PANOECONOMICUS, 2018, Vol. 65, Issue 3 (Special Issue), pp. 289-318
Received: 30 September 2017; Accepted: 17 April 2018.

UDC 330.101.541(73+430)
DOI: https://doi.org/10.2298/PAN1803289P
Original scientific paper

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Macroeconomic Effects of Personal and Functional Income Inequality: Theory and Empirical Evidence for the US and Germany

Summary: This paper presents a simple post-Kaleckian model of distribution and growth that incorporates personal income inequality and interdependent social norms. The model shows in an easily accessible manner that macroeconomic effects of changes in personal and functional income distribution can potentially reinforce or dampen each other. The resulting variety of demand and growth regimes is due to different distributional effects on consumption demand. Therefore, the second part of the paper investigates the empirical relevance of the additional demand regimes by estimating aggregate consumption functions with variables for personal and functional income distribution for the United States and Germany. We find similar effects of functional income distribution for both countries. However, for the US, we find positive long-run effects of personal income inequality on consumption. The effect is strongest for the top 10% income share and the Gini index and less strong for the top 5% and 1% income shares. While this is evidence for relative consumption patterns, it also supports the view that the "super rich" are a relatively distant class for most people - questioning the notion of expenditure cascades from the very top to the very bottom. In contrast, for Germany we fail to find compelling evidence for effects of personal income distribution.

Key words: Income inequality, Personal and functional income distribution, Relative income hypothesis, Kaleckian model.

JEL: C22, D31, D33, E11, E12, E25.

Acknowledgement: I would like to thank Eckhard Hein, Engelbert Stockhammer and two anonymous referees for very helpful comments and suggestions. I am also grateful for valuable questions and comments by the participants of the 20th FMM Conference in Berlin, 21 October, 2016, by the participants of the Interactive Inequality Workshop that was hosted by the International Inequalities Institute and the Young Scholars Initiative at the London School of Economics and Political Science in London, 12-14 June, 2017 and by the participants of the 14th International Conference "Developments in Economic Theory and Policy" in Bilbao, Spain, June 29-30, 2017. I also want to thank Josefine Prante and Finn Cahill-Webb for language editing. All remaining errors are of course mine.

While distributional conflict was at the heart of post-Keynesian macroeconomics, the focus was on the functional distribution of income. More recently, there have been several attempts to incorporate personal income distribution and interdependent social norms into Kaleckian models of distribution and growth. However, these extensions have usually been applied to already quite complex models, often solved by numerical simulation. This paper contributes to the literature by overcoming the corresponding lack of accessibility and traceability of these models. It provides a simple and illustrative Kaleckian macroeconomic model that is open to different relationships between personal income inequality and aggregate demand and growth, thereby adding further theoretical flexibility to the basic post-Kaleckian model. Potential short- to midterm effects of changes in personal and functional income distribution on aggregate demand

and growth can be discussed within this framework. The model fits well to the general Kaleckian models presented in recent post-Keynesian textbooks (e.g. Eckhard Hein 2014; Marc Lavoie 2014) and is therefore especially relevant for students and teachers who want to stress the importance of personal income distribution within such a framework.

The resulting variety of macroeconomic regimes in the proposed model is due to differing distributional effects on aggregate consumption. Therefore, the second contribution of this paper is empirical. It provides a brief summary of the econometric literature on consumption (or saving) and income distribution, focussing on the macroeconomic effects of personal income distribution since the effects of functional income distribution on consumption have been found to be quite robust throughout the literature. Furthermore, aggregate consumption functions are estimated for the US and Germany, two countries which have been very different when it comes to the development of aggregate consumption and the saving rate, but which both experienced distributional changes in the same direction in the medium to long run before the crisis. The estimations extend commonly used single equation specifications of aggregate consumption which distinguish between profit and wage income by adding different measures of personal income inequality and controlling for wealth and debt effects. We focus on consumption in the second part of the paper since the innovation of the theoretical model is the inclusion of personal income distribution in the saving (or consumption) function. Other empirical components of the model (in particular the investment and net export functions) have been estimated elsewhere (see Hein 2014, Chapter 7 for a survey).

The paper is structured as follows: Section 1 develops a pedagogical post-Kaleckian model that includes personal income distribution and interdepend social norms. Section 2 provides a brief review of the related empirical literature and estimates aggregate consumption functions for the United States and Germany to investigate the effects of personal and functional income distribution. The last section concludes.

1. Interdependent Social Norms and Personal Income Inequality in a Simple Post-Kaleckian Model

Modern post-Keynesians have increasingly used the Kaleckian framework to investigate questions of functional income distribution. Yet, personal income inequality and interdependent preferences did not figure prominently in the corresponding models. This is especially unfortunate, because there were substantial changes in both, personal and functional income distribution in the last decades, but the relative strength of changes in both distributional dimensions has been highly heterogeneous across countries and often corresponded to different macroeconomic developments (Till van Treeck and Simon Sturn 2012; Christian A. Belabed, Thomas Theobald, and Van Treeck 2018). And, despite the relevance of functional income distribution stressed by Kaleckian macroeconomic models, there is also a growing body of research that sees personal income inequality as one causal factor of the Great Recession (Van Treeck and Sturn 2012; Van Treeck 2014). This has also led to a revival of theories of interdependent consumption norms in the spirit of Thorstein Veblen (1899) and James S.

Duesenberry (1949), since social norms can be a decisive factor for the effects of rising income inequality. Carefully distinguishing between effects of personal and functional income distribution on aggregate consumption in theoretical models and empirical specifications seems therefore highly relevant. Therefore, more recently, there have indeed been some attempts to incorporate the combination of personal income distribution and interdependent social norms into the consumption function of Kaleckian distribution and growth models (Gennaro Zezza 2008; Jakob Kapeller and Bernhard Schütz 2014, 2015; Daniel Detzer 2016; Mark Setterfield and Yun K. Kim 2016; Belabed, Theobald, and Van Treeck 2018). Personal income inequality is often introduced into these models by splitting the wage income earning class into high and low wage income groups often corresponding to workers *vs*. managers, non-supervisory *vs*. supervisory workers, etc. Some authors instead assume that entrepreneurs or rentiers earn part of the wage share. By incorporating a relative income term with an emulation parameter into the consumption functions of lower income groups it is then commonly assumed that the lower income groups try to emulate the consumption expenditures of the higher income earners to some extent. In some models the richest income class, mostly corresponding to rentiers or entrepreneurs, is emulated by high wage earners or, in other models, regarded as a somewhat distant class without being an emulation target for another income group. This distinction is connected to the question whether the strongest expenditure cascades can be triggered by redistribution to the very top. Depending on the specific model at hand such emulation effects have been combined with debt accumulation, financial norms and constraints and with Minskyian dynamics. There have also been some other attempts to include either emulation effects or personal income inequality into Keynesian macroeconomic models (Amitava K. Dutt 1992, 2008; Lavoie 1996; Hein 2012; Daniele Tavani and Ramaa Vasudevan 2014).

The extensions with a combination of personal income distribution and social norms have usually been applied to already quite complex models, which are often solved by numerical simulation. We try to overcome the often-associated lack of accessibility and traceability by providing a simple analytical model that retains the key points of the more complex models related to potentially diverging effects of changes in functional and personal income distribution due to interdependent social norms. This is achieved by introducing a simple variation inspired by Laura Carvalho and Armon Rezai (2016), who implement macroeconomic effects of personal inequality by making the propensity to save from wages depend directly on a measure of wage inequality. However, based on their discussion of US saving rates per income quintile, they assume that rising wage inequality always leads to a rising propensity to save out of wage income. Contrasting with this assumption, the literature on socially interdependent behavioural norms going back to Veblen (1899), Duesenberry (1949) and more recently Robert H. Frank, Adam S. Levine, and Oege Dijk (2014) presents theoretical arguments that the opposite effect is also possible. And indeed, developments in countries like the US suggest that such effects may have been relevant prior to the Great Recession (Barry Z. Cynamon and Steven M. Fazzari 2008; Van Treeck 2014). Yet, Carvalho and Rezai (2016) use their cross-sectional observation of an increasing propensity to save over income quintiles in the United States as an argument that the propensity to save is positively correlated to income and that, therefore, it is justified to assume that the saving rate is also positively correlated with inequality. However, this argument seems unconvincing for the following reason: theories of interdependent social norms clearly state a theoretical argument why there should be an increasing saving rate in the cross-sectional dimension with respect to income. The compatible empirical observation would be that the saving rate increases with increasing relative income, and, therefore, from low-income to high-income quintiles. However, in addition, these theories state that a quintile's saving relative to disposable income in a times series context, in which relative income changes for this specific quintile, can either be increasing or decreasing, depending on the strength and direction of relative income effects and, hence, on interdependent behavioural norms. One compatible empirical observation would be that for a specific quintile the saving rate decreases over time if relative income with respect to other quintiles decreases. Exactly this is observable in the data of Carvalho and Rezai (2016, p. 494, Figure 1) for the lowest three income quintiles in the period from 1990 to 2000, a period of strongly increasing personal income inequality.

