe this, note that from equation (1) the rate of profit is:

$$r = (1 - \psi)u \tag{4}$$

where $\psi = \omega L / Y$ is the wage share of income and $u = Y / K$ is the income–capital ratio. Then, from the very own mathematical definition of r, ψ and u:

$$\left(\hat{\omega} + \hat{L}\right) - \left(\hat{r} + \hat{K}\right) = (\hat{\omega} - \hat{\xi}) / (1 - \psi) \tag{5}$$

where $\hat{\xi} = \hat{Y} - \hat{L}$ is the growth rate of labour productivity.[4]

We do not need any aggregate production function or any assumption about perfect or imperfect competition to obtain equation (5), it comes from the NIPA definitions. Combining equations (2) and (5), we obtain the aggregate elasticity of substitution:

$$\sigma = (\hat{K} - \hat{L}) / \left[(\hat{K} - \hat{L}) + \left(\frac{\hat{\omega} - \hat{\xi}}{1 - \psi} \right) \right] \tag{6}$$

In other words, equation (6) means that, for any change in the capital–labour ratio, the elasticity of substitution is greater than one when there is a fall in the wage share of income ($\hat{\omega} < \hat{\xi}$). The opposite holds when the wage share increases. In both cases, organising the analysis in terms of the elasticity of substitution of an aggregate production function limits the explanation of changes in the functional distribution of income to just one residual parameter.

The heterodox alternative to equation (2) is to organise the discussion in terms of effective demand and social conflict. In this context, the wage share of income can change because of technology, as in mainstream models, but it can also change because of demand and distributive shocks not related to technology. To see how, our second step is to present a simple model that explains the dynamics of the wage share of income.

[3] For an alternative explanation of Piketty's results that is consistent with neoclassical theory but does not depend on $\sigma > 1$, see Rowthorn (2014), available at http://www.cbr.cam.ac.uk/fileadmin/user_upload/centre-for-business-research/downloads/working-papers/wp462.pdf. According to Rowthorn, most empirical studies find $\sigma < 1$ and Piketty's results come from a valuation effect, i.e. 'a disproportionate increase in the market value of certain real assets'.

[4] To obtain equation (5), note that $\hat{r} = \hat{u} - \hat{\psi}[\psi / (1 - \psi)]$ from equation (4).

3. Astructuralist model of employment and distribution

The heterodox literature on growth and distribution usually revolves around a macroeconomic model with two state variables: one for the functional distribution of income and another for the level of economic activity.[5] The most usual choices are the wage share of income, on the distribution side, and the income–capital ratio, on the demand side. The basic framework can incorporate more state variables, which increases complexity and results in multiple equilibria.[6] For the purpose of this note, we will use the simplest version of two variables to interpret the change in the functional distribution of income analysed by Piketty.

Starting with distribution, from our previous definitions the change in the wage share is simply:

$$\dot{\psi} = \psi(\hat{\omega} - \hat{\xi}) \tag{7}$$

where $\dot{X}$ is the time derivative of X, for any variable X. Equation (7) is an accounting identity. To introduce economic theory into it, we need to assume that the real wage and labour productivity are functions of income distribution and the level of economic activity. For simplicity, we will use the wage share itself to measure the distribution of income and set the rate of employment as our index of economic activity.[7]

More formally, let $\lambda = L / N$, be the ratio of employment to the labour force N. Since $L = Y / \xi$, our second accounting identity is simply:

$$\dot{\lambda} = \lambda(\hat{Y} - \hat{\xi} - \hat{N}) \tag{8}$$

Taken together, equations (7) and (8) form a 2×2 dynamical system in which social conflict ($\hat{\omega}$), technology ($\hat{\xi}$), effective demand ($\hat{Y}$) and demography ($\hat{N}$) determine income distribution together with employment.

To simplify the exposition, we will assume that the growth rate of the labour force is an exogenous variable throughout our analysis.[8] For the three remaining reaction functions, assume that there exists a steady state with positive values for both the wage share and the rate of employment and that we can take the following linear approximations around such a point:

$$\hat{\omega} = \omega_0 + \omega_\lambda \lambda + \omega_\psi \psi \tag{9}$$

[5] For the main works or 'founding fathers' of this type of modelling, see Rowthorn (1980), Marglin (1984), Skott (1989), Dutt (1990), Taylor (1991) and Foley and Michl (1997). The model presented in this paper is an adaptation of Barbosa-Filho and Taylor (2006).

[6] For two examples of this increasing complexity, see Barbosa-Filho (2004) and von Armin *et al.* (2013).

[7] Most structuralist or Kaleckian models of growth and distribution set the income–capital ratio as their index of economic activity to obtain a direct link between the wage share of income and the growth rate of capital. We will use the rate of employment, because the bargaining power of workers depends more on the labour market than on the rate of capacity utilization. Despite this, the two variables have a positive correlation and one can go from one to another by introducing some additional state variables into the model (von Armin and Barrales, 2014).

