Macroeconomic Effects of Personal and Functional Income Inequality - Theory and empirical evidence for the US and Germany*

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Abstract: This paper presents a simple illustrative post-Kaleckian model of distribution and growth that incorporates personal income inequality and interdependent social norms. 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 and global developments in the decades prior to the Great Recession that are connected to inequality, consumption and saving behaviour for different countries. Furthermore, aggregate consumption functions are estimated for the United States and Germany. The finding of previous studies regarding a higher elasticity of aggregate consumption with respect to wage then with respect to profit income is confirmed. We fail to find compelling evidence for effects of personal income distribution in Germany. For the US we find significant positive long-run effects of personal income inequality on consumption with the effect being strongest for the top 10% income share and the Gini index and less strong for the top 5% and 1% income shares.

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1 Introduction

In the decades prior to the recent global financial and economic crisis, some unexpected things happened in a number of countries, most prominently in the United States. From the 1980s onwards, the inequality of incomes across households started to rise tremendously (Piketty and Saez 2006). In the US, this development was paralleled by a moderate, but continuous, decline of the wage share. In the face of the corresponding decline in the share of income going to low income households it would have been reasonable to expect that the rise in inequality would materialise in dampened aggregate consumption and, therefore, a lack of aggregate demand from a traditional Keynesian perspective. In contrast, from a traditional neoclassical viewpoint it would have been reasonable to ignore the surge in inequality because it would have been interpreted as a result of rational allocation that would neither affect aggregate consumption nor saving. However, none of both expectations would have matched the actual development. Indeed, quite the opposite was happening: aggregate consumption strongly increased as a share of GDP in the United States and the aggregate saving rate showed a near continuous fall from 1980 onwards (Van Treeck 2014, p. 424 f.). At the same time, household debt-to-income ratios began to soar to unforeseen heights (Cynamon and Fazzari 2008, p. 18). In contrast to the development in the US and other advanced, largely Anglo-saxon, economies, a different development took place in other countries, one of the most notable examples being Germany (Behringer, Belabed et al. 2013). There, the fall of the wage share was stronger compared to the rise in income inequality across households. Different from the US experience and more in line with traditional Keynesian views, consumption lagged behind previous trends, while household debt-to-income ratios showed no general increase over the period from 1980 to the Great Recession. Yet, Germany saw a strong increase in growth contributions from the current account due to weak domestic demand. Another slightly different development occurred in China, where both

the functional and the personal distribution of income changed dramatically prior to the global crisis. However, China, more similar to the German case than to the US, saw a strong increase in personal saving rates instead of a rise in consumption or household debt-ratios (cf. Van Treeck and Sturn 2012, p. 25-28, Behringer, Belabed et al. 2013, p. 207-211). Like Germany, China too had a high and increasing current account surplus in the decades leading up to the crisis. Because of such strongly differing developments in countries which saw increases in income inequality it seems that the relationship between income inequality, consumption and the macroeconomy is more nuanced than the above mentioned basic theoretical perspectives suggest.

Despite the tremendous rise in inequality, US aggregate consumption increased steadily and the United States experienced a period of relatively stable growth that was only briefly dampened by the burst of the New Economy bubble in the early 2000s. In turn, the relatively robust US growth, due to a large and increasing current account deficit, also stabilised global growth - especially in current account surplus countries like Germany and China. This seemingly stable macroeconomic development inspired some of the most respected economists of the time to believe in what they called the 'Great Moderation' of global capitalism. It was the believe in a new economic era, in which capitalism was extricated from strong business cycle fluctuations and major crises, mainly due to the stabilizing role of new-Keynesian-grounded monetary policy. Unfortunately, what was soon to follow was the the worst global financial and economic downturn since the Great Depression.

By now, there is a large and growing body of research that investigates the link between income inequality and the Great Recession. With respect to the US, one basic line of argument is shared by many authors in different versions (cf. Van Treeck and Sturn 2012, Van Treeck 2014): rising personal income inequality in the US intensified pressure on low and middle income households, which in

turn went increasingly into debt to maintain or increase expenditures. While the regulation of the financial system became increasingly inefficient after 1980, this behaviour on the consumption and credit demand side was coupled with fearless lending behaviour on the credit supply side and a financial crisis became hard to avoid. However, the above mentioned examples of Germany and China suggest that this is not a necessary outcome of increasing inequality, and while the explanation might fit to the US case it seems implausible to serve as a general explanation of the link between inequality and the global crisis. Indeed, the different development of consumption and saving, despite rising income inequality, in countries like China and Germany corresponded to growing global and regional imbalances, which are often seen as yet another major cause of the Great Recession and the subsequent crisis in the Euro area.

While inequality was almost extinct as a research topic in mainstream economics prior to the Great Recession, it had a comeback with a number of publications in more recent years.[1] At least with the publication of 'Capital in the Twenty-First Century' (Piketty 2014) inequality as a major topic has also found its way back into major public and political debates about contemporary capitalism. These mainstream publications focus on the distribution of wealth and income across households, which is known as the personal income and wealth distribution.[2] On the other hand, distributional conflict has been at the heart of post-Keynesian economics (cf. Hein 2014). The focus has been, however, on the distribution of income between wages and profits, which is known as the functional income distribution. While this focus led to rich theoretical and empirical literature on macroeconomic effects of functional income inequality, the post-Keynesian literature on macroeconomic effects of changes in personal income distribution

[1] See for example Rajan (2010), Kumhof and Ranciere (2010), Stiglitz (2012) and Kumhof, Ranciere et al. (2012).

[2] Grüning et al. (2015) is a notable exception. Using the neoclassical notion of the 'corporate veil', they incorporate functional income inequality into a heterogeneous-agent dynamic stochastic general equilibrium model building on the framework of Kumhof, Ranciere et al. (2012).

is much less comprehensive. However, as the brief outline of the developments prior to the Great Recession suggests there are strong theoretical and empirical arguments that both of the above mentioned distributional conflicts, personal income distribution and functional income distribution, play an important role for economic developments. In the light of these arguments, it seems difficult to justify the different emphases placed on personal and functional income inequality by mainstream and post-Keynesian economics (cf. Van Treeck 2014).

Accordingly, this paper deals with the theoretically ambiguous macroeconomic effects of changes in personal *and* functional income distribution. The main questions to be investigated are the following:

> What are the potential effects of changes in personal and functional income distribution on aggregate demand and growth from a theoretical viewpoint?
>
> What does the empirical evidence suggests in terms of aggregate consumption demand for the United States and Germany?

These questions will be investigated from two related angles: post-Keynesian macroeconomic theory and econometric estimation, respectively. First, Section 2 briefly summarises different attempts to include personal income inequality and interdependent social norms into Kaleckian macroeconomic models. These models are usually very complex and often solved by numerical simulation. Based on the the literature on interdependent behavioural norms the paper tries to overcome the corresponding lack of accessibility and traceability by providing a simple and illustrative post-Kaleckian model of distribution and growth that is open to different relationships between personal inequality and aggregate demand and growth. The macroeconomic effects of personal and functional income distribution are then discussed within this framework. Section 3 provides an investigation of related empirical literature. The focus is on the macroeconomic effects of personal income inequality, as 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 United States and Germany in order to investigate the effects of personal income and functional income distribution. The last section concludes.

Since the relationship between inequality, consumption and the macroeconomy is very complex this paper has some obvious limitations. For example, the thesis is not discussing how personal and functional income inequality influence each other. Furthermore, the macroeconomic model that will be outlined in Section 3, as well as the the econometric analyses of section four, are abstracting from debt and wealth effects. We are also not discussing broader issues of financialisation or the emergence of financial fragility. A more comprehensive investigation would need to take these and other aspects of inequality into account.