We will therefore not follow their restrictive assumption. Instead, by building on Carvalho and Rezai's basic idea, this section provides a post-Kaleckian model of distribution and growth in which different relationships between personal income inequality and the saving rate can lead to various macroeconomic outcomes. The main purpose of this exercise is to illustrate in a simple way that the effects of redistribution between profits and wages, on the one hand, and redistribution between households, on the other hand, can either reinforce or dampen each other depending on country and time specific consumption and financial norms. This has also been shown in the much more complex models mentioned above, yet, our model is easy to solve analytically and fits well to the basic Kaleckian model frameworks presented in recent textbooks like Hein (2014) and Lavoie (2014).

In the following, we assume that personal income inequality can be approximated by wage inequality, as is also often done in more complex models and we also abstract from interdependencies between functional and personal income distribution. Of course, both assumptions are simplistic. However, it seems reasonable to assume that wage and personal income distribution are correlated to a high degree. And the co-development of personal and functional income distribution has been very heterogeneous across different countries, as some experienced only minor increases in profit shares, but large increases in measures of personal distribution in the period from about 1980 to the Great Recession (e.g. US, UK), while for some countries it was the other way around (e.g. Germany).

We model a closed economy without a government sector in the tradition of the basic post-Kaleckian model with saving out of wages (Amit Bhaduri and Stephen Marglin 1990). The well-known basic assumptions and model equations can be found in recent textbooks like Hein (2014, Section 7.2.2) or Lavoie (2014, Section 6.3) and here we are only stating our variation to the basic model and the equations needed to calculate the equilibrium values.

The crucial variation to the basic post-Kaleckian model is that we endogenize the propensity to save from wages (s_W) by making it depend on exogenously given wage income inequality (Γ) in the following simple manner:

$$s_W = s_0 - \eta\Gamma,\ 0 < \Gamma < 1,\ 0 < s_W < 1. \tag{1}$$

While doing so we assume that the values of the parameters s_0 and η are such that $s_W < s_\Pi$ is always ensured, where s_Π is the propensity to save out of profit income. In (1), s_0 represents the propensity to save from wages when there is no effect of wage inequality. Alternatively, it can be interpreted as the propensity to save from wages if wages were equally distributed ($\Gamma = 0$). The social norms parameter η represents the responsiveness of the propensity to save from wages to increasing wage inequality. The sign and absolute value of η are determined by the specific consumption and financial norms prevailing in the economy. These norms determine the willingness of households to lower or increase their savings in the face of a relative income decline and the ability to go into debt for consumption purposes. Factors influencing the willingness are related to different consumption theories which stress various influences on consumption decisions. These encompass socially interdependent consumption norms and habit persistence (Veblen 1899; Duesenberry 1949), interdependent financial norms of households (Richard H. Thaler and H. M. Shefrin 1981; Cynamon and Fazzari 2008) and absolute income effects (John M. Keynes 1936). The ability to go into debt to increase or maintain consumption expenditures is determined by the financial norms of the credit system and can be related to financialisation, deregulation, originate and distribute business models of banks, new financial instruments, etc. (Cynamon and Fazzari 2008; Aldo Barba and Massimo Pivetti 2009).

In a situation in which η is positive the social norms are such that, at the aggregate, increasing wage inequality encourages working households as a whole to increase their propensity to consume from total wage income. That means the consumption norms must be such that a sufficiently large number of working households who lost wage income relative to others are willing and able to maintain or even increase their relative consumption expenditures, and, thus, cause a fall of the aggregate propensity to save from wages. While we are not modelling a financial system explicitly here, this can be associated with increasing debt of these households if the financial norms of the economy allow for it. A positive η is equivalent to the assumption that any negative absolute income effects on consumption, stemming from increasing wage inequality, are overcompensated by relative income effects or effects of habit persistence (including subsistence consumption) at the aggregate level.

In contrast, a negative η implies that the consumption and financial norms of the model economy are such that in case of increasing personal income inequality households who lost relative income are not willing and/or not able to maintain or increase their consumption expenditures to such an extent that it overcompensates the savings of households who gained relative income. Hence, the aggregate propensity to save from wages increases. In this case, any positive relative income or habit effects on consumption are overcompensated by negative absolute income effects. Of course, we could also think of a situation in which relative and absolute income effects exactly compensate each other at the aggregate ($\eta = 0$), i.e. there is no aggregate effect of wage inequality on the propensity to save from wages.

It should be noted that there are many other factors which could affect the propensity to save out of wages in Equation (1) through effects on the constant (s_0) or the parameter (η) or even affect the overall propensity to save through changes in both saving from profits and from wages. Such an effect could for example come from an ongoing aging process and/or from labour market reforms. For instance, the importance of fixed-term and part-time contracts could change, thereby altering worker's incentives for precautionary saving and/or changing their capacity to go into debt (Jesus Ferreiro and Felipe Serrano 2013). In principle, such effects could counteract the effects of wage inequality or functional distribution. However, for the rest of the paper the focus will be on the partial effects of income distribution, assuming that other factors remain constant or are too weak to fully compensate effects of wage inequality. For example, for the case of aging processes, we could assume that wage and profit earners propensity to save is affected in the same way, which would not alter the effects of changing functional income distribution and that norms related to consumption financing lead to stronger effects of wage inequality on workers saving compared to effects of aging processes. In the following, we therefore abstract from such complications.

With (1) our new Kaleckian saving rate (σ) becomes:

$$\sigma = \frac{S}{pK} = \frac{S_\Pi + S_W}{pK} = \frac{s_\Pi \Pi + s_W(Y - \Pi)}{pK} = \left[(s_0 - \eta\Gamma) + \big(s_\Pi - (s_0 - \eta\Gamma)\big)h\right]\frac{u}{v} \qquad (2)$$

where S, p, K, S_Π, S_W, Π, W, Y, h, u, v denote aggregate saving, the general price level, the nominal capital stock, saving out of profits, saving out of wages, profit income, wage income, real output, the gross profit share (including overhead costs), capacity utilization (in terms of potential output $u = Y/Y^p$) and the capital-potential output ratio ($v = K/Y^p$), respectively. With this new saving rate, we can calculate the new equilibrium values for our slightly extended post-Kaleckian model. The equilibrium condition for the goods market is that saving equals investment:

$$g = \sigma \qquad (3)$$

where g is the basic post-Kaleckian investment rate that depends on animal spirits (α), capacity utilization (u) and the profit share (h):

$$g = \frac{I}{K} = \alpha + \beta u + \tau h \qquad (4)$$

with I denoting real investment and β and τ being the responsiveness of investment to changes in capacity utilization and the profit share, respectively. The adjustment to the Kaleckian goods market equilibrium takes place *via* capacity utilization. For the goods market equilibrium to be stable in the short-run, the stability condition needs to be fulfilled:

$$\frac{\partial\sigma}{\partial u} - \frac{\partial g}{\partial u} > 0 \Rightarrow \left[(s_0 - \eta\Gamma) + \big(s_\Pi - (s_0 - \eta\Gamma)\big)h\right]\frac{1}{v} - \beta > 0. \qquad (5)$$

In the following we assume that this condition is always fulfilled and we denote the left side of this inequality as $\mathcal{SC} = \left[(s_0 - \eta\Gamma) + \left(s_\Pi - (s_0 - \eta\Gamma)\right)h\right]\frac{1}{v} - \beta$. By substituting (2) and (4) into (3), and solving for u, we obtain equilibrium capacity utilization:

$$u^* = \frac{\alpha + \tau h}{\mathcal{SC}}. \quad (6)$$

Substituting (6) into (4) (or (2)) yields the equilibrium values for capital accumulation and the saving rate:

$$g^* = \sigma^* = \frac{(\alpha + \tau h)\left[(s_0 - \eta\Gamma) + \left(s_\Pi - (s_0 - \eta\Gamma)\right)h\right]\frac{1}{v}}{\mathcal{SC}}. \quad (7)$$

The partial derivatives of these equilibrium values with respect to the profit share yield the demand and the accumulation regime of our model economy. The demand regime is determined by:

$$\frac{\partial u^*}{\partial h} = \frac{\tau - \left(s_\Pi - (s_0 - \eta\Gamma)\right)\frac{u^*}{v}}{\mathcal{SC}} \quad (8)$$

and the accumulation regime by:

$$\frac{\partial g^*}{\partial h} = \frac{\left[\tau(s_0 - \eta\Gamma) + \left(s_\Pi - (s_0 - \eta\Gamma)\right)(\tau h - \beta u^*)\right]\frac{1}{v}}{\mathcal{SC}}. \quad (9)$$

The well-known possibility of different demand and growth regimes with respect to functional income distribution is obviously maintained in our model, because we cannot know the signs of these partial effects before we specify relations between our model parameters. Demand and growth can either be wage-led, implying $\partial u^*/\partial h < 0$ for demand and $\partial g^*/\partial h < 0$ for growth, or profit-led, implying $\partial u^*/\partial h > 0$ for demand and $\partial g^*/\partial h > 0$ for growth. The overall demand and growth regime might be wage-led, conflictive or profit-led. Which regime prevails in the economy depends on the specific parameters in the functions for the saving and investment rate. Note, that the equations for the partial effects with respect to the profit share now contain the variable for personal income inequality Γ. Therefore, if we hold all other parameters of the model constant, but change personal income distribution, this will change the partial effects with respect to functional income distribution. If the change in Γ is sufficiently large, this can potentially change the sign of the respective partial effect. This means that endogenizing the propensity to save from wages also makes the demand and growth regimes with respect to functional income distribution dependent on the size distribution of income, which links the model to discussions on the endogeneity of regimes (Thomas I. Palley 2017).