[8] On the one hand, the growth rate of the working age population is a slow-moving variable given by demographic trends and immigration policy. On the other hand, the participation rate in the labour force does fluctuate during the business cycle, but it is also a bounded variable subject to slow-moving, long-run trends. Our model can include the participation rate as another endogenous variable, at the cost of adding a third differential equation to our dynamical system, but this would not change the results substantially.

$$\hat{\xi} = \xi_0 + \xi_\lambda \lambda + \xi_\psi \psi \tag{10}$$

and

$$\hat{Y} = \gamma_0 + \gamma_\lambda \lambda + \gamma_\psi \psi \tag{11}$$

The intercept coefficients in the above equations represent fixed effects and will be used later to represent exogenous shocks that can change the steady state of our model. Before that, we will comment on the economic meaning of each partial derivative of our reaction functions.

4. Theoretical assumptions

In both mainstream and heterodox models, it is common to model real-wage growth as a positive function of the employment rate, because a low rate of unemployment raises workers' bargaining power. The justification for this can come from profit and utility maximisation by firms and workers under imperfect competition, respectively, or the reserve army assumption of Marx. Whichever, real-world data do show a positive correlation between real wages and the employment rate (Blanchflower and Oswald, 1994).

Moving on to the effect of income distribution on real-wage growth, there is no clear theoretical assumption about this relationship in the heterodox literature, nor a robust stylised fact from the data. From a purely logical perspective, we have three possible hypotheses: positive, negative or zero impact. More specifically, the real wage can accelerate as the wage share of income goes down because a low ψ is perceived as an 'unfair' or 'unjustified' distribution of income by society, which in turn increases workers' bargaining power at any rate of employment. Alternatively, a reduction in the wage share of income may actually reduce workers' bargaining power at any given rate of employment, if it means that capitalists accumulate too much political power and are able to control the political debate by, for example, convincing enough voters that 'greed is good' because high profits eventually 'trickle down' to workers. The sign of ω_ψ depends, therefore, on the balance between democracy and plutocracy. The final result may even be that income distribution has no impact on workers' bargaining power. The political impact of Piketty's (2013) book, as well as recent political pressures to increase the minimum wage in the USA and Germany, might be evidence of the first hypothesis in practice, but this is an issue to be verified empirically.

Now consider labour productivity. The usual assumption in heterodox models is that an increase in the wage share of income reduces the rate of profit, for a given income–capital ratio, which in turn makes firms invest more in labour-saving technologies. In terms of our model, this means that $\hat{\xi}$ is a positive function of the wage share of income. This assumption also means that the 'aggregate technology of production' responds to changes in the relative price of labour, which is compatible with the mainstream approach based on aggregate production functions. However, the main difference between the mainstream and our structuralist reading of equation (10) is that we do not use a representative agent nor assume perfect competition to say that technology respond to relative prices. The relative prices of labour and capital are a result of

political and market power in our model and the aggregate production function comes directly from the economy's averages instead of from a representative firm.[9]

Further for labour productivity, we do not have a clear indication of the effect of the rate of employment on $\hat{\xi}$ from theory. As before, there are three possible logical cases. First, labour productivity growth may be a negative function of the rate of employment because a tight labour market raises job security and reduces workers' effort. Second, in the opposite direction, increased job security may actually raise workers' effort and productivity in the same way that better nutrition and a good working environment do. Third, it may also be the case that the rate of employment simply has no effect on labour productivity. The sign of ξ_λ is, therefore another issue to be investigated empirically. The long-standing literature on efficiency wages (Yellen and Akerlof, 1986) can support either the first or second hypothesis, depending on which mechanism is stronger. Despite this, the more intuitive result is that an increase in the rate of unemployment raises labour productivity, at least temporarily, in a context of imperfect information.

Next consider income growth. The impact of the rate of employment on aggregate demand growth is usually negative because of monetary policy rules. More specifically, inflation targeting means that the government manages the growth rate of aggregate demand to keep inflation expectations close to some pre-announced level.[10] Since a high rate of employment is usually associated with a high rate of inflation in the short run, we should expect income growth to be a negative function of λ in equation (11). The negative impact of the rate of employment on income growth may also come from the political aspects of full employment pointed out by Kalecki (1943), according to whom the government stabilises the rate of employment, but avoids full employment, to keep workers' bargaining power under control.

Finally, the impact of income distribution on income growth is another controversial issue that has to be set empirically. On the one hand, an increase in the wage share of income tends to accelerate consumption in the short run, because of the high propensity to spend out of labour income versus capital income. On the other hand, an increase in the wage share of income also tends to decelerate investment and net exports in the short run, because of its negative impact on the rate of profit and international competitiveness. Changes in the income–capital ratio may offset the impact of the wage share on the rate of profit in the short run, but capital productivity tends to be slow-moving or stable in the long run. The final impact of the wage share on aggregate demand is therefore undetermined *a priori*, meaning that the sign of γ_ψ has to be defined empirically in equation (11).

Let us now see the possible mathematical configurations of our dynamic model.