2 Interdependent preferences and personal income inequality in Kaleckian macroeconomic models

The combination of the principle of effective demand with issues of growth and the distribution of income between profits and wages has been a major part of the post-Keynesian research program at least since the publications of Nicholas Kaldor (1955/56) and Joan Robinson (1956) (cf. Hein 2014). 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. However, recently there have been some attempts to incorporate the combination of personal income distribution and interdependent social norms into neo- and post-Kaleckian models of distribution and growth (Belabed et al. 2013; Detzer

2016; Kapeller and Schütz 2014; Kapeller and Schütz 2015; Setterfield and Kim 2016; Zezza 2008).

Personal 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 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. Depending on the specific model at hand such emulation effects have been combined with debt accumulation, financial norms and constraints and Minskyian dynamics.[3]

These extensions usually have been applied to already quite complex models, which are often solved by numerical simulation. The next section tries to overcome the corresponding lack of accessibility and traceability by providing a simple and illustrative post-Kaleckian model of distribution and growth that is open to different relationships between personal inequality and aggregate demand and growth.

[3]Note that there have also been other attempts in the literature to include either emulation effects or personal income inequality into Keynesian macroeconomic models. For personal income distribution: see for example Dutt (1992), Lavoie (1996), Tavani and Vasudevan (2014). On other explicit or implicit attempts to include interdependent social norms see for example Dutt (2008), Hein (2012). There have also been attempts to implement relative income effects into neoclassical models of consumption based on utility-maximization (see for example Dybvig 1995), 2008, Alvarez-Cuadrado and Van Long 2011). However, there is usually no role for the functional distribution of income in these models.

2.1 A simple illustrative macroeconomic model with potentially differing effects of functional and personal income inequality

Attempts to include personal income inequality and interdependent social norms into post-Keynesian models often make use of a fairly complex model structure. We try to overcome the often associated lack of accessibility and traceability by providing a simple analytical model that is open to different relationships between personal inequality, aggregate demand and growth. Based on the literature on consumption theory and the important distinction between absolute and relative income effects, we will introduce a simple variation regarding the propensity to save out of wage income in a basic post-Kaleckian macroeconomic model. This variation is inspired by Carvalho and Rezai (2016) who implement effects of personal inequality by making a 'small but important modification' (p. 5) to the neo-Kaleckian model: they let the propensity to save from wages depend directly on a measure of wage inequality. However, based on their discussion of saving rates per income quintile, they make the assumption that rising wage inequality always leads to a rising propensity to save out of wage income. Contrasting with this assumption, the literature on interdependent social and behavioural norms going back to Thorstein Veblen 1899 presents theoretical arguments that the opposite effect might also be possible. Veblen's basic arguments and ideas have also been presented in formal models in the work of Duesenberry (1959) and Frank et al. (2014). And indeed, developments in countries like the US suggest that such effects have been relevant prior to the Great Recession (Cynamon and Fazzari 2008). Nevertheless, Carvalho and Rezai (2016) use the cross-sectional observation of an increasing propensity to save over income quintiles in the United States (see Figure 1) 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

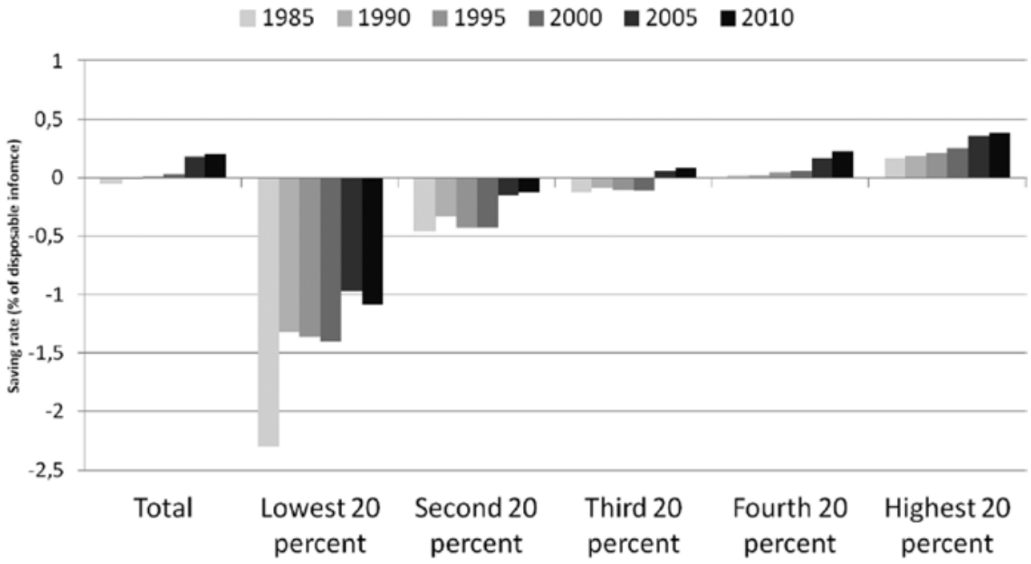

Figure 1: *Saving rate per income quintile in the USA (1985-2010) (Source: Carvalho and Rezai (2016, Figure 1))*

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 the saving relative to disposable income in a times series context in which income increases or decreases for a specific quintile can either be increasing or decreasing, depending in particular on the strength and direction of relative income effects and interdependent behavioural norms. One possible compatible empirical observation would be that for a specific quintile, the saving rate decreases over time if income inequality with respect to other quintiles increases. Exactly this is observable in the data of Carvalho and Rezai for the lowest three income quintiles in the period from 1990 to 2000, a period of strongly increasing inequality (Carvalho and Rezai 2016, Figure 1). Furthermore, it seems surprising that their dataset shows an increasing total saving rate for the

USA in the period before the Great Recession. This is add odds with other data. These issues would deserve further discussion, but they go beyond the scope of this paper.

We will therefore not make such a restrictive assumption. Instead, by building on Carvalho and Rezai's idea to let the propensity to save out of wage income directly depend on a measure of wage inequality 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 very simple way that the effects of redistribution between profits and wages on the one hand and redistribution between households on the other hand can potentially be very different depending on prevailing consumption and financial norms (this has already been shown in the much more complex models mentioned above).[4] In the following, we assume that personal income inequality can be approximated by wage inequality, which we take as given exogenously. We also abstract from interdependencies between functional and personal income distribution.

We model a closed economy without a government sector in the tradition of the basic post-Kaleckian model (Bhaduri and Marglin 1990) with saving out of wages, using the notation of Hein (2014, Chapter 7). We assume that our economy produces a homogeneous real output (Y), which can be used for consumption and investment. We abstract from overhead labour and depreciation of the capital stock (K). Moreover, we exclude technical change and, therefore, imply a constant labour-output ratio ($a = L/Y$) and a constant capital-potential output ratio ($v = K/Y^p$). Capacity utilisation ($u = Y/Y^p$) is endogenous and usually below 1, meaning that output is usually below the potential output given by the capital stock ($Y < Y^p$). Labour supply is assumed to be usually in excess, which means

[4] A related important motivation for building the model was to provide a simple post-Keynesian model including personal income inequality for graduate students, that fits well into the basic model frameworks presented in recent textbooks like Hein (2014) and Lavoie (2014).

that it usually does not constrain output. Following Kalecki's price theory and abstracting from raw material costs, we assume that prices (p) are determined by mark-up pricing on unit labour costs in oligopolistic markets, which gives us the following equation for the general price level:

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

where m is the mark-up and W depicts the sum of nominal wages. The mark-up in the model economy is determined by the degree of market concentration or the importance of price competition in the goods market and the relative bargaining power of capital and labour (cf. Hein 2014, p. 191). The profit-share (h) in our closed economy is determined by the mark-up:[5]

$$h = \frac{\Pi}{pY} = \frac{pY - W}{pY} = 1 - \frac{W}{pY} = 1 - \frac{1}{1 + m} = \frac{m}{1 + m}, \tag{2}$$

with Π being the sum of nominal profits. The endogenous profit rate is given by the following equation:

$$r = \frac{\Pi}{pK} = \frac{\Pi}{pY}\frac{Y}{Y^p}\frac{Y^p}{K} = \frac{hu}{v}. \tag{3}$$

The investment rate (g) in our model depends on animal spirits (α), capacity utilization and functional income distribution:

$$g = \frac{I}{K} = \alpha + \beta u + \tau h, \tag{4}$$

where I is investment and β and τ denote the responsiveness of investment to changes in capacity utilization and the profit share, respectively.