Let us now consider the partial effects of our equilibrium values with respect to personal income distribution:

$$\frac{\partial u^*}{\partial \Gamma} = \frac{(\alpha + \tau h)(1 - h)\frac{\eta}{v}}{\mathcal{SC}^2} \quad (10)$$

$$\frac{\partial g^*}{\partial \Gamma} = \frac{(\alpha + \tau h)(1-h)\beta \frac{\eta}{v}}{\mathcal{SC}^2}. \tag{11}$$

If $\eta > 0$, we have $\partial u^*/\partial \Gamma > 0$ and $\partial g^*/\partial \Gamma > 0$, meaning that the economy specific consumption and financial norms would be such that increasing wage inequality would lead to a fall in the propensity to save from wage income. On the other hand, if $\eta < 0$, the increase in inequality is contractionary, because the consumption and financial norms would lead to an increase in the propensity to save from wages and $\partial u^*/\partial \Gamma < 0$ and $\partial g^*/\partial \Gamma < 0$. Of course, the signs of the partial effects, with respect to Γ for either $\eta > 0$ or $\eta < 0$, are due to the validity of the paradox of thrift, since $\partial u^*/\partial s_W < 0$ and $\partial g^*/\partial s_W < 0$. Obviously, if $\eta = 0$, there is no effect of increasing wage inequality, and we find ourselves in the world of the basic post-Kaleckian model, in which only functional income redistribution leads to changes in u^* and g^*. In a setting in which $\eta > 0$, the increase in wage income inequality would be expansionary, regardless of other parameters. At the same time, however, the effect of redistribution between wages and profits could be either wage-led, conflictive or profit-led, depending on the model parameters. This result illustrates in a simple way how the effects of functional and personal redistribution can potentially differ quite strongly, depending in particular on the consumption and financing behaviour of households in response to personal income redistribution and also on the financial norms on the credit supply side. These factors determine the value and the sign of the parameter η, which has an influence on the partial effects ofthe model.

Table 1 summarises the theoretically possible effects of a simultaneous marginal increase in personal and functional income inequality in a wage-led or profit-led demand or growth regime. For both regimes, there are four different conceivable scenarios depending on the absolute size of the respective partial effects and the sign of the social norms parameter. This means that the different distributional effects on aggregate consumption become key in determining the model economy's regime. In a wage-led demand or growth regime in which η is positive and the absolute size of the partial effect of personal income redistribution is bigger than the absolute size of the partial effect of functional income redistribution the overall effect of rising personal and functional income inequality on demand or growth will be expansionary. This case resembles the *consumption-driven profit-led regime* elaborated in Kapeller and Schütz (2015). If one would ignore the effect of personal inequality on consumption in an empirical investigation, as would be the case in an empirical application ofthe most basic Kaleckian framework, the demand or growth regime would appear to be profit-led, even though it is actually wage-led. The opposite case would prevail if η is positive, but the negative partial effect of functional income redistribution outweighs the positive partial effect of rising personal income inequality. In this case simultaneously rising personal and functional income inequality have a contractionary effect, though the positive effect due to rising personal inequality dampens the negative effect of rising functional income inequality, hence this case can be called "decelerated wage-led". The intermediary case would be that the positive effect of rising personal income inequality exactly compensates the negative effect of functional redistribution in favour of profit income and hence the simultaneous increase of both types of inequality appears as if there is no effect at all. For the cases of a profit-led demand or growth regime, the four different scenarios can be described in an analogous fashion. If demand or growth are profit-led and η is positive, the overall effect will be positive, and rising personal inequality will accelerate the effect from redistribution to profits. On the other hand, when η is negative, the overall effect is expansionary when the size of the effect of a rising profit share is higher than the absolute value of the partial effect of rising personal inequality. Yet, the rise in personal inequality will dampen the expansionary effect, hence it can be called a "decelerated profit-led" case. The intermediary regime would again prevail if both effects exactly compensate each other, which would appear as if there is no effect at all. And we would have the "seemingly wage-led" case, if the effect of the rising profit share is overcompensated by the negative effect from rising personal income inequality and the overall effect is contractionary, even though demand or growth are actually profit-led. From the eight different scenarios in Table 1 the seemingly profit-led, the seemingly wage-led and the two intermediary scenarios must appear as empirical puzzles in an empirical investigation that is solely based on the basic Kaleckian framework and which would hence not control for effects of rising personal income inequality in the estimation of the consumption function. On the other hand, in the case of the accelerated wage- or profit-led regimes the effects of functional income distribution would be overestimated with such an empirical consumption function.

Table 1 highlights the flexibility of theoretical outcomes of the post-Kaleckian model that we gain by the simple variation that was introduced in Equation (1). The macroeconomic effects of redistribution in the functional and in the personal dimension can either reinforce or dampen each other. While this seems to be a very basic insight, it has been overlooked by most Kaleckian models. It should be noted however that the above model is of very limited use for long-run analyses for the case thatη is positive, since it does not consider any debt dynamics. The model assumes that in a scenario where $\eta > 0$ households, which wish to increase their consumption expenditures relative to their (wage) income due to emulation and habits, are always able to finance this desired increase, even if their consumption at some point exceeds their income. While this is grounded in the assumption of facilitative financial norms, it is highly unrealistic that ever increasing personal inequality would lead to ever-increasing consumption and, therefore, infinite credit supply even to (over-)indebted households. At some point, the credit system might question the creditworthiness of highly indebted households, which could lead to decreasing credit supply and/or rising financial fragility and finally a financial crisis, and thus an end of the expansionary effect of increasing personal inequality and indeed might reverse it. Additionally, the increasing cost of interest and principal payments will be a burden on households. Such contradictory effects of household indebtedness have been modelled in various ways by several authors (see for example Dutt 2005, 2006; Hein 2012; Kapeller and Schütz 2014, 2015; Detzer 2016; Setterfield and Kim 2016; Belabed, Theobald, and Van Treeck 2018).

In our proposed model, the saving (or consumption) function is the key equation, which modifies the results of our framework in comparison to basic Kaleckian models. Including personal *and* functional income distribution into empirical estimations of aggregate consumption or saving is therefore highly relevant for identifying demand and growth regimes empirically. Therefore, in the next section we review the empirical evidence on the question of distributional effects on aggregate consumption and provide some own estimations in order to tentatively explore the relevance of effects of personal and functional income distribution for the theoretical model discussed above.

Table 1 Potential Effects of Marginally Rising Personal and Functional Income Inequality in Wage-Led or Profit-Led Regimes

	Absolute income effects dominate behaviour of s_w: $\eta < 0$	Relative income effects dominate behaviour of s_w: $\eta < 0$
Wage-led demand/ growth regime	Expansionary (seemingly profit-led) *or* Seemingly no effect *or* Contractionary (decelerated wage-led)	Contractionary (accelerated wage-led)
Profit-led demand/ growth regime	Expansionary (accelerated profit-led)	Expansionary (decelerated profit-led) *or* Seemingly no effect *or* Contractionary (seemingly wage-led)

Source: Author's.

2. Empirical Evidence

The model presented above gives an illustrative theoretical account on the potentially differing effects of changes in personal and functional income distribution associated with rising inequality and the potential for an alteration of the traditional demand and growth regimes in Kaleckian macroeconomic models. It remains an empirical question which specific effects prevailed in different countries. As has been illustrated by the model above, the estimation of aggregate consumption functions with variables for functional and personal income distribution as regressors is of key importance in this regard. Accordingly, this section provides a brief review on related empirical literature as well as an empirical investigation on aggregate consumption for the United States and Germany.

2.1 Related Empirical Literature

Based on the Bhaduri-Marglin model, a rich empirical literature on the connection between functional income distribution and aggregate demand and growth has grown in the last decades, the results of which are mixed, however. Recent surveys of the literature can be found in Hein (2014, Section 7.4) or Engelbert Stockhammer and Rafael Wildauer (2016, pp. 1616-1618). Different econometric methods have been employed to investigate the question on wage- *vs*. profit-led demand and growth regimes. As Stockhammer and Wildauer (2016) point out, the findings of the strand in the literature that makes use of VAR-models or panel methods are mixed. Authors who rely on single equation procedures, in contrast, find wage-led domestic demand in most countries, yet, the results on external trade are mixed too (ibid.). This section will only briefly describe the main and rather robust findings on the connection between consumption or saving behaviour and functional income distribution. The main focus then lies on the empirical studies which directly or indirectly estimate the relationship between personal income distribution and aggregate consumption or saving behaviour.