5. The employment and distribution curves

According to equations (9)–(11), the nullclines for ψ and λ are:

$$\psi = \left(\frac{\omega_0 - \xi_0}{\xi_\psi - \omega_\psi} \right) + \left(\frac{\omega_\lambda - \xi_\lambda}{\xi_\psi - \omega_\psi} \right) \lambda \tag{12}$$

[9] This also facilitates studies that decompose labour productivity growth between intersector and intrasector effects (Roncolato and Kucera, 2014).

[10] For a structuralist analysis of inflation, see Barbosa-Filho (2014).

and

$$\psi = \left(\frac{\gamma_0 - \xi_0 - \eta_0}{\xi_\psi - \gamma_\psi} \right) + \left(\frac{\gamma_\lambda - \xi_\lambda}{\xi_\psi - \gamma_\psi} \right) \lambda \tag{13}$$

respectively, where $\eta_0 = \hat{N}$ to afford a common notation for exogenous parameters.

In the terminology of structuralist models, equations (12) and (13) represent the 'distribution' and 'employment' curves of our economy, respectively.[11] From the previous assumptions, we cannot determine the slopes of these curves from theory alone. What we can do from theory is classify the possible outcomes that might be found in the real world.[12]

When the slope of equation (12) is positive, meaning that an increase in the rate of employment raises the value of the wage share that is consistent with a stable income distribution, our economy has a 'profit-squeeze' or 'Marxian' distribution regime. When the opposite happens, our economy has a 'wage-squeeze' or 'Kaldorian' distribution regime. Recent empirical studies of advanced economies indicate that Marx is the norm and Kaldor the special case.[13]

By analogy, when the slope of equation (13) is positive, meaning that an increase in the wage share tends to raise the rate of employment that is consistent with a stable labour market, our economy has a 'stagnationist' or 'wage-led' demand regime. When the opposite happens, our economy has an 'exhilarationist' or 'profit-led' distribution regime.[14] The evidence so far points to a predominance of profit-led regimes in advanced economies (Kiefer and Rada, 2013), probably because of inflation targets and balance-of-payments constraints on demand growth.

Advanced economies also show 'predator–prey' dynamics between the wage share and the rate of employment, of the kind first proposed by Goodwin (1967) in economics. The wage share is the 'predator' because an increase in the rate of employment tends to raise the bargaining power of workers and push up their income share. The rate of employment is the 'prey' because a rise in the wage share reduces the rate of profit, raises inflation and reduces the trade balance, which in turn set forth contractionary macroeconomic policies that push down the rate of employment.[15]

As we will see below, the US data clearly show counterclockwise or predator–prey fluctuations between the wage share and employment rate, but around a moving steady state. Before that, we will use the pattern of real-world data to restrict our theoretical model to four possible cases.

[11] Barbosa-Filho and Taylor (2006) define a 'capacity' or 'demand' curve in terms of a stable income–capital ratio, which has a similar economic meaning to the employment curve adopted here.

[12] Given its origins in development economics, structuralist macroeconomics does not usually close its models from theory alone. This may strike some people as vague, but it is an important and flexible method to deal with the complexity of the real world.

[13] Under some econometric specifications, the USA seemed to be Kaldorian in the late 1950s and early 1960s.

[14] The stagnationist versus exhilarationist taxonomy comes from Bhaduri and Marglin (1990); the more intuitive wage-led versus profit-led taxonomy from Taylor (1991).

[15] Some people may be uncomfortable in calling the wage share a 'predator', but this is only a label from biological systems, with no moral value attached to it. Despite this, an alternative way to say the same thing is to work with the rate of unemployment instead of the rate of employment. In this case, the 'bad' rate of unemployment would be the predator of the 'good' wage share. We will proceed with the rate of employment because this simplifies the maths.

6. Phase diagrams and cyclical fluctuations

From a mathematical perspective, our 2 × 2 dynamical model has four possible cases that display counterclockwise fluctuations on the employment versus wage share plane.[16] Figure 1 shows the four phase diagrams and each theoretical possibility will be analysed separately.

First, the economy can exhibit Goodwin's predator–prey dynamics with a Marxian distributive regime and a profit-led employment regime. This case is also locally stable by definition and we will use it as a reference to analyse the US economy in the next section. The economic meaning of this case is that both the rate of employment and income distribution show reversion to the mean, probably driven by macroeconomic policy, which makes the system stable around the steady state.