Two types of functional income exist in our model economy: wages (W) earned

[5] See Hein (2014, section 5.2) for a richer discussion of the determinants of the mark-up and the profit share.

by working households and profits (Π) earned by firm owning households. We assume that only part of both functional income types are spent for consumption purposes and the rest is saved, as described by the following equation:

$$S = S(\Pi, W) = S_\pi(\Pi) + S_w(W) = s_\pi \Pi + s_w W, \tag{5}$$

with S as total saving, S_π, S_w denoting saving out of profits and saving out of wages, respectively and s_π, s_w depicting the respective propensities to save from profit and wage income. Saving out of profits and wages is achieved by either buying assets issued by the firm sector or by building up deposits with the financial sector, which is not explicitly modelled here. Note that the different propensities to save are strictly related to the two functional income categories and not to specific persons, households or classes.[6] We do, however, make the reasonable assumption that the propensity to save from profits is higher than the propensity to save from wages ($0 \leq s_w < s_\pi \leq 1$). Hein (2014, p. 273) recalls two important reasons for this. For one thing, firms are do not distribute all of their profits to their owners, but build up retained earnings, which count as savings by definition. Moreover, it is reasonable to assume that the majority of working households only receive a very small part of the distributed profits and that the main part goes to a minority of the households which own extremely large parts of the corporate sector. The latter group is assumed to have a much higher per head income than the households who predominantly rely on wages as a source of income. As was mentioned in section two, the AIH and theories with interdependent preferences, as well as more sophisticated versions of the PIH/LCH, are compatible with increasing saving rates in the cross sectional dimension of income distribution across the population.

If we divide equation 5 by the nominal capital stock, we obtain the saving rate

[6]This is necessary, as working households built up financial assets through saving, which means that they will earn part of the profits in the form of interest or dividends (Hein 2014, p. 273).

in our model economy:

$$\sigma = \frac{S}{pK} = \frac{S_\pi + S_w}{pK} = \frac{s_\pi \Pi + s_w (Y - \Pi)}{pK} = [s_w + (s_\pi - s_w) h] \frac{u}{v}, \quad 0 \leq s_w < s_\pi \leq 1. \tag{6}$$

Equation 6 corresponds to the saving rate of the basic post-Kaleckian model with saving from wages, as in Hein (2014, section 7.2.2). It is determined by to the profit share, capacity utilization, the constant capital-potential output ratio, and the exogenously given propensities to save from profits and wages. However, we now introduce a crucial variation to the basic post-Kaleckian model. We endogenize the propensity to save from wages by making it depend on wage income inequality in the following simple manner:

$$s_w = s_0 - \eta \Gamma, \quad \Gamma \geq 0, \quad 0 \leq s_0 \leq 1. \tag{7}$$

In equation 7, s_0 is a constant that represents the propensity to save if there is no effect of wage inequality on the propensity to save from wage income. Alternatively, it can be interpreted as the propensity to save from wages if wages are equally distributed. Wage income inequality is represented by Γ, where an increase in Γ is associated with an increase in wage inequaltiy. Finally, η is the social norms parameter and denotes 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 the strenght of relative and absolute consumption concerns, the financial norms of households, habit persistence, minimum levels of consumption and wealth based consumption due to asset price increases. These factors are related to a wide set of consumption theories going back to interdependent social norms (especially Veblen 1899 and

Duesenberry 1959, more recently also Frank et al. 2014, on financial norms Thaler and Shefrin 1981 and Cynamon and Fazzari 2008), the Keynesian absolute income hypothesis (Keynes (1936)) and neoclassical consumption theory in various forms (as reviewed in Browning and Lusardi 1996 and Deaton 1992). The *ability* to go into debt in order 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, etc.

In a situation in which η is positive the social norms are such that, on the aggregate, increasing wage inequality encourages working households as a whole to increase their propensity to consume from total wage income W. For example, the consumption norms must be such that a sufficiently large number of working households that lost wage income relative to others want to maintain or increase their relative consumption expenditures, and, thus, cause a fall of the aggregate propensity to save from wages. This can be achieved by lowering their individual propensity to save from wages. While we are not modelling a credit system explicitly here, this can be associated with increasing debt of these households if the financial norms of the economy allow for it. The corresponding loans could, for example, come from other households which gained relative income or from profit earning households. Of course, the loans could also stem, from banks, which we do not model explicitly, however. It could even be the case that the individual propensity to save from wages of some of the households turns negative, though the aggregate propensity to save from wages remains positive.[7]All of this would lead to a lower propensity to save from wage income, since a positive η can be seen as equivalent to the assumption that any possible negative absolute income effects on consumption, stemming from increasing personal income inequality, would be overcompensated by relative income effects at the aggregate level. In

[7]An even more extreme case could occur if the aggregate propensity to save from wages turns negative, but we do not consider this case and its implications, as we assumed that $0 < s_w < 1$.

the opposite case, a negative η would imply that the consumption and financial norms of the model economy would be such that, in case of increasing personal income inequality households who lost relative income are not willing and/or able to maintain or increase their consumption expenditures to such an extent that it overcompensates the savings of households who gained income. Hence, the aggregate propensity to save from wages would increase. In this case, any positive relative income effects on consumption, due to rising personal inequality, would be 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. In this case, η would be zero and there would be no aggregate effect of personal income distribution on the propensity to save from wages.

With our new formulation of the propensity to save from wages the saving rate of the economy becomes:

$$\sigma = \left[(s_0 - \eta\Gamma) + (s_\pi - (s_0 - \eta\Gamma))\, h\right] \frac{u}{v}. \tag{8}$$

This new saving rate enables us to calculate the respective partial effects of functional and personal income redistribution on the equilibrium values in our model. The equilibrium condition for the goods market is that saving equals investment and hence:

$$g = \sigma. \tag{9}$$

The adjustment to the post-Kaleckian goods market equilibrium takes place via capacity utilization. In order for the goods market equilibrium to be stable in the short-run, the following condition needs to be fulfilled:

$$\frac{\partial \sigma}{\partial u} - \frac{\partial g}{\partial u} > 0 \Rightarrow \left[(s_0 - \eta\Gamma) + (s_\pi - (s_0 - \eta\Gamma))\, h\right] \frac{1}{v} - \beta > 0. \tag{10}$$

Equation 10 implies that the response of the saving rate to the adjustment of

capacity utilization needs to be stronger than the response of the investment rate. In the following, we always assume this to be the case. Furthermore, we assume the following without modelling it explicitly: firms do have some view on target or 'normal' rates of capacity utilization, yet, this is a relatively wide range rather than a unique rate. Moreover, the range itself is endogenous to the actual rates of past periods, as firms adapt their target to past actual states of the economy. These assumptions are necessary to provide a relatively wide corridor in which the model will not suffer from 'Harrodian instability'.

