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Income Distribution and Current Account Imbalances

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Abstract

We develop a three-country, stock-flow consistent macroeconomic model to study the effects of changes in both personal and functional income distribution on national current account balances. Each country has a household sector and a non-household (corporate) sector. The household sector is divided into income deciles, and consumer demand is characterized by upward-looking status comparisons following the relative income hypothesis of consumption. The strength of consumption emulation depends on country-specific institutions. The model is calibrated for the United States, Germany and China. Simulations suggest that a substantial part of the increase in household debt and the decrease in the current account in the United States since the early 1980s can be explained by the interplay of rising (top-end) household income inequality and institutions. On the other hand, the weak domestic demand and increasing current account balances of Germany and China since the mid-1990s are strongly related to shifts in the functional income distribution at the expense of the household sector.

Keywords: income distribution, relative income hypothesis, household debt, stock-flow consistency, current account, institutions

JEL CLASSIFICATION SYSTEM: D31, D33, E16, E21, E25, F32, F41

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1 Introduction

The question how income distribution effects aggregate demand and macroeconomic stability has a long tradition in economics. Two main lines of thought can be identified. A first strand in the literature has focused on the implications of the personal income distribution for household saving and hence aggregate demand. In particular, the relative income hypothesis in the tradition of Duesenberry (1949) predicts that the desired current consumption of any given household will be positively related to the consumption of others within the household's social reference group. With upward-looking status comparisons, an increase in income inequality can give rise to "expenditure cascades" and a fall in the aggregate saving rate (Frank, 2007; Frank et al., 2010). For several decades prior to the Great Recession, the relative income hypothesis had been largely forgotten as a result of the dominance of the representative agent framework underlying the permanent income and the life-cycle hypothesis of consumption in the tradition of Modigliani and Brumberg (1954) and Friedman (1957). Yet, due its apparent relevance for the fall in saving and the unsustainable rise in household debt prior to the Great Recession especially in the United States, the relative income hypothesis has experienced a certain renaissance in the mainstream of the economics profession (van Treeck, forthcoming, for a survey). In an innovative contribution, Kumhof et al. (2012) argue that the rise in personal inequality and the country-specific reactions to it can also help to explain the global current account imbalances, generally held to be another contributing factor to the global financial crisis. Specifically, they argue that in advanced economies with highly developed financial markets, including most notably the United States and the United Kingdom, rising inequality has led to a deterioration of national saving-investment balances, as the poor and middle classes borrowed from the rich and from foreign lenders to finance consumption. In emerging economies, especially China, inequality has also increased, but financial markets are less developed and hence do not allow the lower and middle classes to respond to lower incomes by borrowing. This leads to weak domestic demand and an export-oriented growth model, with wealthy creditors effectively lending to foreign rather than domestic borrowers.

On the other hand, the Classical theories of underconsumption historically have been mainly concerned with the functional distribution of income. According to the Classical saving function, the propensity to save of workers (households) is negligible, while capi-

talists (firms) save a substantial part of their income. The fear has therefore been that a falling share of wages in national income would lead to insufficient aggregate demand and oversaving due to a lack of purchasing power of the 'consuming classes' (e.g. Malthus, 1820; Hobson, 1909). The focus on functional income distribution and sectoral saving behaviour also plays a major role in Post Keynesian models of distribution and growth in the tradition of Kalecki (1954) and Kaldor (1966). Similarly, the financial balances approach, which has given rise to the literature on stock-flow consistent (SFC) modelling, is grounded in an analysis of macroeconomic sectors (firms, household, government, rest of the world) and the distribution of income between the different sectors (Godley and Lavoie, 2007). In current policy-oriented debates, it is sometimes argued that any sustained recovery from the Great Recession needs to be 'wage-led' after several decades of declining labour income shares in many countries (ILO, 2012).

In our view, it is somewhat unfortunate that the two strands in the literature are currently rather segmented. The present paper develops a macroeconomic model where both dimensions of income distribution, functional and personal, are explicitly taken into account. The model is based on the SFC approach following Godley and Lavoie (2007). In particular, the model has the following features. There are three countries, and each country has a household and a non-household (corporate) sector. Functional distribution is defined as the distribution between corporate income and household income. The corporate sector invests, and investment is sensitive to the rate of capacity utilization. The household sector is divided into ten deciles in each country. The consumption demand of each decile depends on its own income and on the actual consumption of the next highest decile. A shift in the functional distribution at the expense of households, which leaves the personal income distribution unaffected, weakens aggregate demand, because households have a higher propensity to spend out of income than firms. Via its effect on imports, the reduction in aggregate demand implies an increase in the current account in the country where the share of household income in national income is reduced, and a decrease in the current account in the other countries, *ceteris paribus*. At the same time, a rise in personal income inequality leads to a lower national saving rate and strengthens aggregate demand, due to emulation effects (expenditure cascades). This implies that an increase in household income inequality in one country leads to a decrease in the current account in this country, and an increase in the current account in the other countries, *ceteris paribus*. The model also allows us to track the evolution of household debt by income decile in each country. The degree