The effect of functional income distribution on aggregate consumption or saving is usually estimated in a single equation approach and the findings are relatively robust across different studies (Hein 2014, Section 7.4). The consumption or saving function is often estimated as a function of the profit share or, alternatively, as a function of both, the sum of wages and the sum of profits (Hein and Lena Vogel 2008, Table 1). These studies find statistically significant differences between the marginal propensity to consume (or save) out of profit and wage income (Hein 2014, p. 300). Therefore, one of the most robust findings on the empirical connection between aggregate demand and functional income distribution is that aggregate consumption is inversely related to redistribution in favour of profits.

While there are many empirical studies which report microeconometric evidence for Veblen effects, the relative income hypothesis and the importance of interdependent preferences at the individual level (David Neumark and Andrew Postlewaite 1998; Francisco Alpizar, Fredrik Carlsson, and Olof Johansson-Stenman 2005; Samuel Bowles and Yongjin Park 2005; Erzo F. P. Luttmer 2005; Enrichetta Ravina 2007; Parfait U. Gasana 2009), only a few empirical studies investigate the relationship between personal income distribution and aggregate consumption or saving. The results of Christopher Brown (2004) and Carvalho and Rezai (2016) for the US suggest negative (positive) aggregate effects of increasing personal income inequality on consumption (saving) behaviour. Brown (2004) is estimating a single equation time series model for US consumption expenditures over the period 1978-2000. Besides disposable income and a consumer sentiment variable, he includes the Theil-Index as an explanatory variable that measures private sector (non-supervisory worker) wage inequality between industries. He finds a statistically significant negative effect of rising inequality on consumption expenditure. Carvalho and Rezai (2016) estimate a two-dimensional threshold vector autoregressive model including capacity utilisation and the labour income share for the US from 1967 to 2010. While they are not directly controlling for personal income inequality, their threshold variable is the Gini index, which allows them to estimate different coefficients for regimes of low and high personal income inequality respectively. Their threshold for the two regimes corresponds to the value of the Gini in 1981. With this methodology, they can investigate whether the level of personal income inequality had an influence on the responsiveness of capacity utilization to functional income distribution. They find that the US is in an overall profit-led demand regime, but that the increase in inequality after 1981 has made US aggregate demand more profit-led, which would correspond to an increase of the propensity to save out of wages due to increasing wage inequality. The empirical studies of Brown (2004) and Carvalho and Rezai (2016) are in line with the absolute income hypothesis and more sophisticated versions of the permanent income or life-cycle hypothesis with bequest, precautionary savings, etc. They would therefore reject an explanation of the falling saving rate in the US based on relative consumption concerns and rising personal income inequality. Given these findings, the fall of the aggregate US saving rate would remain a puzzle.

In contrast, the results of Alexander B. Darku (2014) for Canada, and Jan Behringer and Van Treeck (2015), for a panel of twenty countries including the US, find strong empirical evidence for negative effects of rising personal income inequality on household saving rates through relative consumption concerns. Darku (2014) is using a panel including all ten Canadian provinces to estimate the relationship between personal saving rates and personal income inequality (1981-2010), which is represented by the Gini coefficient. Controlling for standard determinants of saving rates, he finds a statistically significant negative effect of increasing inequality for Canada as a whole, as well as for seven out of ten provinces. His results are robust to using the Kuznets ratio as a variable for personal income inequality. Behringer and Van Treeck (2015) use a panel of twenty countries to estimate the effects of personal and functional income distribution on household and corporate financial balances as well as on the current account for the years 1972-2007. They control for standard explanatory variables and use the Gini index, and different top income shares, as measures of personal inequality. They find that rising personal income inequality leads to a statistically significant decrease of the private household financial balance and the current account. In addition, they find that a fall in the wage share leads to a statistically significant increase in the current account. Furthermore, Wildauer (2016) exploits the unique features of the Survey of Consumer Finances (SCF) to explore jointly the role of personal income distribution and asset prices (i.e. the importance of Minskyian households) on US household borrowing. He finds support for the expenditure cascades hypothesis conditional on homeownership and argues for a synthesis of research on expenditure cascades and Minskyian financial dynamics. The results of Darku (2014), Behringer and Van Treeck (2015) and Wildauer (2016) confirm a relative income hypothesis explanation of falling saving rates and increasing personal income inequality in Canada and the US, as well as in other countries.

In contrast to these five studies, Stockhammer and Wildauer (2016) present evidence for another panel of eighteen countries that there are neither negative nor positive effects of personal income distribution on aggregate consumption. They estimate aggregate demand and its components in a panel of eighteen OECD countries in the period from 1980 to 2013. In their specifications of the consumption function, they include GDP as a measure for income, the wage share as a measure for functional income inequality and different variables for personal income inequality: two different measures of the Gini index and the top 1% income share. In addition, they include variables for household debt, as well as property and stock prices, as a measure for household wealth. They find that redistribution in favour of wage income has a modest but robust positive statistically significant effect on consumption. They also find that household debt has significant positive effects on aggregate consumption. Their estimation provides only weak evidence for wealth effects, since the estimated coefficients on property prices are often statistically insignificant and small, and stock prices have no statistically significant effects at all. With respect to personal inequality, Stockhammer and Wildauer (2016) fail to find any statistically significant effects on aggregate consumption, which they interpret as evidence against the existence of relative income or consumption effects at the aggregate. However, it can be argued that their findings are in line with theories of interdependent social norms, although, in contrast to the findings of Darku (2014) and Behringer and Van Treeck (2015), they suggest that potentially negative absolute income effects and potentially positive relative income effects of increasing personal income inequality have compensated each other, such that no aggregate effect on consumption emerged. They also include the personal inequality variables into estimations of investment. While they find no statistically significant effects of the top income share, they find a statistically significant negative effect on investment for the Gini index, which they interpret as evidence that any relative status effects on housing do not influence aggregate investment.

What emerges from this literature is that the econometric evidence on the relationship between personal income inequality and aggregate consumption or saving and aggregate demand is rather mixed. One reason for the mixed results of empirical investigations of personal income inequality and aggregate consumption and saving might be that the data on consumption and saving are not complements. In theory, household saving and consumption would move “in step”, though with opposite signs. This is not the case for the data on saving and consumption. There are a number of private household expenditures which do not count as consumption in the national accounts, but which nevertheless draw down their savings. This is especially true for some positional goods which are defined as being especially relevant for social status comparison (Frank 2005). While the empirical studies which investigate aggregate consumption (Brown 2004; Stockhammer and Wildauer 2016) do not find evidence for relative income effects, the studies which investigate household financial balances or saving rates (Darku 2014; Behringer and Van Treeck 2015; Wildauer 2016) do find such evidence.

Nevertheless, two aspects of the findings in the empirical literature seem particularly puzzling. With respect to the findings of Brown (2004), Darku (2014) and Carvalho and Rezai (2016) it seems questionable if it is really true that two countries, with such a similar development in personal income inequality and consumption as a share of GDP or saving rates, as Canada and the US, are so different when it comes to the connection between these variables. Second, with respect to the findings of Behringer and Van Treeck (2015) and Stockhammer and Wildauer (2016), one can ask if general relationships between personal income inequality and saving or consumption behaviour within a set of several countries can really be assumed, since consumer and financial norms are probably strongly heterogeneous across different countries such as the US, Germany and China, for example, which would also lead to different relationships between personal income inequality and consumption. While panel estimation techniques can control for country heterogeneity to some extent the results of Behringer and Van Treeck (2015) and Stockhammer and Wildauer (2016) are hardly compatible with each other. In the next subsections, we will therefore investigate the question on the relationship between the size distribution of income and aggregate consumption for Germany and the US separately in different single equation estimations.

2.2 Data and Estimation Strategy

We apply our econometric analyses to two countries, which experienced quite different developments in the decades prior to the Great Recession: the US and Germany. For the US and other countries with strongly increasing personal income inequality and falling saving rates, we would expect that we can find some empirical evidence for a positive connection between personal inequality and aggregate consumption. This would fit well to a positive η in the theoretical model presented above. In contrast to the US, we would rather expect not to find evidence for a positive relationship between personal inequality and consumption for Germany. As we are also interested in the effects of functional income inequality, we also investigate the empirical relationship between functional income inequality and aggregate consumption in both countries. We would expect to find an inverse relationship in both countries, since the empirical literature is rather clear on that account.

We make use of the commonly used empirical specification of the consumption function in single-equation form as applied in Hein and Vogel (2008), Özlem Onaran and Giorgos Galanis (2014) and Onaran and Thomas Obst (2016), for example. Onaran and Galanis (2014) and Onaran and Obst (2016) provide a discussion on the advantages of this approach compared to VAR models in the context of estimating aggregate demand.