By substituting equations 4 and 8 into equation 9, and solving for u, we obtain the equilibrium capacity utilization:

$$u^* = \frac{\alpha + \tau h}{\left[(s_0 - \eta\Gamma) + (s_\pi - (s_0 - \eta\Gamma))\, h\right] \frac{1}{v} - \beta}. \tag{11}$$

Substituting equation 11 into equation 4 (or 8) and equation 3 yields the equilibrium values for capital accumulation and the profit rate, respectively:

$$g^* = \sigma^* = \frac{(\alpha + \tau h)\left[(s_0 - \eta\Gamma) + (s_\pi - (s_0 - \eta\Gamma))\, h\right] \frac{1}{v}}{\left[(s_0 - \eta\Gamma) + (s_\pi - (s_0 - \eta\Gamma))\, h\right] \frac{1}{v} - \beta}, \tag{12}$$

$$r^* = \frac{(\alpha + \tau h)\frac{h}{v}}{\left[(s_0 - \eta\Gamma) + (s_\pi - (s_0 - \eta\Gamma))\, h\right] \frac{1}{v} - \beta}. \tag{13}$$

Calculating the partial derivatives of these equilibrium values, with respect to the profit share, yields the usual results with the slight variation, however, that the partial effects now include our new distribution dependent propensity to save

from wages:

$$\frac{\partial u^*}{\partial h} = \frac{\tau - (s_\pi - (s_0 - \eta\Gamma))\frac{u}{v}}{\left[(s_0 - \eta\Gamma) + (s_\pi - (s_0 - \eta\Gamma))\, h\right]\frac{1}{v} - \beta}, \tag{14}$$

$$\frac{\partial g^*}{\partial h} = \frac{\frac{1}{v}\left[\tau(s_0 - \eta\Gamma) + (s_\pi - (s_0 - \eta\Gamma))(\tau h - \beta u)\right]}{\left[(s_0 - \eta\Gamma) + (s_\pi - (s_0 - \eta\Gamma))\, h\right]\frac{1}{v} - \beta}, \tag{15}$$

$$\frac{\partial r^*}{\partial h} = \frac{\frac{1}{v}\left[\alpha + 2\tau h - (s_\pi - (s_0 - \eta\Gamma))h\frac{u}{v}\right]}{\left[(s_0 - \eta\Gamma) + (s_\pi - (s_0 - \eta\Gamma))\, h\right]\frac{1}{v} - \beta}. \tag{16}$$

The well-known possibility of different demand and growth regimes with respect to functional income distribution is obviously maintained in our model, as we cannot know the signs of the partial effects before we specify relations between our model parameters. Demand and growth can either be wage-led [8] or profit-led[9]. 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 (equation 8 and 4, respectively).[10] Note, however, that the equations for the partial effects, with respect to the profit share, now contain the exogenously given variable for personal income inequality Γ. Therefore, if we hold all other parameters of our 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 even change the sign of the respective partial effect. This means that endogenizing the propensity to save from wages also made the demand and growth regimes, with respect to functional income distribution, dependent on the size distribution of

[8] Implying $\frac{\partial u^*}{\partial h} < 0$ for demand and $\frac{\partial g^*}{\partial h} < 0$ for growth.

[9] Implying $\frac{\partial u^*}{\partial h} > 0$ for demand and $\frac{\partial g^*}{\partial h} > 0$ for growth.

[10] See Hein (2014, p. 284-285) for a discussion of different parameter constallations in the basic post-Kaleckian model with saving from wages.

income in our model.

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

$$\frac{\partial u^*}{\partial \Gamma} = \frac{(\alpha + \tau h)(1-h)\dfrac{\eta}{v}}{\left(\left[(s_0 - \eta\Gamma) + (s_\pi - (s_0 - \eta\Gamma))\, h \right] \dfrac{1}{v} - \beta \right)^2}, \tag{17}$$

$$\frac{\partial g^*}{\partial \Gamma} = \frac{(\alpha + \tau h)(1-h)\beta\dfrac{\eta}{v}}{\left(\left[(s_0 - \eta\Gamma) + (s_\pi - (s_0 - \eta\Gamma))\, h \right] \dfrac{1}{v} - \beta \right)^2}, \tag{18}$$

$$\frac{\partial r^*}{\partial \Gamma} = \frac{(\alpha + \tau h)(1-h)\dfrac{\eta h}{v^2}}{\left(\left[(s_0 - \eta\Gamma) + (s_\pi - (s_0 - \eta\Gamma))\, h \right] \dfrac{1}{v} - \beta \right)^2}. \tag{19}$$

with $\frac{\partial u^*}{\partial \Gamma} > 0, \frac{\partial g^*}{\partial \Gamma} > 0, \frac{\partial r^*}{\partial \Gamma} > 0$ if $\eta > 0$, 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 $\frac{\partial u^*}{\partial \Gamma} < 0, \frac{\partial g^*}{\partial \Gamma} < 0, \frac{\partial r^*}{\partial \Gamma} < 0$.[11] 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 redistribution leads to changes in u^*, g^* and r^*. In a setting in which $\eta > 0$, since the paradox of thrift holds, the increase in wage income inequality would be expansionary, regardless of other parameters — assuming the stability condition to hold and the usual relations between saving from profits and wages. At the same time, however, the effect of redistribution between wages and profits could either be wage-led, conflictive

[11] Note, that 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, as $\frac{\partial u^*}{\partial s_w} < 0$, $\frac{\partial g^*}{\partial s_w} < 0$ and $\frac{\partial r^*}{\partial s_w} < 0$.

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; therefore, they influence the partial effects in our model.

It has to be noted, however, that the above model is highly unrealistic, since it does not include any debt effects. The model assumes that in a scenario where $\eta > 0$ households, which wish to increase their consumption 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 will question the creditworthiness of highly indebted households, which would lead to decreasing credit supply and end the expansionary effect of increasing personal inequality and indeed might reverse it.[12] To implement such a mechanism, we would need to incorporate financial constraints, but that would go beyond the scope of this paper — but it would be an interesting future extension of the model.

2.2 Open economy effects of redistribution

This section gives an outlook on a possible open economy extension of the model presented in the previous section without stating the whole model. Only the partial effects of changes in functional and personal income distribution on net exports are stated. Except for the equation of the propensity to save from wages,

[12] Also, the increasing cost of interest and principal payments will be a burden on households.

(7) the notation and the basic model equations again follow Hein 2014, section 7.3 and will not be stated below. The mechanisms at work by which personal inequality effects the current account in this simple open economy model resemble the ones specified in the more complex model of Belabed et al. (2013). If we endogenize the propensity to save from wages in the same way as in equation 7, we obtain the following partial effects of a change in personal and functional income inequality on equilibrium net exports:

$$\frac{\partial b^*}{\partial h} = \frac{\psi \frac{\partial e^r}{\partial h} \left(\left[(s_0 - \eta\Gamma) + (s_\pi - (s_0 - \eta\Gamma))\, h \right] \frac{1}{v} - \beta \right) + \phi \left[(s_\pi - (s_0 - \eta\Gamma)) \frac{u}{v} - \tau \right]}{\left[(s_0 - \eta\Gamma) + (s_\pi - (s_0 - \eta\Gamma))\, h \right] \frac{1}{v} - \beta + \phi}, \tag{20}$$

$$\frac{\partial b^*}{\partial \Gamma} = \frac{\phi(1-h)\frac{-\eta}{v}}{\left[(s_0 - \eta\Gamma) + (s_\pi - (s_0 - \eta\Gamma))\, h \right] \frac{1}{v} - \beta + \phi}. \tag{21}$$

The effects are ambiguous and depend on the specific model parameters. For the partial effect of the profit share this matches the result in the basic open-economy post-Kaleckian model with saving out of wages. Yet, the effect is endogenous to personal income inequality. The partial effect of personal income inequality will only depend on the sign of η, irrespective of other parameters (given that Keynesian stability prevails). If η is positive, the partial effect of redistribution of personal income in favour of high income households is negative. If η is negative, the partial effect is positive. Let us assume the following three country scenario based on discussions of social norms, cultural and institutional settings in the USA, Germany and China (see for example Cynamon and Fazzari 2008, Van Treeck and Sturn 2012, Behringer, Belabed et al. 2013, Belabed et al. 2013):