to which households reduce saving and increase their demand for credit following a decline in relative income depends on an emulation parameter in the consumption function which itself depends on country-specific institutions affecting household behaviour. Moreover, the supply of household credit by the banking sector depends on the country-specific financial development.

The model is calibrated for the United States, Germany and China. Simulations are carried out by shocking the functional and personal income distributions in each country in line with empirical data. All three countries have experienced strong shifts in either the functional or the personal income distribution, or both, during the three decades prior to the Great Recession. The United States has been the largest current account deficit country worldwide. Germany and China, by contrast, have cumulated the largest current account surpluses worldwide during the decade before the Great Recession.

We argue that shifts in income distribution have contributed to these developments in the following way: In the United States, the functional income distribution has remained roughly stable, but top-end household income inequality has increased dramatically. This has triggered very substantial expenditure cascades all the way down the income ladder. Emulation in consumption is very strong in this country as a result of the institutional specificities of the labour market (high labour mobility, weak precautionary saving), the educational system (private schools) and the financial system (easy access to credit). In Germany, the shares of wages and household income in national income have strongly decreased, with the result of reduced private household spending and aggregate demand. By contrast, top-end income inequality has not increased very much, despite the rather strong rise in the Gini coefficient of household income. Expenditure cascades have been limited as a result of relatively stable top income shares, but also due to a rather different institutional setting (low labour mobility, publicly financed education system). In China, both the functional income distribution (lower household income) and the personal income distribution (rising top-end inequality) have changed considerably prior to the Great Recession. The former effect has weakened private household and aggregate demand. Yet, expenditure cascades have been limited due to an underdeveloped financial system which has limited the access to personal credit. In both Germany and China, the rise in the current account balance stems to a large extent from the higher saving of the non-household sectors, *i.e.*, corporations and the government.

The remainder of the paper is structured as follows. In Section 2, we review the existing

literature and discuss in which respects our approach differs from previous works. Section 3 presents empirical facts on income distribution, household debt and the current account for the United States, Germany and China. Section 4 presents the main building blocks of the model, and Section 5 discusses the methods of calibrating the model. Section 6 presents numerical simulations and Section 7 concludes. The full model is provided in an Appendix.

2 Review of the existing literature

2.1 Is there a link between rising (top-end) income inequality, rising household leverage and current account imbalances?

The view that rising income inequality has been a main underlying cause of the economic and financial crisis in the United States starting in 2007 is now rather common among economists and policymakers (for surveys of the literature see Atkinson and Morelli, 2010; van Treeck and Sturn, 2012). There are different variations on the theme, but the main argument is that low and middle income consumers in the United States have reduced their saving and increased debt as a reaction to rising (permanent) income inequality since the early 1980s. This process was facilitated by government action, both directly through credit promotion policies and indirectly through the deregulation of the financial sector and an accommodating monetary policy. As a result, private consumption and employment remained high, despite the presumably higher propensity to save of rich households who benefitted from rising inequality, but at the cost of an unsustainable credit bubble and a large current account deficit (e.g. Palley, 2012; Frank, 2007; Cynamon and Fazzari, 2008; Fitoussi and Stiglitz, 2009; Rajan, 2010; Kumhof and Ranciere, 2010).

At a more general level, the issue of differential saving rates has been rediscovered by the economics profession in recent years. Dynan et al. (2004) found a strong positive relationship between personal saving rates and lifetime income. Their results have recently been confirmed by Alvarez-Cuadrado and Vilalta (2012). Different theoretical explanations have been given for the positive link between relative lifetime income and saving rates, including uncertainty with respect to income and health expenses, different degrees of patience across income groups (Mankiw, 2000), bequest motives and asset-based means testing (Dynan et al., 2004), wealth in the utility function or capitalist spirit (Zou, 1995),

or positional externalities in consumption (Frank, 2007).