Second, a Marxian wage-led economy can also show counterclockwise fluctuations of the employment rate and the wage share. The rate of employment shows unstable dynamics in isolation in this case, but the dynamics of the wage share can neutralise this and produce local stability around the steady state.[17] One of the conditions for stability is that the slope of the distribution curve is greater than the slope of the employment curve in this case.[18]

Third, a Kaldorian profit-led economy can also show counterclockwise and stable dynamics of the employment rate and the wage share of income. Again, one of the conditions for stability is that the slope of the distribution curve is greater than the

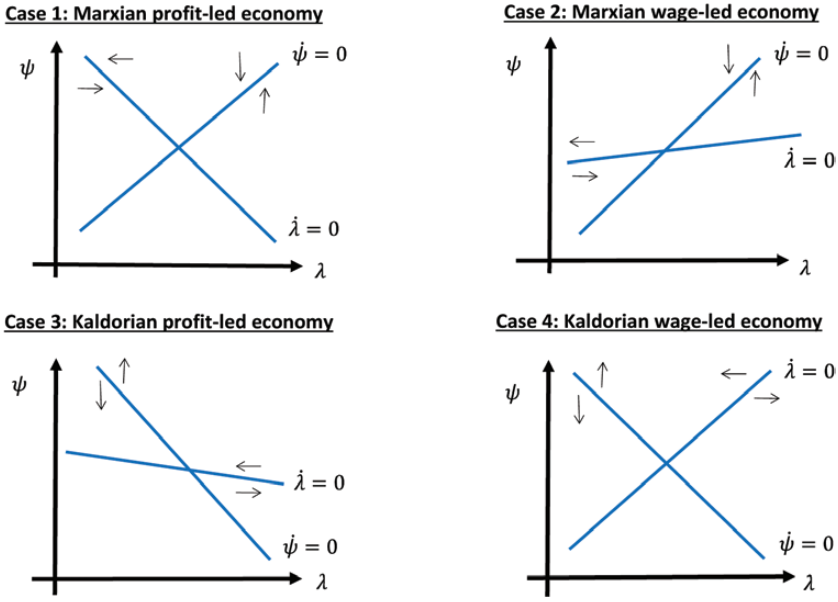

Fig. 1. *Possible phase diagrams of the 'predator–prey' system between the wage share and the employment rate.*

[16] For the system to have predator–prey fluctuations, the off-diagonal entries of its Jacobian matrix must have opposite signs. This leaves the signs of the two diagonal entries open for definition; hence four possible cases.

[17] The Jacobian matrix can still have a negative trace.

[18] The Jacobian matrix must have a positive determinant.

slope of the employment curve. In this case, it is the wage share that shows explosive dynamics in isolation, but the stability of the rate of employment can make the system locally stable.

Finally, a Kaldorian wage-led economy can show predator–prey dynamics between the wage share and the employment rate, as long as both variables are unstable in isolation. This case is also unstable by definition. In other words, even in the face of a small shock, the fluctuations in employment and income distribution spiral out of control until the system reaches one of the three types of equilibrium mentioned earlier, or 'extinction', with zero employment and zero wage share.[19]

Let us now analyse the exogenous shocks that can move the steady state of our system. For simplicity, we will represent this by changes in the intercept of each reaction function of our model in a Marxian profit-led economy, which seems to be the predominant structure in advanced economies.

7. Exogenous shocks and comparative statics

From our previous assumptions, exogenous shocks can come from four sources: the real wage (ω_0), aggregate demand (γ_0), labour productivity (ξ_0) and demography (η_0). Figure 2 shows the impact of negative shocks coming from these four sources and each case will be commented on separately.

Starting with the real wage, consider an exogenous reduction in ω_0 due to, for example, lower trade barriers to imports coming from low-wage countries, no adjustment of the minimum wage in the face of inflation, a reduction in unionisation or any other institutional change that reduces the bargaining power of workers for any given values

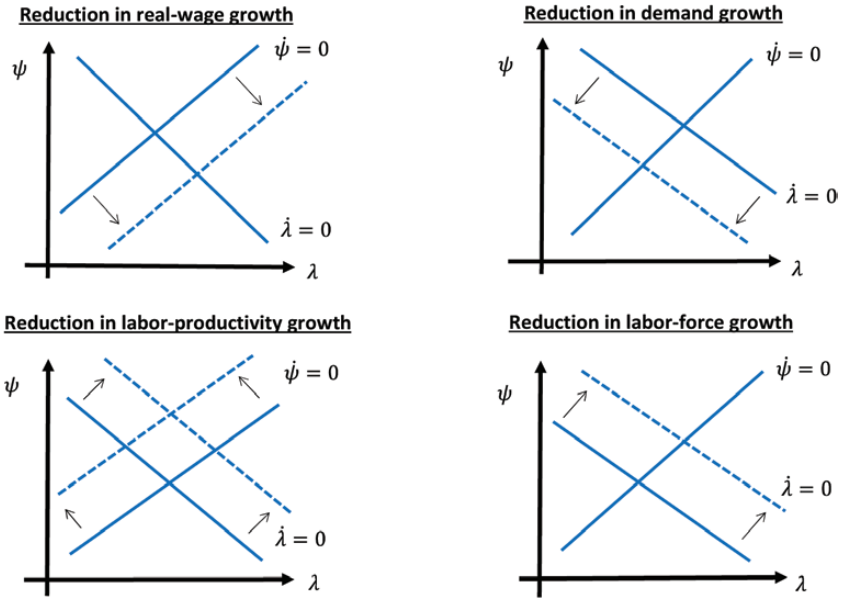

Fig. 2. *Impact of exogenous shocks in a Marxian profit-led economy.*

[19] For an example of non-linearities and multiple equilibria in a similar model, see Nikiforos and Foley (2012).

of the wage share and the rate of employment. This kind of shock moves the distribution curve downward in a Marxian profit-led economy, which in turn means a reduction in the wage share of income and an increase in the rate of employment.