1. USA: $\frac{\partial b^*}{\partial h} > 0$, $\frac{\partial b^*}{\partial \Gamma} < 0$,

2. Germany: $\frac{\partial b^*}{\partial h} > 0$, $\frac{\partial b^*}{\partial \Gamma} > 0$,

3. China: $\frac{\partial b^*}{\partial h} > 0$, $\frac{\partial b^*}{\partial \Gamma} > 0$.

Compared to the development of personal income inequality the change in functional income inequality in the USA was relatively moderate prior to the Great Recession. In Germany it was the other way around and in China both personal and functional income inequality increased tremendously. If we assume that in the USA, for the period 1980 until the Great Recession, the absolute effect of functional redistribution on net exports was lower than the absolute effect of personal redistribution, the model is able to illustrate some of the major domestic and global developments in the period form 1980 until the Great Recession.

3 Empirical evidence

The model presented above gives an illustrative theoretical account on the potentially differing effects of personal and functional income distribution. It remains an empirical question which specific effects prevailed in different countries. 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.

3.1 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 Stockhammer and Wildauer (2015, p. 8 f.). Different econometric methods have been employed to investigate the question on wage- vs. profit-led demand and growth regimes. As

Stockhammer and Wildauer (2015) 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, p. 297 f.). 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.[13] 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.

As was already noted above, there are only a few empirical studies which investigate the relationship between personal income distribution and aggregate consumption or saving.[14] 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)

[13] See Hein and Vogel (2008, table 1) for an overview of functions used in different studies.

[14] There is, however, a number of empirical studies which report microeconometric evidence for Veblen effects, the relative income hypothesis and the importance of interdependent preferences at the individual level (see for example Neumark and Postlewaite (1998), Alpizar et al. (2005), Bowles and Park (2005), Luttmer (2005), Ravina (2007), Gasana (2009)).

wage inequality between industries. He finds a statistically significant negative effect of rising inequality on consumption expenditure. Darku (2014) is using a panel including all ten Canadian provinces to estimate the relationship between personal saving rates and personal income inequality, 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, *ceteris paribus*. On the other hand, they find that a fall in the wage share leads to a statistically significant increase in the current account. Stockhammer and Wildauer (2015) 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 (2015) fail to find any statistically significant effects on aggregate consumption, which they interpret as evidence against the existence of relative income or consumption effects in the aggregate. However, it can be argued that their findings rather support the existence of relative consumption concerns, since they do not find significant negative effects of personal inequality, which would mean that positive relative and negative absolute income effects have compensated each other. 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. Carvalho and Rezai (2016) estimate a two-dimensional threshold vector autoregressive model including the variables capacity utilisation and the labour income share for the USA 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. In their estimation the 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.

What emerges from this survey is that the econometric evidence on the relationship between personal income inequality and aggregate consumption or saving and aggregate demand is rather mixed. While, on the one hand, the results of Brown

(2004) and Carvalho and Rezai (2016) for the USA suggest negative (positive) aggregate effects of personal income distribution on consumption (saving) behaviour, the results of Darku (2014) for Canada, and Behringer and Van Treeck (2015), for a panel of twenty countries including the US, find strong empirical evidence for negative effects on household saving rates through relative consumption concerns. In contrast to both of these groups, Stockhammer and Wildauer (2015) present evidence for another panel of eighteen countries that there are neither negative nor positive effects of personal income distribution on aggregate consumption. 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 USA based on relative consumption concerns and rising personal income inequality. Given these findings, the fall of the saving rate would remain a puzzle. The results of Darku (2014), and Behringer and Van Treeck (2015), on the other hand, confirm a relative income hypothesis explanation of falling saving rates and increasing personal income inequality in Canada and the USA, as well as in other countries. The findings of Stockhammer and Wildauer (2015) would be 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.

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' (Frank 2005) which are defined as being especially relevant for social status comparison. While the empirical studies which investigate aggregate consumption (Brown 2004, Stockhammer and Wildauer 2015) 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) do find such evidence.

Nevertheless, two aspects of the findings in the empirical literature seem a bit puzzling. With respect to the findings of Brown (2004), Darku (2014) and Carvalho and Rezai (2016) we are asking ourself if it really is 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 USA, 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 (2015), we ask if general relationships between personal income inequality and saving or consumption behaviour can really be assumed, since consumer and financial norms are probably strongly heterogeneous across countries such as the USA, 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 (2015) 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 procedures.

3.2 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 USA and Germany. For the USA and other countries, with strongly increasing 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 $\eta > 0$ in the theoretical model presented in section 2.1. Yet, due to the mixed results of the empirical literature on the connection between personal inequality and consumption or saving behaviour presented in the previous section, we are aware that such effects might be hard to find in the data. 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 findings in the empirical literature are rather clear on that account.

We orientate ourself along the empirical specification of the consumption function and the results of Hein and Vogel (2008) in order to be able to use predominantly national accounts data (with the exception of the personal inequality variables) and to have results for direct comparison. The annual data we are using for the estimation are retrieved from three different sources:

- The variables that can be represented by national account data (i.e. real private consumption (C), total gross profit income (P) and total wage income (W)) were obtained from the annual macro-economic database (AMECO) of the European Commission (EC 2016). The sample for all the AMECO data is restricted to 1960. This is year constitutes the starting date of the sample we analyse.

- We use different variables for personal income inequality:
  - The estimated Gini index ($GINI$) from the Standardized World Income Inequality Database (SWIID) (Solt 2014). This data set is available until 2012.
  - The top (10%, 5% and 1%) income shares (TIS) of the World Wealth and Income Database (WID 2016).

Table 4 in the appendix provides specific definitions and sources for each of the variables we are using in the estimations. 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 time series of the Gini index for Germany has gaps in 1961, 1963, 1965 and 1966. Therefore, the missing data points for the top income shares and the Gini were constructed by linear interpolation for Germany.

As do Hein and Vogel (2008), we apply a single equation approach to the data for varying time periods. In order to avoid spurious regressions, all variables are tested for stationarity. Results of the augmented Dickey-Fuller tests (ADF) are reported in section B of the appendix. Most of the variables in log-transformed levels were found to be integrated of order one (I(1)). Furthermore, the two-step Engle-Granger approach, as ountlined in Hassler (2004), was applied to test for cointegration (see section C in the appendix).[15] For the US the tests revealed cointegration relationships between aggregate consumption and total wage income and between consumption and the inequality variables, which induces us to estimate error correction models 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 (see for example Hein and Vogel (2008) and Onaran et al. (2011). Therefore a logarithmic first differences specification is used in the estimations for Germany.