Even if it is acknowledged, as an empirical matter, that households with higher lifetime incomes save a larger fraction of their income, it remains unclear whether a rise in inequality will raise or lower aggregate personal, let alone national saving. Leigh and Possi (2009, p.58), for example, argue that "(i)f the rich save more than the poor, then a mean-preserving transfer from poor to rich would raise aggregate saving rates." This view continues to be the conventional wisdom among many Keynesian economists (e.g. Palley, 2010; Lavoie and Stockhammer, 2012). Yet, the opposite may be true in the presence of strong demonstration effects when households with declining relative incomes reduce their saving by so much as to overcompensate the increased saving of the richer households.

Frank et al. (2010) argue that precisely this possibility has been the empirically relevant case in the United States in recent decades. Their "expenditure cascades" model is based on demonstration effects and on the behavioural notion that "people generally look to others above them on the income scale rather than to those below" (Frank et al., 2010, p. 7). Therefore, the negative effect of rising inequality on saving will be the more pronounced, the further a shift in inequality occurs towards the top of the income distribution, as this may trigger expenditure cascades going all the way down the income ladder.

In other countries, however, rising personal income inequality seems to have acted as a drag on consumer spending. In Germany, for example, rising inequality seems to have interacted with labour market and welfare institutions to increase the demand for precautionary saving (Carlin and Soskice, 2009), while in China an underdeveloped financial system has restricted the supply of household credit (Kumhof et al., 2012).

Some studies have analysed the effects of changes in personal inequality on saving or household spending econometrically. Schmidt-Hebbel and Serven (2000) estimate a panel of 19 developed and 33 developing countries and find no link between the Gini coefficient and gross national saving. Leigh and Possi (2009) find a strongly negative relationship between lagged top 1% and 10% income shares and current national saving rates in a panel of 11 developed countries for the period 1921-2002. The relationship only holds, however, when the model is estimated with pooled ordinary least squares (POLS), and disappears, when country and time fixed effects are added to the model. Frank et al. (2010), on the other hand, find indirect evidence in support of the expenditure cascades model, using data for the 50 U.S. States and 100 most populous counties. In a similar vein, Bertrand

and Morse (2011) conclude that up to a quarter of the decline in the U.S. household saving rate over the last three decades could be attributed to "top-down consumption spillover effects". Kumhof et al. (2012) find evidence of a negative relationship between the share of total household income accruing to households at the top (1% or 5%) and the current account in a panel regression analysis for 14 OECD countries for the period 1968-2008. These results are confirmed by Al-Hussami and Remesal (2012) who estimate a larger panel including developing countries and add an interaction term between personal income inequality and a measure of financial development. Similarly, Alvarez-Cuadrado and Vilalta (2012), using a small macro-panel of six major economies over the period 1955 to 2007 household survey data, find evidence of rising income inequality interacting with the level of financial development in reducing household saving.

Several analyses also find evidence of a positive relationship between income inequality and private household debt and other measures of financial distress particularly for the United States (Christen and Morgan, 2005; Boushey and Weller, 2006; Iacoviello, 2008; Mian and Sufi, 2009). The macroeconomic implications of rising household debt in the face of higher inequality are formally modelled, within a closed economy setting, by Dutt (2006), Zezza (2008), Kumhof and Ranciere (2010), Kapeller and Schütz (2012), Kim et al. (2012).

2.2 Personal and functional income distribution

Clearly, the rise of inter-household inequality has been at the forefront of political debates in recent years (OECD, 2008, 2011; Stiglitz, 2012). Special emphasis has been on documenting the evolution of top household incomes around the world (Piketty and Saez, 2006; Leigh, 2007; Atkinson et al., 2011). It has become common practice to distinguish two groups of countries according to the evolution of top household income shares throughout the 20th century: a first group, largely consisting of Anglo Saxon countries where top household income shares follow a U-shaped pattern, showing a strong secular increase since the early 1980s; and a second group of countries, including, amongst others, many European countries, and Japan, where top income shares have followed an L-shaped pattern, *i.e.*, showing no (or a more limited) increase in recent decades (Piketty and Saez, 2006, Kumhof et al., 2012)..

Leigh (2007) argues that top income shares are closely related to other measures of personal inequality and recommends the use of top income shares in panel regression analyses when other measures of inequality are not available for a sufficient number of countries and over long enough time spans. He finds a significant relationship between top income shares and other inequality measures, such as the Gini coefficient both in pooled OLS and in country fixed effects estimations, suggesting that changes in top income shares can also be used to proxy changes in other inequality measures.