The annual data we are using for the estimation are retrieved from different sources:

- The variables that can be represented by national accounts data (i.e. real private consumption (C), total gross profit income (Π) and total wage income (W) were obtained from the Annual Macro-Economic Database (AMECO) of the European Commission (European Commission 2016)[1].
- We use different variables for personal income inequality:
  (i) The estimated Gini index ($GINI$) from the Standardized World Income Inequality Database (SWIID) (Frederick Solt 2014);
  (ii) The top (10%, 5% and 1%) income shares (TIS) of the World Wealth and Income Database (2016)[2];
  (iii) Note that the data on the top income shares for Germany are only available at four-year frequency in the period from 1960 to 2000. Also, the series of the Gini index for Germany has gaps in 1961, 1963, 1965 and 1966. Therefore, the missing data points for the inequality variables were constructed by linear interpolation for Germany.
- In addition to including inequality variables, we control for wealth effects by including data on private net wealth (non-financial assets + financial assets - liabilities) retrieved from the World Wealth and Income Database.
- For the US, we also control for debt effects by including data on total credit of households and non-profit-institutions serving households (NPISH) taken

[1] **European Commission.** 2016. Annual Macro-Economic Database. http://ec.europa.eu/economy_finance/ameco/user/serie/SelectSerie.cfm (accessed July 7, 2016).
[2] **World Wealth and Income Database.** 2016. World Inequality Database. http://www.wid.world (accessed July 7, 2016).

from the Bank for International Settlements (BIS 2017)[3]. For Germany, we cannot control for debt effects due to data availability.

Due to data availability, the sample for the US is 1960-2012 and for Germany it is 1960-2008 for the estimations including the top income shares and 1960-2012 for those including the Gini. Table 6 in the Appendix provides specific definitions, time periods and sources for each of the variables we are using in the estimations.

For clarification, it should be noted that the use of total gross operating surplus for aggregate profit income is reflecting the fact that a substantial part of profit income is retained by firms and therefore saved by definition, which plays an important role for the effects of functional income distribution.

We apply a single equation approach to the data for varying time periods. To avoid spurious regressions, all variables are tested for stationarity. Results of Augmented Dickey-Fuller tests (ADF) are reported in the Appendix. Most of the variables in log-transformed levels were found to be integrated of order one. Furthermore, the two-step Engle-Granger approach, as outlined in Uwe Hassler (2004), was applied to test for cointegration (see Appendix). Due to the relatively small number of observations in the sample it was not possible to apply the Johansen test for cointegration. For the US, the Engle-Granger tests find cointegration relationships between aggregate consumption and total wage income and between consumption and all inequality variables, which induces us to estimate error correction models (ECM) for aggregate consumption in logarithmic form. For Germany, the tests failed to find long-term relationships between consumption and the explanatory variables which matches other findings in the literature (Hein and Vogel 2008; Onaran, Stockhammer, and Lucas Grafl 2011; Onaran and Galanis 2014; Onaran and Obst 2016). Therefore, a logarithmic first differences specification is used in the estimations for Germany.

For the US, we first estimate the long-term relationship between the cointegrated variables in logarithmic levels of the following form:

$$c_t = \alpha_0 + \alpha_1 w_t + \alpha_2 q_t + z_t \tag{12}$$

where c_t stands for the log of real private final consumption expenditure, α_0 is a constant, w_t is the log of real compensation of employees of the total economy, q_t is the log of the respective inequality variable and z_t is the error term for which the usual assumptions are applied. For the different inequality variables $gini_t$ depicts the log of the Gini index and ... tis_t depicts the log of the respective top income share (10%, 5% or 1%). Equation (12) is purely based on the cointegration tests which only found wage income and the different inequality variables to be cointegrated with consumption. Yet, it has to be noted that cointegration between consumption and total gross profit income cannot be tested by the Engle-Granger approach because the ADF-test found profit income to be I(0). However, a long-run estimation of consumption, should also allow for other income sources than wage income. Therefore, for comparison purposes only, we also estimated a long-run equation for consumption with wage income and

[3] **Bank for International Settlements.** 2017. BIS Statistics. https://www.bis.org/statistics/totcredit.htm (accessed January 10, 2017).

inequality as the cointegrating variables and all other explanatory variables as control variables. This equation is given by:

$$c_t = \alpha_0 + \alpha_1 \pi_t + \alpha_2 w_t + \alpha_2 q_t + \alpha_3 nw_t + \alpha_4 hb_t + z_t \tag{13}$$

where π_t is the log of total gross profits, nw_t stands for the log of private net wealth and hb_t for the log of total credit of households and non-profit-institutions serving households. Secondly, we estimate error correction models including profit income (Π), wage income (W), private net wealth (NW), houshold borrowing (HB), the respective inequality variable (Q) and lagged endogenous variables as the short-term regressors. The error correction term (ECT_{t-1}) of the respective model is given by the lagged estimated residuals of Equation (12). Only for comparisons purposes again, we also present estimations of ECMs with the ECT_{t-1} given by lagged estimated residuals of Equation (13). The general framework for the estimation procedure is given by the following equation where lower case letters indicate logarithmic transformation, Δ denotes the first difference operator and ϵ_t is the error term applying usual assumptions:

$$\Delta c_t = const + \sum_{i=1}^{n} \beta_{AR,i} \Delta \mathrm{c}_{t-1} + \sum_{i=0}^{n} \beta_{\pi,i} \Delta \pi_{t-i} + \sum_{i=0}^{n} \beta_{w,i} \Delta \mathrm{w}_{t-i} + \sum_{i=0}^{n} \beta_{nw,i} \Delta \mathrm{nw}_{t-i} + \sum_{i=0}^{n} \beta_{hb,i} \Delta \mathrm{hb}_{t-i} + \sum_{i=0}^{n} \beta_{q,i} \Delta \mathrm{q}_{t-i} + \gamma ECT_{t-1} + \epsilon_t. \tag{14}$$

Starting with one lag for each explanatory variable and following the general-to- specific approach, insignificant lags are successively eliminated from the equation and different post-estimation tests are employed.

For Germany, we extend the usual single equation specification to directly take the potential effects of personal income inequality into account, while we also control for wealth effects. The general estimation equation is of the following form:

$$\Delta c_t = const + \sum_{i=1}^{n} \alpha_{AR,i} \Delta \mathrm{c}_{t-1} + \sum_{i=0}^{n} \alpha_{\pi,i} \Delta \pi_{t-i} + \sum_{i=0}^{n} \alpha_{w,i} \Delta \mathrm{w}_{t-i} + \sum_{i=0}^{n} \alpha_{nw,i} \Delta \mathrm{nw}_{t-i} + \sum_{i=0}^{n} \alpha_{q,i} \Delta \mathrm{q}_{t-i} + \epsilon_t. \tag{15}$$

Starting from this general equation, again insignificant lags are successively eliminated to obtain a parsimonious model.

Estimation of all the above regression equations was done by applying the method of ordinary least squares. The next section presents the estimated coefficients of the parsimonious models found in our estimation procedure and a discussion of the implications we can draw from them.

2.3 Results

The first four columns of Table 2 present the estimated long-run coefficients of the cointegration relationship based on Equation (12) for different measures of inequality. For comparison, the last four columns of the table present estimations of Equation (13) for different measures of inequality. As can be seen from Table 2 the estimated long-term wage income elasticity of consumption is about 1 in the first four columns based on Equation (12), and roughly between 0.7 and 0.8 in the last four columns based on Equation (13). From a Keynesian/Kaleckian perspective, a relatively high long-run elasticity of consumption to wage income seems to be a reasonable result.

Regarding inequality, we found positive long-run relationships between aggregate consumption and personal income inequality. The estimated long-run personal inequality elasticity of US consumption is highest for the top 10% income share, followed by the Gini index, the 5% share and substantially lower for the 1% share. This result might indicate that expenditure cascades where indeed triggered by redistribution from the very top (1% and 5%) but that the effects on consumption where much stronger when redistribution happened in favour of the top 10% and at the middle of the income distribution (as reflected by gini). This would be in line with the argument that the richest income groups in terms of emulation behaviour are a somewhat "distant" stratum for majority of society. This finding casts some doubt on the theoretical argument related to expenditure cascades which maintains that redistribution at the very top (top 1%) can have the strongest impact on aggregate consumption (Frank, Levine, and Dijk 2014).

This result is a bit difficult to explain within the more complex macroeconomic models that have been proposed to include emulation and personal income inequality, which usually either assume that there is emulation of the "super rich" and therefore, strong cascades from the top to the bottom, or that there is no emulation of the richest strata, but only emulation between low- and high-wage earning households. Perhaps, we can make sense of it in the following way: while there is an effect of redistribution towards the top 1% and 5% on aggregate consumption, this effect might be triggered by emulation within the richer classes. It seems reasonable to assume that the types of goods purchased are different from the ones that are important for emulation behaviour at the middle of the income distribution. Therefore, the emulation of the 1% and 5% does not cascade down from the very top to the very bottom of the distribution, but rather, there are several disconnected emulation patterns in the economy. Of course, the positive long-term effects of the different inequality variables can also be connected, at least in part, to habit persistence including minimum levels of consumption, which essentially also is a form of relative consumption behaviour, since perceived minimum levels of consumption are determined by social norms once the standard of living exceeds a certain threshold (Kapeller and Schütz 2015, p. 65).