[15] 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 we first estimate the long term relationship between the cointegrated variables in logarithmic levels of the following form (lower case letters indicating logarithmic transformation):

$$c_t = \alpha_0 + \alpha_1 w_t + \alpha_2 inequ_t + z_t, \tag{22}$$

where C_t stands for real private final consumption expenditure, α_0 is a constant, W_t is the real compensation of employees of the total economy, $INEQU_t$ is the respective inequality variable and z_t is the error term for which the usual assumptions are applied. Secondly, we estimate the following general error correction model using the lagged estimated residuals of equation 22 as the error correction term (ect_{t-1}), where again lower case letters indicate logarithmic transformation and d denotes the first difference operator:

$$d(c_t) = const + \sum_{i=1}^{2} \beta_{1i} d(c_{t-i}) + \sum_{j=0}^{2} \beta_{2j} d(\pi_{t-j}) + \sum_{k=0}^{2} \beta_{3k} d(w_{t-k}) + \sum_{l=0}^{2} \beta_{4l} d(inequ_{t-l}) + \gamma ect_{t-1} + \varepsilon_t. \tag{23}$$

Starting with two lags for each differenced 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, in a first step the same consumption function as in Hein and Vogel (2008) is estimated. The general estimation equation is of the following form:

$$d(c_t) = const + \sum_{i=1}^{2} \alpha_{1i} d(c_{t-i}) + \sum_{j=0}^{2} \alpha_2 j d(\pi_{t-j}) + \sum_{k=0}^{2} \alpha_{3k} d(w_{t-k}) + \varepsilon_t. \tag{24}$$

Starting from this general equation again insignificant lags are successively eliminated to obtain a parsimonious model. Due to the log-log specification of the estimation equations we can easily interpret the estimated coefficients on π_t and

w_t as the respective income elasticities of aggregate private final consumption expenditures. This first estimation serves to assure ourself that we can replicate the results of Hein and Vogel (2008) which are in line with other findings in the empirical literature.

In a next step we extend the specification used by Hein and Vogel (2008) to directly take the potential effects of personal income inequality into account:

$$d(c_t) = const + \sum_{i=1}^{2} \alpha_{1i} d(c_{t-i}) + \sum_{j=0}^{2} \alpha_{2j} d(\pi_{t-j}) + \sum_{k=0}^{2} \alpha_{3k} d(w_{t-k}) + \sum_{k=0}^{2} \alpha_{4l} d(inequ_{t-l}) + \varepsilon_t. \tag{25}$$

The coefficient on $inequ_t$ can be interpreted as the personal income inequality elasticity of private final consumption expenditure.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 or cannot draw from them.

3.3 Results

Table 1 presents the estimated long-run coefficients of the cointegration relationship (equation 22) for different measures of inequality and table 2 shows the estimated coefficients of the parsimonious version of the error correction model (equation 23) for the United States in the period from 1960 to 2012. The parsimonious model does not include any lagged explanatory variables, except for the error correction term, and also no contemporaneous variables of inequality since they always turned out to be insignificant at the commonly used significance levels. Note that all estimated coefficients on the error correction terms (ect_{t-1}) in table 2 are negative and significant at commonly used significance levels. This verifies our cointregration tests because negativity and significance of ther error correction term are necessary for cointegration relationships.

As can be seen from table 1 the estimated long term wage income elasticity of consumption is about 1 in all three estimated long term equations depending on the variable representing personal inequality. Is this a meaningful result for the US? It would indicate that long term increases of wage income where associated with an equally high long term percentage increase of aggregated consumption in most of the sample period. This would mean that any saving from wages of higher wage earning households has been compensated by consumption from wages of lower wage earning households in the long run. Given the developments of aggregated consumption and the personal saving rate in the US this seems not unrealistic. The high long-run elasticity of consumption to wage income therefore 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 with respect to the top 10% income share, followed by the Gini index, the 5% share and 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 (Gini). This would be in line with the argument that the richest income groups in terms of emulation behaviour are a somewhat 'distant' class to the majority of society. It casts some doubt on the theoretical argument related to expenditure cascades which maintains that redistribution at the top can have the strongest impact on consumption.In terms of consumption functions in macroeconomic models it would be more in line with models in which the richest income groups are a target of lower groups, however, with the emulation effects being not as strong as at the middle of the distribution.

The estimated short-term coefficients on the contemporaneous variables of profit and wage income in first differences in table 2 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 of the regressions with different inequality variables, since the size of the estimated coefficients does not vary strongly and the coefficients on $d(\pi_t)$ and $d(w_t)$, as well as the constant, are all significantly different from zero at the 1% significance level. Moreover, we find reasonable values of the adjusted R-squared for all of our regressions. We also tested for issues related to misspecification, heteroskedasticity and serial correlation in the residuals, as can be seen from the lower part of table **??**. 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 homoskedasticity of the White-Test and there was also no evidence for autocorrelated residuals, as the Durbin-Watson statistic and the Breusch-Godfrey test did not allow for a rejection of the null hypothesis of no first- or higher-order autocorrelation. We also fail to reject the null hypothesis of normally distributed residuals.

Table 1: Estimates of long term coefficients from equation 22. USA 1960 - 2012.

w_t	1.067	0.965	0.987	1.00
$gini_t$	0.402			
$10\%tis_t$		0.503		
$5\%tis_t$			0.319	
$1\%tis_t$				0.166
Observations	51	51	51	51

Data corrected for outliers in 1983 and 2009.
Source: Author's calculations.

Our results on the short-run income elasticities resemble the ones of Hein and Vogel (2008, p. 491), who found a constant of 0.013, a short-run profit income

Table 2: Estimates of error correction models (parsimonious versions of equation 23) with different variables for personal income inequality. USA 1960 - 2012.

Inequality variable in ect_{t-1}:	$gini_t$	$10\%tis_t$	$5\%tis_t$	$1\%tis_t$
const	0.011***	0.011***	0.011***	0.010***
	(0.002)	(0.002)	(0.002)	(0.002)
$d(\pi_t)$	0.158***	0.158***	0.161***	0.164***
	(0.031)	(0.032)	(0.032)	(0.032)
$d(w_t)$	0.539***	0.546***	0.544***	0.544***
	(0.049)	(0.050)	(0.05)	(0.049)
ect_{t-1}	-0.12***	-0.116**	-0.109**	-0.109**
	(0.042)	(0.048)	(0.043)	(0.040)
Number of observations	49	49	49	49
Adj. R^2	0.864	0.857	0.859	0.861
Durbin-Watson statistic	1.595	1.483	1.516	1.545
Breusch-Godfrey (P)		0.240	0.290	0.343
Ramsey RESET Test (P)	0.18	0.296	0.246	0.233
White-Test (P)	0.501	0.143	0.217	0.329
NORM (P)	0.785	0.595	0.648	0.718

Notes: Standard errors in parentheses.
***/**/* indicates significance at the 1%/5%/10% level respectively.
Data corrected for outliers in 1983 and 2009.
Source: Author's calculations.

elasticity of 0.17 and a short-run wage income elasticity of 0.472, all significant at the 1% level.[16] Since we did not find significant short-run coefficients on the inequality variables, neither of lags nor of contemporaneous first differences, we fail to find dynamic 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, except for the error adjustment, in the United States for the estimated period. 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 any case, our findings deliver evidence that the increase in personal income inequality had no negative effect on aggregate consumption in the US. This result contrasts with the traditional Keynesian view based on the AIH, and with various versions of the PIH 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 estimation of equation 22 and 23 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 2.1 would be that for the US η had a positive sign over most of the sample period.

Table 3) shows the results of the parsimonious short-run estimations for Germany. The results for the short-run coefficients on profits and wages are similar to the

[16]The differences between our short-run estimations and the ones of Hein and Vogel (2008) narrow down to negligible levels if we restrict our estimation to their sample size (1960-2005, results available upon request).

ones for the US. 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 $d(\pi)$ and $d(w)$, as well as on the constant, are close to the ones found by Hein and Vogel and they are highly significant across our different estimation equations. As do Hein and Vogel, we find a stronger differential between the income elasticities for Germany than for the US. 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 homoskedasticity of the White-Test and there was no evidence for autocorrelated residuals from the Durbin-Watson statistic.

With regard to 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 for 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 5% level.However, while the sign remains negative and the size of the coefficient on $d(gini_t)$ is of similar size, the significance of this effect hinges on the use of the summarised, and for the years 1961, 1963, 1965 and 1966 also linearly interpolated, Gini index from the SWIID.[17] The summarised Gini was used in order to be able to report the adjusted R-squared and post-estimation diagnostics. We obtained the summarised Gini by calculating the mean of the 100 series for the Gini index of Germany that were computed by multiple imputation and therefore represent the uncertainty of the constructed data. Multiple imputation estimation takes the uncertainty of the data into account by adjusting the coefficients and standard errors for the

[17]Results available from the author upon request.