Next, consider an exogenous reduction in the growth rate of aggregate demand due to, for example, a major financial crisis that reduces credit expansion and pushes consumption down as most families have to reduce their debt–income ratios. This kind of shock moves the employment curve downward in a Marxian profit-led economy, which in turn results in a lower wage share and a lower rate of employment.

Third, consider a reduction in the growth rate of labour productivity due to, for example, an exogenous increase in the price of energy that reduces the valued added per unit of labour. This shock moves both the employment and distribution curves upward in a Marxian profit-led economy, which in turn means a higher wage share. The rate of employment may either go up or down, depending on the magnitude of the shock on each curve.

Finally, consider a deceleration of the labour force due to, for example, the end of the demographic effects of a baby boom in the past. This shock has the same effect as an exogenous increase in aggregate demand growth, i.e. it shifts the employment curve upward and raises both the wage share and the rate of employment.

As we will see in the next section, the US economy experienced all of the above shocks in recent decades as well as some other types of shock.

8. Employment and income distribution in the USA

Figure 3 shows the US data on employment and income distribution since the late 1940s. The wage share is the compensation of employees as a percentage of the net domestic income at production prices.[20] The rate of employment is the ratio of civilian employment to the civilian labour force.[21] The two series are stationary under the usual statistical tests, provided that we control for structural breaks, which are many.

For example, consider the wage share. A visual analysis indicates four probable breaks. First, the wage share increased rapidly during the Korean War, in 1951–53, and remained at such a level until the mid-1960s. Second, the escalation of the Vietnam War and Lyndon Johnson's 'War on Poverty' coincided with another upward jump in the wage share in the late 1960s. After this, the wage share fluctuated around a relatively stable plateau until the mid-1990s, when Bill Clinton's welfare reform and the acceleration of labour productivity pulled by information technology raised the profit share of income. Finally, the financial crash of 2008 resulted in a temporary but substantial increase in the wage share, since profits plummeted, but its long-run impact appears to be another downward shift in the wage share.

Moving to employment, the Korean War does not seem to have had a structural impact on the US employment rate, which fluctuated around 95% from the late 1940s through the late 1960s. After this, there seems to have been three structural changes, which in turn either lag or coincide with the changes in the wage share mentioned above. More specifically, the long-run rate of employment shifted downward in the early 1970s and then fluctuated around 93% until the early 1990s. The second possible shock

[20] From Table 1.10 of the NIPA, published by the US Bureau of Economic Analysis.
[21] From series LNS14000000, published by the US Bureau of Labor Statistics.

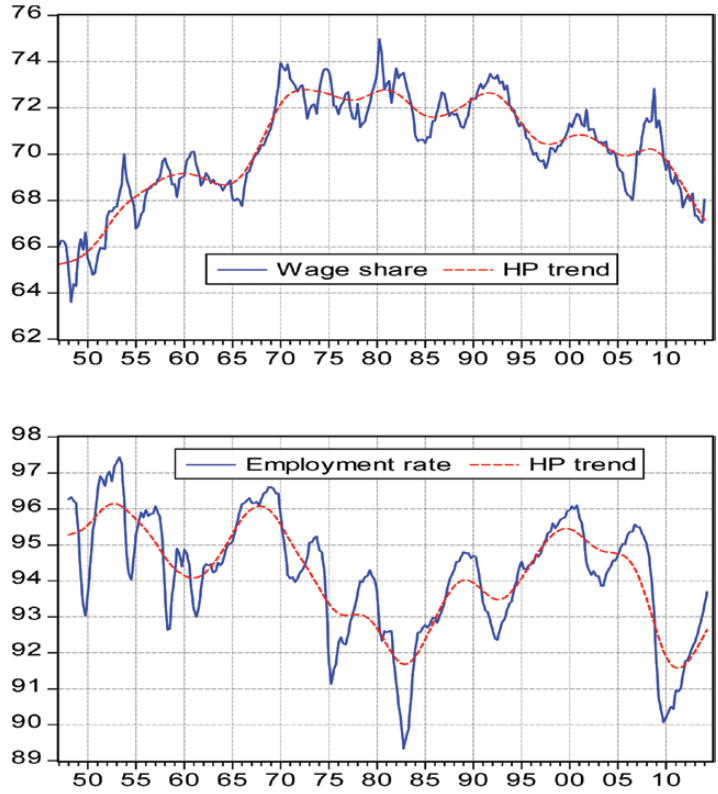

Fig. 3. *Wage share of net domestic income at production prices and employment rate of the civilian labour force in the US economy (both variables in percentage points).*
Note: HP trend is the Hodrick–Prescott trend of the variable.
Source: US Bureau of Economic Analysis and US Bureau of Labor Statistics.

occurred in the mid-1990s, in the wake of US economic expansion during the Clinton administration, and it pushed the average rate of employment back to 95%. Finally, the financial crash of 2008 was a third and clearly negative shock to employment.