Table 3a and 3b show the estimated coefficients of the error correction models for the United States in the period from 1960 to 2012, with Table 3a presenting the estimations with all variables and lagged values and Table 3b containing the parsimonious versions. The first four columns of Tables 3a and 3b include estimations with the ECT_{t-1} based on the estimations of Equation (12). The parsimonious models in Table 3b only include the lag of net wealth as a lagged exogenous variable in first differences. There are no contemporaneous variables of inequality in the parsimonious models, since they always turned out to be statistically insignificant at the commonly used significance levels. Note that all estimated coefficients on the error correction terms (ECT_{t-1}) in the first four columns of Tables 3a and 3b are negative and highly significant. This verifies our cointregration tests because negativity and high significance of the error correction term are necessary for cointegration relationships. For comparison again, the ECM estimations in the last four columns of Tables 3a and 3b are based on the long-run estimation of Equation (13), however, compared to the first four columns the resulting models differ mainly by net wealth becoming insignificant and lagged debt being significant (but negative), while the estimated coefficients of profit and wage income show no qualitative differences.

The estimated short-term coefficients on the contemporaneous variables of profit and wage income in first differences in Tables 3a and 3b confirm the standard finding of a higher elasticity of aggregate consumption to an increase in wage income than to an increase in profit income. This result is robust across all the estimations, since the size of the estimated coefficients does not vary strongly and the coefficients on $\Delta\pi_t$ and Δw_t, are all significantly different from zero at the 1% significance level. We also tested for issues related to misspecification, heteroscedasticity and serial correlation in the residuals, as can be seen from the lower part of Table 3b. The post-estimation diagnostics for the non-parsimonious estimations of Table 3a are reported in the appendix (see Table 11). We cannot reject the null hypothesis of no general misspecification, tested by the Ramsey RESET test, for any of the usual significance levels in any of the regressions. The same holds true for the null hypothesis of homoscedasticity of the White-Test and there is also no evidence for autocorrelated residuals, as the Breusch-Godfrey test did not allow for a rejection of the null hypothesis of no autocorrelation. We also cannot reject the null hypothesis of normally distributed residuals.

Table 2 Coefficients of the Long-Run Relationship between Consumption (Dependent Variable), Wages and Different Inequality Variables, US 1960-2012

	Long-run estimation with cointegrating variables				Long-run estimation with all explanatory variables			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
π_t					0.2069	0.2178	0.2268	0.236
w_t	1.067	0.965	0.987	1.00	0.7837	0.726	0.7055	0.689
$gini_t$	0.402				0.2538			
$10\%tis_t$		0.503				0.3315		
$5\%tis_t$			0.319				0.173	
$1\%tis_t$				0.166				0.0815
nw_t					-0.1367	-0.1099	-0.104	-0.1025
hb_t					0.1497	0.1139	0.134	0.1458
Obs.	51	51	51	51	51	51	51	51

Notes: Cointegration tests failed to find a long-run relationship between consumption and profits, net wealth, household debt, respectively, therefore, the last four columns are for comparison purposes only. Data corrected for outliers in 1983 and 2009.

Source: Own calculation.

Table 3a ECM Estimations of Consumption with Different Variables for Personal Income Inequality; Non-Parsimonious Estimations with All Explanatory Variables, and Lagged Values, US 1960-2012

	Estimation with all variables and lagged values							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
const	0.011*** (0.002)	0.008*** (0.002)	0.009*** (0.002)	0.009*** (0.002)	0.010*** (0.002)	0.009*** (0.003)	0.010*** (0.003)	0.010*** (0.003)
Δc_{t-1}	0.0388 (0.146)	0.0983 (0.148)	0.0767 (0.148)	0.0659 (0.148)	0.0445 (0.159)	0.0973 (0.162)	0.0755 (0.162)	0.0686 (0.162)
$\Delta \pi_t$	0.111*** (0.03)	0.118*** (0.03)	0.119*** (0.030)	0.124*** (0.031)	0.130*** (0.033)	0.14*** (0.035)	0.136*** (0.036)	0.137*** (0.037)
$\Delta \pi_{t-1}$	-0.0424 (0.0336)	-0.0423 (0.0339)	-0.0426 (0.0342)	-0.0400 (0.0346)	-0.0780** (0.0356)	-0.0742** (0.0352)	-0.0742** (0.0357)	-0.0730* (0.0359)
Δw_t	0.521*** (0.0644)	0.528*** (0.0613)	0.527*** (0.0617)	0.529*** (0.0628)	0.489*** (0.0686)	0.469*** (0.0673)	0.471*** (0.0684)	0.470*** (0.0712)
Δw_{t-1}	-0.0123 (0.108)	-0.0356 (0.108)	-0.0209 (0.107)	-0.0110 (0.107)	0.0369 (0.115)	-0.00958 (0.119)	0.0165 (0.117)	0.0255 (0.116)
ECT_{t-1}	-0.153*** (0.0439)	-0.186*** (0.0561)	-0.164*** (0.0504)	-0.151*** (0.0472)	-0.229** (0.0961)	-0.238** (0.109)	-0.192* (0.0953)	-0.175* (0.0930)
$\Delta gini_t$	-0.00821 (0.0732)				0.0587 (0.0871)			
$\Delta gini_{t-1}$	-0.0206 (0.0702)				0.0219 (0.0777)			
$\Delta 10\%tis_t$		0.0499 (0.0586)				0.0415 (0.0652)		
$\Delta 10\%tis_{t-1}$		-0.00236 (0.0559)				0.00708 (0.0609)		
$\Delta 5\%tis_t$			0.0294 (0.0371)				0.0198 (0.0408)	
$\Delta 5\%tis_{t-1}$			0.00284 (0.0358)				0.0128 (0.0387)	
$\Delta 1\%tis_t$				0.0128 (0.0175)				0.00815 (0.0193)
$\Delta 1\%tis_{t-1}$				0.00154 (0.0175)				0.00559 (0.0192)
Δnw_t	0.0373 (0.0256)	0.0423 (0.0269)	0.0392 (0.0270)	0.0363 (0.0274)	0.0111 (0.0288)	0.0168 (0.0291)	0.0182 (0.0295)	0.0182 (0.0299)
Δnw_{t-1}	-0.0579* (0.0315)	-0.0789** (0.0306)	-0.0776** (0.0309)	-0.0787** (0.0306)	-0.0395 (0.0358)	-0.0499 (0.0349)	-0.0541 (0.0351)	-0.0555 (0.0350)
Δhb_t	0.145** (0.0597)	0.122* (0.0632)	0.131** (0.0631)	0.132** (0.0638)	0.233*** (0.0672)	0.211*** (0.0672)	0.216*** (0.0688)	0.216*** (0.0698)
Δhb_{t-1}	-0.0676 (0.0510)	-0.0244 (0.0565)	-0.0355 (0.0559)	-0.0408 (0.0559)	-0.142** (0.0570)	-0.0944 (0.0558)	-0.109* (0.0564)	-0.114* (0.0572)
Obs.	45	45	45	45	45	45	45	45

Notes: Standard errors in parentheses. ***, **, * indicates significance at the 1%, 5%, 10% level, respectively. Refer to Table 2 for the specific estimation of the long-run relationship for each of the short-term estimations. Data corrected for outliers in 1983 and 2009. Post-estimation statistics can be found in Table 11 of the Appendix.

Source: Own calculation.

Table 3b ECM Estimations of Consumption with Different Variables for Personal Income Inequality; Parsimonious Estimations, US 1960-2012

	Parsimonious model estimations							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
const	0.011*** (0.002)	0.010*** (0.002)	0.010*** (0.002)	0.011*** (0.002)	0.012*** (0.002)	0.010*** (0.002)	0.011*** (0.002)	0.011*** (0.002)
$\Delta\pi_t$	0.118*** (0.028)	0.121*** (0.028)	0.123*** (0.028)	0.126*** (0.029)	0.127*** (0.029)	0.145*** (0.032)	0.142*** (0.032)	0.143*** (0.032)
$\Delta\pi_{t-1}$					-0.062** (0.026)	-0.064** (0.026)	-0.062** (0.026)	-0.059** (0.027)
Δw_t	0.524*** (0.051)	0.516*** (0.051)	0.517*** (0.051)	0.523*** (0.051)	0.473*** (0.048)	0.459*** (0.051)	0.462*** (0.051)	0.463*** (0.052)
Δw_{t-1}								
ECT_{t-1}	-0.119*** (0.039)	-0.137*** (0.042)	-0.122*** (0.039)	-0.114*** (0.036)	-0.23*** (0.064)	-0.254*** (0.077)	-0.225*** (0.072)	-0.214*** (0.071)
Δnw_t	0.0499** (0.023)	0.046** (0.023)	0.047** (0.023)	0.047** (0.023)				
Δnw_{t-1}	-0.085*** (0.025)	-0.082*** (0.025)	-0.082*** (0.025)	-0.084*** (0.025)				
Δhb_t	0.068** (0.026)	0.088*** (0.026)	0.084*** (0.026)	0.078*** (0.026)	0.250*** (0.048)	0.239*** (0.048)	0.242*** (0.049)	0.241*** (0.05)
Δhb_{t-1}					-0.153*** (0.039)	-0.115*** (0.039)	-0.128*** (0.039)	-0.134*** (0.04)
Adj. R^2	0.900	0.902	0.901	0.901	0.913	0.910	0.908	0.907
Breusch-Godfrey (P)	0.759	0.789	0.780	0.798	0.922	0.739	0.712	0.684
Ramsey RESET test (P)	0.285	0.427	0.395	0.361	0.453	0.729	0.761	0.792
White-Test (P)	0.608	0.231	0.286	0.360	0.245	0.254	0.186	0.136
NORM (P)	0.642	0.587	0.593	0.675	0.8576	0.902	0.873	0.825
Obs.	48	48	48	48	46	46	46	46

Notes: Standard errors in parentheses. ***, **, * indicates significance at the 1%, 5%, 10% level, respectively. Refer to Table 2 for the specific estimation of the long-run relationship for each of the short-term estimations. Cointegration tests failed to find a long-run relationship between consumption and profits, net wealth, household debt, respectively, therefore, the last four columns are for comparison purposes only. Data corrected for outliers in 1983 and 2009.