Table 3: Estimates of equations 24 and 25 Germany 1960 - 2012 (1960-2008 for the estimations including top income shares).

	H & V 08					
$const$	0.008***	0.006***	0.006***	0.007***	0.007***	0.007***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
$d(\pi_t)$	0.117***	0.129***	0.131***	0.116***	0.116***	0.115***
	(0.033)	(0.04)	(0.032)	(0.041)	(0.041)	(0.041)
$d(w_t)$	0.527***	0.528***	0.519***	0.528***	0.527***	0.528***
	(0.034)	(0.038)	(0.036)	(0.038)	(0.038)	(0.038)
$gini_t$			-0.082**			
			(0.0398)			
$10\%tis_t$				-0.008		
				(0.078)		
$5\%tis_t$					-0.021	
					(0.059)	
$1\%tis_t$						0.003
						(0.032)
Number of observations	45	48	46	44	44	44
Adj. R^2	0.949	0.845	0.865	0.853	0.854	0.853
Durbin-Watson statistic	2.140	1.698	1.867	1.8695	1.893	1.852
Ramsey RESET Test (P)	0.430	0.119	0.461	0.223	0.238	0.221
White-Test (P)	0.474	0.841	0.728	0.655	0.851	0.580

Notes: The sample period for Hein and Vogel (2008) (H&V08) is 1960 - 2005.
Data corrected for outliers in 1975, 1991 and 2009.
Standard errors in parentheses.
***/**/* indicates significance at the 1%/5%/10% level respectively.
Source: Second collumn from Hein and Vogel (2008, p. 491). The rest are the author's own calculations.

variability between imputations according to the combination rules by Rubin (1987). By using the summarised Gini index, we exclude this uncertainty from the regression. This might be less problematic for advanced countries than for developing countries (see Solt 2009, p. 238) — however, we should still be very cautious in assessing the result for the coefficient on $d(gini_t)$ in table 3. 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 for 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. Note, however, that the top income shares were also interpolated and that, therefore, all four inequality variables for Germany have a high degree of uncertainty with respect to their validity. It might well be that we fail to track down existing effects due to such invalidities in the data.

The results for Germany run counter to the possible existence of 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 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, since the estimated coefficients for the top income shares are not statistically significant, and the statistical significance of the negative effect of the Gini index hinges on the use of summarised and interpolated SWIID data. 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 (2015) and, therefore, speaks against an explanation of aggregate consumption in terms of the absolute income hypothesis or the permanent income and the life-cycle hypothesis (including bequest and precautionary savings, etc.). It would, however, be compatible with an relative income hypothesis explanation of consumption and

personal income inequality, in which relative and absolute income effects of rising personal income inequality cancel each other out. Yet, as noted above, the data on personal inequality for Germany suffers from high uncertainty — we therefore refrain from concluding that this is strong evidence against negative effects of increasing personal inequality in Germany.

4 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 inequality can potentially have contrary effects on aggregate demand and growth. It can illustrate some of the major domestic and global developments in the decades prior to the Great Recession that are connected to inequality, consumption and saving behaviour for different countries.

In an empirical investigation, aggregate consumption functions have been estimated for the United States and Germany to explore whether effects of functional and personal income distribution can be found. The findings of previous studies regarding a substantial difference between the the elasticities of aggregate consumption with respect to wage and profit income was confirmed. The econometric analyses did not find compelling evidence for effects of personal income distribution in Germany. For the US we found significant positive long-run effects of personal income inequality on consumption with the effects being strongest on the top 10%

income share and the Gini index and less strong effects on the top 5% and 1% income shares.

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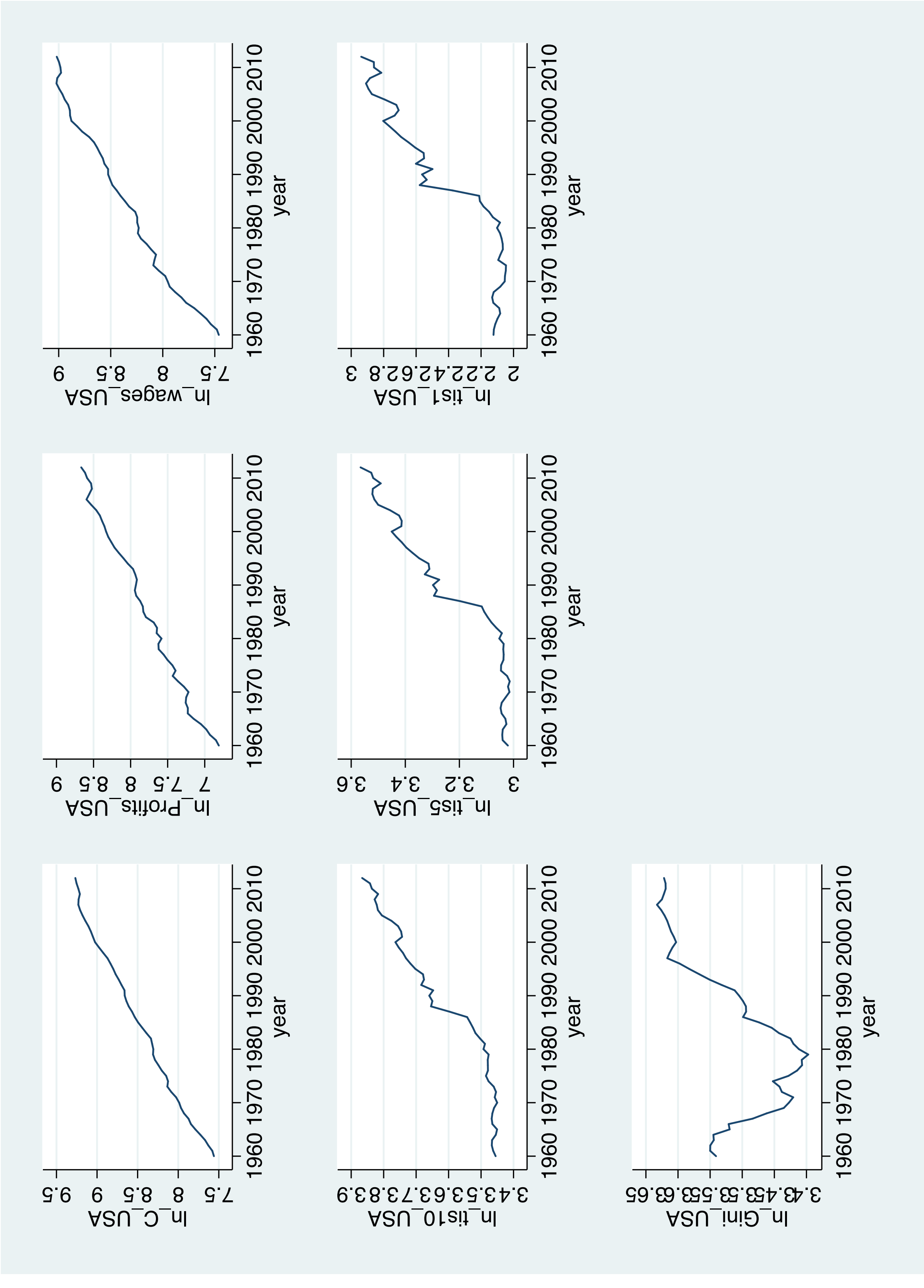
A Data sources and graphs of time series

Table 4: Description and sources of the data used for the estimations in section 4.