It is too early to know whether the 2008 financial crash is a temporary (pulse) or permanent (level) shock to employment and income distribution in the US economy. As we will see below, the usual statistical tests point to both possibilities as well as to a slow return of the economy to its new steady state. However, before we present econometric results, it is worth observing the scatter diagram of the wage share and the employment rate because it clearly reproduces the predator–prey dynamics we proposed in our structuralist Goodwin model.

Figure 4 presents the scatter diagram for the whole sample period. To facilitate the visual analysis, we plotted the Hodrick–Prescott trends of the wage share and employment rate. The data clearly show the counterclockwise fluctuation of employment and income distribution, with the employment rate as the 'prey' and the wage share as the 'predator'.[22] The fluctuations follow the pattern we proposed in our theoretical model, but around a moving steady state.

[22] Or, the unemployment rate as the 'predator' and the wage share as the 'prey'.

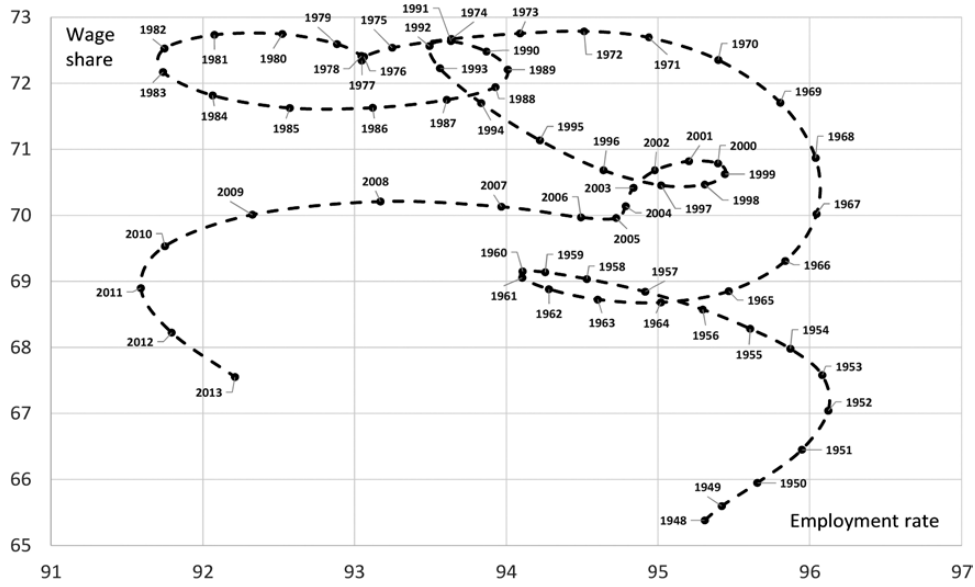

Fig. 4. *Scatter diagram of the Hodrick–Prescott trends of the wage share and employment rate in the US economy (both variables in percentage points).*
Source: Author's estimate.

9. The econometric model

Based on our structuralist theoretical model, the natural questions are, is the US Marxian or Kaldorian? Wage led or profit led? As we saw earlier, there are four possible structural configurations consistent with the counterclockwise fluctuations displayed by the data, three of which are from stationary systems. To check the US case, we estimated a vector autoregressive (VAR) system for our two state variables. We also introduced dummy variables into the model to test whether or not the data confirm the structural breaks we identified from a visual analysis.

The statistical appendix presents the estimated coefficients of the VAR model. The econometric results for the whole sample period indicate a stationary system with a Marxian distribution curve, a profit-led employment curve and some structural breaks. More specifically, we introduced four 'level' dummy variables into the model: a permanent change in the intercepts of both equations in 1951, 1967, 1995 and 2009.

The statistical results indicate that, at the 2% level of statistical significance, there was a positive shock to the US wage share in both 1951 and 1967. The results also indicate a negative shock to the wage share in 1995 and 2009, but only the former is statistically significant at the 2% level. So, despite the reduction in the wage share in recent years, it will take some time for us to know whether the 2008 financial crash changed the long-run distribution of income in the USA.

Moving to employment, the results indicate a positive demand shock in 1967 and a negative one in 2009, both at the 2% level of statistical significance. The results for the rate of employment also indicate a positive shock in 1951 and a negative one in 1995, but these events are not statistically significant. Altogether, the equation for the rate of

employment confirms the intuitive perception that the late 1960s was a period of high demand and recent years a period of stagnation in the US economy. We will return to this point in the conclusion (Section 10).

In addition to its permanent effects, the 2008 financial crash may also have had temporary, but still important, effects in the US economy. To test this, we also introduced a 'pulse' dummy variable for the 2008 crisis into our VAR model.[23] As expected, the results indicate that the wage share went up and the employment rate down in the wake of the financial crash, but only the coefficient for the rate of employment is statistically significant at the 2% level.