Source: Own calculation.

The coefficients on net wealth are significant across the regressions in the first four columns of Table 3b. However, they imply (small) negative effects of increasing wealth after one year (since $\beta_{nw,0} + \beta_{nw,1} < 0$), which seems implausible. Simple F-tests for joint significance of nw_t and nw_{t-1} retained this implication for each of the regressions (results available upon request). Kim, Setterfield, and Yuan Mei (2015, pp. 99-101) find also somewhat inconclusive evidence on short-run wealth effects for the US, since the coefficients of their wealth variables are rather small and not robust across different specifications. Stockhammer and Wildauer (2016) also do not find robust wealth effects in their panel. They argue that the wealth effects may not be captured by direct measures of wealth, but are reflected by their debt variable, because wealth is a prerequisite to obtain credit, especially housing wealth for equity withdrawals. Indeed, our debt variable shows a positive effect on consumption and is highly significant across all regressions of Tables 3a and 3b, with the effects being of a similar size as the ones found in Kim, Setterfield, and Mei (2015) for the period 1980-2011. In addition, net wealth becomes insignificant in the regressions of the last four columns of Tables 3a and 3b.

Table 4 Partial Effects of a Change in the Profit Share on the GDP Growth Contribution of Consumption, US 1960-2012

Inequality variable used in estimation:	$gini_t$	$10\%tis_t$	$5\%tis_t$	$1\%tis_t$
$\frac{\partial C/Y}{\partial h}$	-0,3753	-0,3596	-0,3567	-0,3576

Notes: $\frac{\partial C/Y}{\partial h} = e_{c,\pi}\frac{C}{\Pi} - e_{c,w}\frac{C}{W}$ with $e_{c,x}$ denoting the respective estimated elasticity and using average values for $\frac{C}{\Pi}$ and $\frac{C}{W}$ over the sample period.

Source: Own calculation.

Our results on the short-run income elasticities for the US resemble the ones in the literature (Hein and Vogel 2008; Onaran and Galanis 2014). Table 4 presents the partial effect of a change in the profit share on the GDP growth contribution of consumption based on the estimated elasticities in the first four columns of Table 3b and average values over the sample period. The calculated partial effects confirm the contractionary effect of redistribution in favour of profit income on aggregate consumption. Since we did not find significant short-run coefficients on the inequality variables, we fail to find short-run effects of personal income distribution. On the one hand, this can be interpreted such that there were no positive short-run aggregate effects of increasing inequality on aggregate private final consumption expenditure in the United States for the estimated period (except for the error adjustment whenever there was a divergence from the cointegration relationship). However, it is also possible that the frequency of the available data on inequality is not sufficient to reveal an existing positive short-run relationship between personal income inequality and aggregate consumption. In the light of the estimated positive long-run relationships we therefore remain reluctant to reject the existence of a positive dynamic between inequality and consumption in the short run in the sample period.

In any case, our findings deliver evidence that the increase in personal income inequality had no negative, but a positive long-term effect on aggregate consumption in the US. This result contrasts with the traditional Keynesian view based on the absolute income hypothesis, and with various versions of the permanent income hypothesis that include precautionary savings or other assumptions that lead to an inverse relationship between the two, which means that there is no evidence that η in the macroeconomic model discussed above was negative in the US within our sample period. Therefore, our result for the US stand in contrast to the findings of Brown (2004) and Carvalho and Rezai (2016), who find negative effects of personal income inequality for the US. The implication of our findings in terms of the macroeconomic model of Section 1 would be that for the US η had a positive sign over most of the sample period and that the assumption of a positive differential between the propensity to save from profits and the propensity to save from wages is justified. Therefore, changes in personal and functional income inequality had diverging effects on US aggregate consumption.

Table 5 shows the results of the short-run estimations for Germany. The first four columns present estimations with all variables and lagged values, while the second part of the table contains parsimonious estimations. The results for the short-run coefficients on profits and wages are similar to the ones for the US and also resemble the coefficients found for Germany in the literature (e.g. Hein and Vogel 2008; Onaran and Galanis 2014; Onaran and Obst 2016). There is again a substantial difference between the profit and the wage income elasticity of real private final consumption expenditures. The responsiveness of consumption with respect to wage income is substantially higher than the responsiveness with respect to profits. This is in line with the standard results on functional distribution and consumption. The coefficients on $\Delta\pi_t$ and Δw_t are highly significant across our different estimation equations. Again, we cannot reject the null hypothesis of no general misspecification tested by the Ramsey RESET test for any of the usual significance levels in any of the regressions. The same holds true for the null hypothesis of homoscedasticity of the White-test and there was no evidence for autocorrelated residuals from the Breusch-Godfrey test-statistic.

The last row of Table 5 presents the partial effects of a change in the profit share on the GDP growth contribution of consumption for each estimation. Again, the calculated partial effects confirm the contractionary effect of redistribution in favour of profit income on aggregate consumption. The contemporary control variable for wealth effects is statistically significant in all estimations and implies positive wealth effects on German aggregate consumption. Regarding the estimated short-run coefficients on the personal inequality variables, there is a difference to our findings for the US. While we fail to find effects of the top income shares that are statistically different from zero at one of the commonly used significance levels, we find a relatively small negative effect of an increase in the Gini index that is significant at the ten percent level after eliminating all insignificant lagged values from the model. In any case, as the coefficient for the summarised Gini is only significant at the ten percent level and there are no statistically significant effects of the top income shares, this would only be a very weak indication for the existence of aggregate negative effects of personal income inequality on aggregate consumption in Germany for the sample period.

The results for Germany do not indicate any aggregate positive effects of personal income inequality on consumption. The η in the theoretical model would not have a positive sign for Germany. This is not surprising given the development of aggregate consumption and inequality in the country. However, the results also do not provide any persuasive evidence for an inverse relationship between aggregate consumption and personal inequality. Therefore, the η in our macro model would not be negative either but would be zero instead. This more or less corresponds to the findings of Stockhammer and Wildauer (2016) and, therefore, is in line with theories of interdependent social norms in which relative and absolute income effects of rising personal income inequality cancel each other out.

Table 5 Short-Term Estimations of Consumption with Different Variables for Personal Income Inequality, Germany 1960-2008/12

	Estimation with all variables and lagged values				Parsimonious model estimations			
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
const	-0.000910 (0.00302)	-0.00112 (0.00333)	-0.000813 (0.00328)	-0.00105 (0.00325)	0.00205 (0.00236)	0.00122 (0.00237)		
Δc_{t-1}	-0.00323 (0.176)	-0.0311 (0.184)	-0.0330 (0.184)	-0.0225 (0.186)				
$\Delta \pi_t$	0.142*** (0.0460)	0.143*** (0.0496)	0.143*** (0.0495)	0.143*** (0.0495)	0.105*** (0.0367)	0.0971** (0.0373)		
$\Delta \pi_{t-1}$	0.0702 (0.0469)	0.0770 (0.0497)	0.0787 (0.0489)	0.0740 (0.0491)				
Δw_t	0.413*** (0.0661)	0.407*** (0.0712)	0.407*** (0.0708)	0.409*** (0.0708)	0.502*** (0.0345)	0.508*** (0.0353)		
Δw_{t-1}	0.103 (0.100)	0.129 (0.104)	0.127 (0.104)	0.123 (0.104)				
$\Delta gini_t$	-0.0376 (0.0493)				-0.0674* (0.0379)			
$\Delta gini_{t-1}$	0.0179 (0.0505)							
$\Delta 10\%tis_t$		-0.0193 (0.0905)						
$\Delta 10\%tis_{t-1}$		0.0239 (0.0846)						
$\Delta 5\%tis_t$			-0.0195 (0.0712)					
$\Delta 5\%tis_{t-1}$			-0.00695 (0.0675)					
$\Delta 1\%tis_t$				0.00160 (0.0401)				
$\Delta 1\%tis_{t-1}$				-0.0122 (0.0386)				
Δnw_t	0.196** (0.0911)	0.217** (0.0910)	0.215** (0.0914)	0.214** (0.0911)	0.136** (0.0533)	0.155*** (0.0539)		
Δnw_{t-1}	-0.0761 (0.0864)	-0.0937 (0.0878)	-0.0958 (0.0874)	-0.0931 (0.0877)				
Adj. R^2	0.8797	0.8719	0.8723	0.8721	0.8878	0.8735		
Breusch-Godfrey (P)	0.7798	0.7891	0.9940	0.8889	0.7734	0.8102		
Ramsey RESET test (P)	0.3894	0.3340	0.3501	0.3389	0.8878	0.8557		
White-test (P)	0.4274	0.4265	0.4265	0.4265	0.6120	0.4153		
NORM (P)	0.3984	0.3358	0.2747	0.3003	0.3817	0.6488		
Obs.	42	41	41	41	46	47		
$\frac{\partial C/Y}{\partial h}$	-0,1836	-0,1752	-0,1752	-0,1774	-0,3493	-0,3705		

Notes: Standard errors in parentheses. ***, **, * indicates significance at the 1%, 5%, 10% level, respectively. Data corrected for outliers in 1975, 1991 and 2009. The sample period of the estimations with the Gini is 1960-2012, for the estimations with top income shares it is 1960–2008. $\partial\ (C/Y)/\ \partial h = e_{c,\pi} C/\Pi - e_{c,w} C/W$, with $e_{c,x}$ denoting the respective estimated elasticity and using average values for C/Π and C/W over the sample period. The sample period of the estimations with the Gini is 1960-2012, for the estimations with top income shares it is 1960-2008.