Variable	Description	Source
C	Private final consumption expenditure at 2010 prices	AMECO (OCPH)
Π	Gross operating surplus: total economy, Adjusted for imputed compensation of self-employed , deflated by the price deflator private consumption (2010 = 100)	AMECO (UQGD)
W	Compensation of employees: total economy, deflated by the price deflator private consumption (2010 = 100)	AMECO (UWCD)
$GINI$	Estimate of Gini index of inequality in household disposable (post-tax, post-transfer) income	SWIID (gini_net)
10%	Top 10% income share	WID
5%	Top 5% income share	WID
1%	Top 1% income share	WID

Notes: For Germany prior to 1991 the data is equal to the values for West Germany due to data availability.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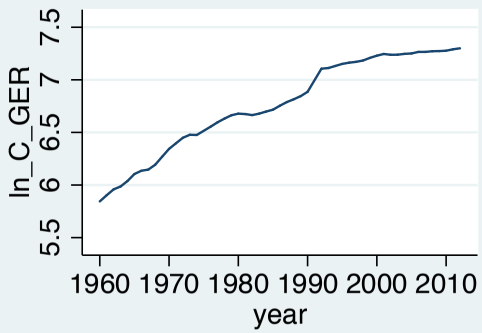
ln_wages_USA
ln_tis10_USA
ln_tis5_USA
ln_tis1_USA
ln_Gini_USA
year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6.5
7
7.5
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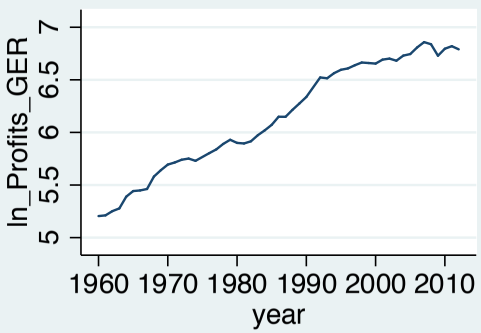
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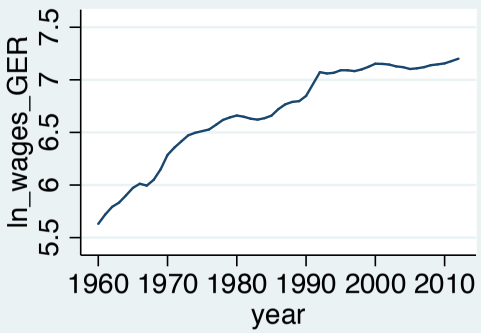
6
6.5
7
1960 1970 1980 1990 2000 2010
year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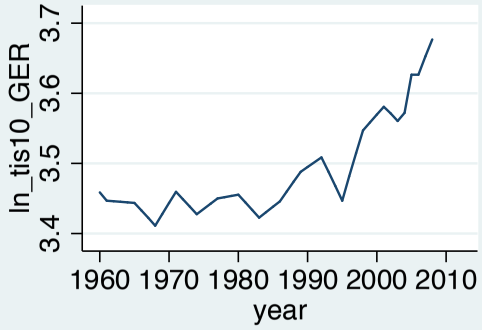
6
6.5
7
7.5
1960 1970 1980 1990 2000 2010
year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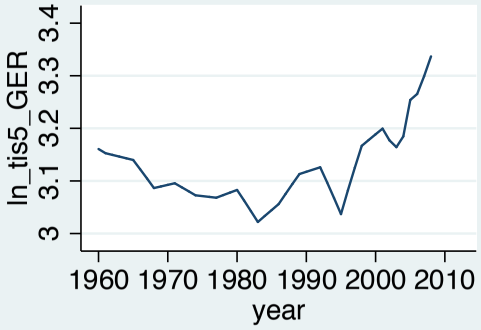
3.4
3.5
3.6
3.7
1960 1970 1980 1990 2000 2010
year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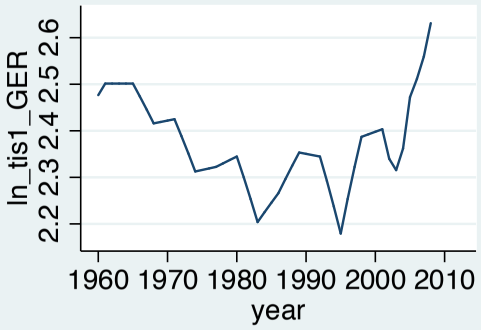
3.3
3.4
1960 1970 1980 1990 2000 2010
year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2.6
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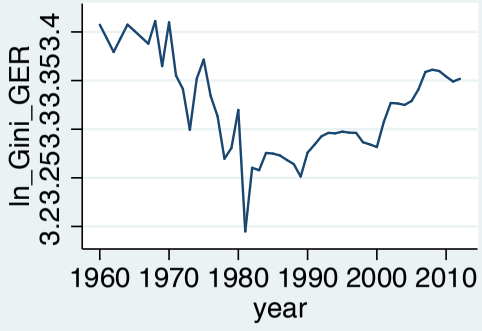
year


ln_Gini_GER
3.2
3.25
3.3
3.35
3.4
1960 1970 1980 1990 2000 2010
year

B Augmented Dickey-Fuller-tests

Table 5: ADF-Tests USA. H0: Series contains a unit-root.

	Log-level		Log-diff	
	Specification	t-statistic	Specification	t-statistic
C	c, t, l	-2.250	c, l	-4.256***
Π	c, t, l	-4.412***	c, l	-5.555***
W	c, t, l	-2.751	c, l	-4.111***
$GINI$	c, ll	-1.184	c, ll	-2.816*
10%	c, t, l	-2.331	c, l	-4.291***
5%	c, t, l	-2.300	c, l	-4.283***
1%	c, t, l	-2.380	c, l	-4.439***

Notes: c: constant; t: time trend; l: first lag; ll: first and second lag
***/**/* indicates significance at the 1%/5%/10% level respectively.

Table 6: ADF-Tests Germany. H0: Series contains a unit-root.

	Log-level		Log-diff	
	Specification	t-statistic	Specification	t-statistic
C	c, t, l	-1.108	c, l	-4.016***
Π	c, t, l	-1.155	c, l	-5.328***
W	c, t, ll	-1.725	c, l	-4.451***
$GINI$	c, l	-1.768	c, l	-6.456***
10%	c, t, l	-0.151	c, ll	-4.057***
5%	c, t, l	-0.817	c, l	-3.480**
1%	c, t, l	-1.198	c, llll	-3.221**

Notes: c: constant; t: time trend; l: first lag
***/**/* indicates significance at the 1%/5%/10% level respectively.

C Cointegration tests

Table 7: Cointegration-Tests USA. Consumption and different explanatory variables. H0: Residuals contain a unit-root (no cointegration).

Log-level		
Explanatory Variable(s)	ADF-Specification	t-statistic
W	c, l	-3.227**
$GINI$	c, ll	-3.364**
10%	c, l	-3.050**
5%	c, l	-3.034**
1%	c, l	-2.998**
$W, GINI$	c, l	-3.428**
$W, 10\%$	c, l	-4.581***
$W, 5\%$	c, l	-4.473***
$W, 1\%$	c, l	-4.431***

Notes: c: constant; t: time trend; l: first lag
Corrected for outliers in 1983 and 2009.
***/**/* indicates significance at the 1%/5%/10% level respectively.

Table 8: Cointegration-Tests Germany. Consumption and different explanatory variables. H0: Residuals contain a unit-root (no cointegration).

Log-level		
Explanatory Variable	ADF-Specification	t-statistic
Π	c, l	-2.011
W	c, l	-1.048
$GINI$	c, t, l	-1.450
10%	c, l	-2.110
5%	c, t, l	-0.126
1%	c, t, l	-3.088

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.