To test the speed of convergence of the US economy after exogenous shocks, Figure 5 presents the impulse–response function of our system to a one standard deviation shock to either the wage share or the rate of employment. The results indicate that the rate of employment goes down after an exogenous increase in the wage share, as well as that the wage share goes up after an exogenous increase in the rate of employment. These results are characteristic of a Marxian profit-led economy and, after the shock, both state variables return to their long-run values after approximately 40 quarters. Most of the adjustment occurs in five years, but full adjustment takes approximately 10 years.

Finally, to calculate the slopes of the distribution and employment curves of the US economy, we used the steady state of the VAR model for the most recent period. The

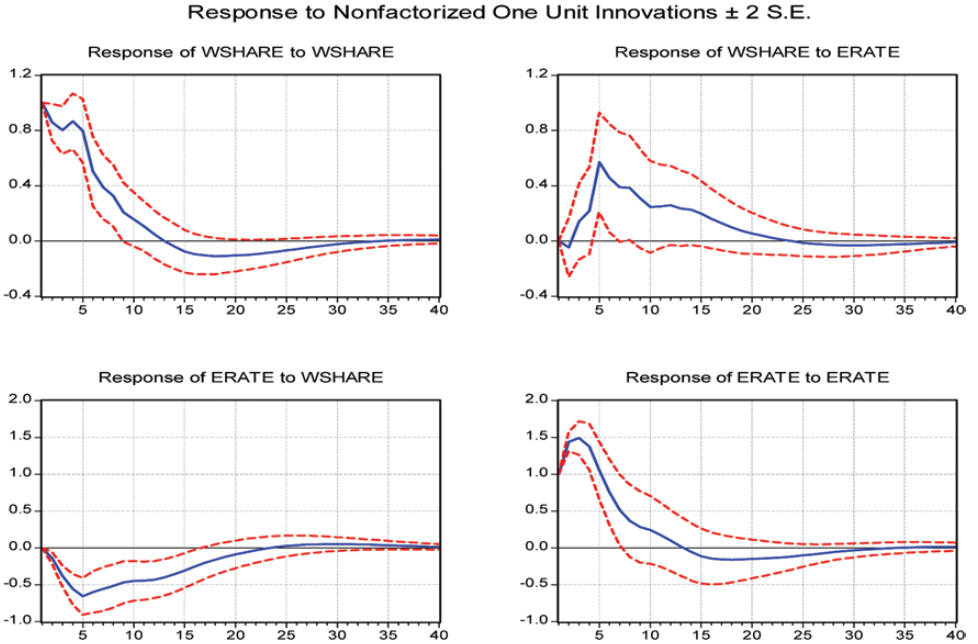

Fig. 5. *Impulse–response function of a VAR model for the quarterly wage share (WSHARE) and employment rate (ERATE) in the US economy (both variables in percentage points).*
Source: Author's estimate.

[23] This variable equals one in the last quarter of 2008 and first quarter of 2009.

estimated coefficients indicate a long-run employment rate of 93.4% and a wage share of 67.9%. The distribution and employment 'curves' in discrete time are:

$$\psi = 13.86 + 0.58\lambda \tag{14}$$

and

$$\psi = 136.80 - 0.74\lambda \tag{15}$$

respectively. Figure 6 plots the two curves for the relevant interval of the wage share and employment rate.

From our econometric results, we can conclude that the wage share was a stationary variable in the USA during the period under analysis, but it was subject to cyclical fluctuations around a moving steady state. With this in mind, we now return to Piketty's (2013) proposition on the functional distribution of income.

10. Conclusion

Pikkety's (2013) theoretical hypotheses about the functional distribution of income are the weakest part of an otherwise landmark book. On the one hand, organising the discussion only in terms of the elasticity of substitution combines too many forces in one residual parameter. As we saw in our structuralist model, the functional distribution of income can change, temporarily or permanently, because of institutional and demand shocks not related to technology. This critique does not mean that Piketty's approach to the functional distribution of income is wrong, but actually that it is too aggregated and unrealistic, as is usual in mainstream growth theory.

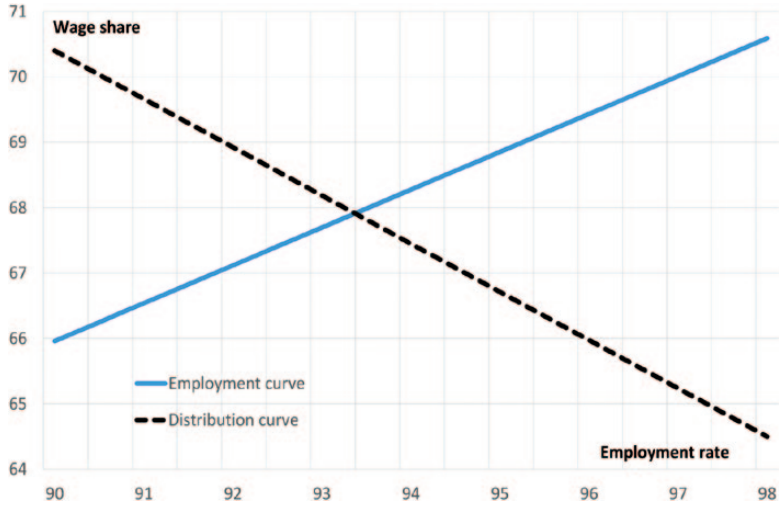

Fig. 6. *US distribution and employment curves in 2013.*
Source: Author's estimate.