Source: Own calculation.

3. Conclusion

A simple post-Kaleckian model of distribution and growth was presented that incorporates personal income inequality and interdependent social norms. This was achieved by making the propensity to save out of wage income endogenous with respect to personal income inequality. Whether the actual aggregate effect of increasing personal inequality on saving and consumption behaviour is contractionary, expansionary or zero depends on the specific consumption and financial norms prevailing in the model economy. The model shows in an easily accessible manner how personal and functional income inequality can potentially have contrary effects on aggregate demand and growth. It can illustrate some of the major domestic developments in the decades prior to the Great Recession that are connected to inequality, consumption and saving behaviour for different countries. The importance of the consumption function for the prevailing macroeconomic regime provided our motivation for an empirical investigation of aggregate consumption behaviour. We estimated aggregate consumption functions for the United States and Germany to explore whether effects of functional and personal income distribution prevail in these countries. Our results confirm findings of previous studies regarding a substantial differential between the elasticities of aggregate consumption with respect to wage and profit income, underlining the negative relationship between falling wage shares and aggregate consumption. For the US, we also found significant positive long-run effects of personal income inequality on consumption, and thus for the relative income hypothesis, with the effects being strongest for the top 10% income share and the Gini index and substantially less strong effects for the top 5% and 1% income shares. In the econometric analyses for Germany, we found only very weak evidence for negative effects of personal income distribution on aggregate consumption. Generally, these empirical results show that it is important to distinguish between macroeconomic effects of functional and personal income distribution.

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Appendix

A1 Some Basic Model Equations

General price level (mark-up pricing)

$$p = (1+m)\frac{W}{Y}$$

Gross profit share

$$h = \frac{\Pi}{pY} = \frac{pY - W}{pY} = 1 - \frac{W}{pY} = 1 - \frac{1}{1+m} = \frac{m}{1+m}$$

Profit rate

$$r = \frac{hu}{v}$$

A2 Data Sources

Table 6 Description and Sources of the Data

Variable	Description	Source
C	Private final consumption expenditure at 2010 prices; 1960-2012.	AMECO (OCPH)
Π	Gross operating surplus: total economy. Adjusted for imputed compensation of self-employed. Deflated by the price deflator private consumption (2010 = 100); 1960-2012.	AMECO (UQGD)
W	Compensation of employees: total economy. Deflated by the price deflator private consumption (2010 = 100); 1960-2012.	AMECO (UWCD)
GINI	Summarised estimations of the Gini index of inequality in household disposable (post-tax, post-transfer) income; 1960-2012.	SWIID (gini net)
10%	Top 10% income share. US: 1960-2012; Germany: 1960-2008.	World Wealth and Income Database
5%	Top 5% income share. US: 1960-2012; Germany: 1960-2008.	World Wealth and Income Database
1%	Top 1% income share. US: 1960-2012; Germany: 1960-2008.	World Wealth and Income Database
NW	Real private net wealth: non-financial wealth (including housing wealth) plus financial wealth minus liabilities (WID). Deflated by the price deflator GDP (2010 = 100) (AMECO); 1960-2012.	World Wealth and Income Database and AMECO
HB	Real total credit of households and NPISH (BIS). Deflated by the price deflator GDP (2010 = 100) (AMECO); US: 1960-2012.	BIS and AMECO

Notes: For Germany prior to 1991 the data is equal to the values for West Germany due to data availability.

Source: Author's.

A3 Augmented Dickey-Fuller- and Cointegration-Tests

Table 7 ADF-Tests US, H_0: Series Contains a Unit-Root

	Log-level		Log-diff	
	Specification	*t*-statistic	Specification	*t*-statistic
c	c,t,I	-2.250	c, I	-4.256***
π	c,t,I	-4.412***	c, I	-5.555***
w	c,t,I	-2.751	c, I	-4.111***
gini	c, II	-1.184	c, II	-2.816*
10%tis	c,t,I	-2.331	c,I	-4.291***
5%tis	c,t,I	-2.300	c,I	-4.283***
1%tis	c,t,I	-2.380	c,I	-4.439***
nw	c, t, IIIII	-2.009	c,I	-6.067***
hb	c, t, III	-2.620	c,I	-4.373***

Notes: c: constant; t: time trend; I: first lag; II: first and second lag, etc. ***, **, * indicates significance at the 1%, 5%, 10% level, respectively.

Source: Own calculation.

Table 8 ADF-Tests Germany, H_0: Series Contains a Unit-Root

	Log-level		Log-diff	
	Specification	*t*-statistic	Specification	*t*-statistic
c	c,t,I	-1.108	c, I	-4.016***
π	c,t,I	-1.155	c, I	-5.328***
w	c,t,II	-1.725	c, I	-4.451***
gini	c, I	-1.768	c, I	-6.456***
10%tis	c,t,I	-0.151	c,II	-4.057***
5%tis	c,t,I	-0.817	c,I	-3.480**
1%tis	c,t,I	-1.198	c,IIII	-3.221**
nw	c, t, II	-1.803	c,II	-3.266**

Notes: c: constant; t: time trend; I: first lag; II: first and second lag, etc. ***, **, * indicates significance at the 1%, 5%, 10% level, respectively.

Source: Own calculation.

Table 9 Cointegration-Tests US, Consumption and Different Explanatory Variables, H_0: Residuals Contain a Unit-Root (no Cointegration)

Log-level		
Explanatory variable(s)	ADF-specification	*t*-statistic
w	c, I	-3.227**
gini	c, II	-3.364**
10%tis	c, I	-3.050**
5%tis	c, I	-3.034**
1%tis	c, I	-2.998**
nw	c, II	-2.012
hb	c, I	-1.690
w, gini	c, I	-3.428*
w, 10%tis	c, I	-4.581***
w, 5%tis	c, I	-4.473***
w, 1%tis	c, I	-4.431***

Notes: c: constant; t: time trend; I: first lag. Corrected for outliers in 1983 and 2009. ***, **, * indicates significance at the 1%, 5%, 10% level, respectively (James G. MacKinnon's (1991) *t*-ratios were used).

Source: Own calculation.

Table 10 Cointegration-Tests Germany, Consumption and Different Explanatory Variables, H_0: Residuals Contain a Unit-Root (no Cointegration)

Log-level		
Explanatory variable(s)	ADF-specification	*t*-statistic
π	c, l	-2.011
w	c, l	-1.048
gini	c, t, l	-1.450
10%tis	c, l	-2.110
5%tis	c, t, l	-0.126
1%tis	c, t, l	-3.088
nw	c, ll	-1.685

Notes: c: constant; t: time trend; l: first lag. Corrected for outliers in 1975, 1991 and 2009. ***, **, * indicates significance at the 1%, 5%, 10% level, respectively (MacKinnon (1991) *t*-ratios were used).

Source: Own calculation.

A4 Post-Estimation Statistics

Table 11 Post-Estimation Statistics for ECM Estimations of Consumption with Different Variables for Personal Income Inequality; Non-Parsimonious Estimations with All Explanatory Variables, and Lagged Values, US 1960-2012

	Estimation with all variables and lagged values							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Adj. R2	0.9148	0.9131	0.9123	0.9120	0.9000	0.8984	0.8963	0.8955
Breusch-Godfrey (P)	0.7760	0.9734	0.5880	0.6693	0.9403	0.7823	0.8837	0.9958
Ramsey RESET test (P)	0.2784	0.2639	0.2797	0.2892	0.5412	0.5346	0.6125	0.7021
White-test (P)	0.4036	0.2383	0.2432	0.2565	0.3143	0.3832	0.3442	0.3230
NORM (P)	0.3854	0.3929	0.4261	0.5180	0.7418	0.8879	0.9320	0.9561

Notes: Estimation results presented in Table 3a.

Source: Own calculation.