On the other hand, Piketty's proposal that there is no natural tendency for the functional distribution of income to be stable is an empirical hypothesis that, so far, has not been confirmed by the data. Black swans do exist and, perhaps, the world economy has entered into a regressive spiral of income concentration and secular stagnation that many economists have feared, many times, in the past. Despite this possibility, our simple structuralist model shows that, at least in the USA, the wage share of income has cyclical fluctuations around a moving steady state with a long period of convergence. In fact, the adjustment is so slow that given a sequence of exogenous shocks, the economy is likely to be hit by another shock before it completes its adjustment to the previous one.

The evolution of the US economy since the late 1940s also shows that the wage share tends to fluctuate between 64% and 74% of net domestic factor income and the civilian employment rate between 90% and 97%. In addition, most of the evolution of income distribution and employment in the USA can be related to the adjustment of the economy to major exogenous shocks, such as wars, new distribution policies (pro-poor in the 1960s and pro-rich in the 1980s) and, indeed, changes in the aggregate technology of production. The later also includes trade liberalisation and composition effects, which alter labour productivity growth.

From our structuralist perspective, the US evidence does not confirm that the functional distribution of income is unstable. This means that the elasticity of substitution of capital for labour is equal to one in the long run, but this is not the relevant question. The relevant question is what makes the elasticity of substitution equal to one and, more importantly, at what levels the wage share and the rate of employment tend to stabilise.

Economic policy in general, and macroeconomic policy in particular, plays an important role in determining the steady state of income distribution and employment rates. The fact that the wage share is stable does not mean that it tends to stabilise at a high or adequate level for a democratic regime. It may actually stabilise at a very low level if the major world economies engage in a race to the bottom to gain international competitiveness by reducing their unit labour costs.

In fact, since the 2008 financial crash, the world economy has been experiencing a competitive 'wage repression', with too many countries trying to accelerate growth from the supply side without proper attention to fallacies of compositions and the existing space for demand expansion. In this context, Piketty's (2013) monumental work on capital income and the dangers of rising income inequality is a breath of fresh air, even if it uses traditional tools and problematic assumptions of mainstream economics.

Appendix: The VAR model

We estimated the VAR model with six lags based on the information criteria of models with one through eight lags. Table A1 shows the estimated coefficients and their corresponding *t*-statistics (in brackets). For the coefficients on the dummy variables, * indicates statistical significance at the 2% level. The results come from the US quarterly series for 1949–2013 (258 observations) and the econometric model explains 96% and 98% of the variance of the wage share and employment rate, respectively.

Table A1. *VAR model coefficients for the US economy in 1949–2013*

Explanatory variable	Wage share equation	Employment rate equation
Wage share ($t-1$)	0.859289	−0.139979
t-statistic	(13.0038)	(−3.50670)
Wage share ($t-2$)	0.05807	−0.058958
t-statistic	(0.68448)	(−1.15042)
Wage share ($t-3$)	0.143253	0.072419
t-statistic	(1.73389)	(1.45102)
Wage share ($t-4$)	−0.074987	0.038186
t-statistic	(−0.90003)	(0.75873)
Wage share ($t-5$)	−0.196587	0.109141
t-statistic	(−2.36714)	(2.17552)
Wage share ($t-6$)	0.096255	−0.128295
t-statistic	(1.55859)	(−3.43895)
Employment rate ($t-1$)	−0.046878	1.440519
t-statistic	(−0.44338)	(22.5543)
Employment rate ($t-2$)	0.249375	−0.590371
t-statistic	(1.33111)	(−5.21665)
Employment rate ($t-3$)	−0.189049	0.093601
t-statistic	(−0.95852)	(0.78563)
Employment rate ($t-4$)	0.344182	−0.139524
t-statistic	(1.75184)	(−1.17561)
Employment rate ($t-5$)	−0.576759	0.198923
t-statistic	(−3.13002)	(1.78708)
Employment rate ($t-6$)	0.285529	−0.082445
t-statistic	(2.91061)	(−1.39126)
Constant	1.011922	14.73489
t-statistic	(0.24258)	(5.84748)
Level dummy for 1951	**0.572636***	0.171376
t-statistic	**(2.46572)**	(1.22158)
Level dummy for 1967	**0.492996***	**0.270242***
t-statistic	**(3.48746)**	**(3.16464)**
Level dummy for 1995	**−0.285403***	−0.087623
t-statistic	**(−3.09401)**	(−1.57250)
Level dummy for 2009	−0.202201	**−0.385179***
t-statistic	(−1.25230)	**(−3.94909)**
Pulse dummy for 2008–09	0.22262	**−0.56799***
t-statistic	(0.69907)	**(−2.95259)**

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