In our view, however, it depends to a large extent on the specific question at hand, whether top income shares should be used interchangeably with other measures of inequality. As noted above, in terms of the expenditure cascades model, this recommendation is clearly not warranted, because an increase in, say, the Gini coefficient, which is relatively insensitive to changes at the tails of the distribution, will have very different (less strongly negative) effects on household saving than a rise in top income shares.

In fact, in some important countries with only modest increases in top income shares such as China, Germany, or Japan, overall measures of income inequality such as the Gini coefficient of household disposable income increased rather dramatically prior to the global financial crisis (OECD, 2008, 2011). Even more importantly for our purposes, there has been a strong decline in the household and labour income shares in these countries combined with persistently high levels of corporate net saving and large current account surpluses. That is, the corporate sector has increased its net lending rather than passing on rising returns to households in the form of top executive remuneration, bonuses, or dividends. In the United States and the United Kingdom, by contrast, the distribution between corporate and personal income has been roughly constant over the past decades.

This interaction between the functional and personal distribution of income is often not accurately dealt with. In the theoretical and econometric analysis by Kumhof et al. (2012), for example, no distinction is made between the personal and the functional distribution of income. There are two types of agents: investors (the top 5% of all households) and workers (the bottom 95%). Investors represent both rich households and firms, yet top income shares are obtained from the World Top Incomes Database and are defined as the top 5% of all tax units in (pre-tax) personal income. No adjustments are made for investors' claims on corporate wealth.

Recently, there has also been renewed interest in factor shares (of wages and profits)

and its determinants (IMF, 2007; Rodriguez and Jayadev, 2010). However, this literature has developed rather independently of the literature on top household income shares, and few systematic attempts have been made at analysing functional and personal measures in an integrated fashion.[1]

Glyn (2009) argues that trends in the salaries of the top 1% of incomes can have a marked effect on labour's share, which then raises the question of how compensation of this kind should be treated. Atkinson (2009), building on Glyn (2009), also makes a strong case for studying factor shares, for three main reasons: to make a link between incomes at the macroeconomic level (national accounts) and incomes at the household level; to help understand inequality in the personal distribution of income; and to address concerns of social justice. A fourth important reason, implicit in Atkinson (2009) and discussed in Subsection 2.3, is the link between functional income distribution and aggregate demand.[2]

2.3 The corporate veil: Functional income distribution and aggregate demand

In most standard macroeconomic models, e.g. of the dynamic stochastic general equilibrium (DSGE) type, the functional income distribution either has no importance whatsoever or it is conflated with the personal income distribution. In effect, since all firms are ultimately owned by individuals, in theory, *i.e.*, with perfect capital markets and in the absence of principle-agent problems, the distribution of income between corporations and households should not matter for either investment or consumption. In reality, however, the corporate veil likely does play an important role in terms of corporate and household spending and financing decisions for various reasons.

Firstly, as far as households are concerned, the difference between accrual and realisation of capital gains is typically large and introduces a great deal of volatility in expected personal income (Atkinson, 2009, p. 9). Hence, it does make a difference for shareholders' consumption demand whether, for instance, they obtain a notional capital gain as a result of positive corporate net saving or whether their current income increases as a result of

[1] Notable exceptions are Adler and Schmid (2011) and Schlenker and Schmid (2013).

[2] Glyn (2009, p. 123) argues: " [...] trends in factor shares are still relevant for both normative and positive analysis of how capitalist economies function. Much remains to be done in [...] evaluating [...] (the) impact (of factor shares) on household income distribution, patterns of accumulation, and macroeconomic stability."

higher wages or profit payouts. Clearly, to the extent that household consumption is more sensitive to current income than capital gains, the expenditure cascades model would predict that aggregate personal saving declines much more strongly when the corporate sector distributes income to rich households in the form of salaries, bonuses or dividends, than when it accumulates net financial assets, even if they are ultimately owned by the same households. In a mechanical sense, then, aggregate demand is adversely affected by a rise in corporate income at the expense of household income, when the marginal propensity to spend out of current income is higher for households than for firms.

The available empirical evidence for the significance of the corporate veil is mixed. Only few studies have analysed the significance of the corporate veil empirically. Denison (1958) noted the relative constancy of national saving independent of changes in corporate saving. Feldstein (1973) and Feldstein and Fane (1973) argued that households were indeed able to pierce the corporate veil, since they found a positive marginal propensity to consume from retained earnings. However, the estimated marginal propensity to consume from income was higher than that from corporate retained earnings, implying only incomplete piercing of the corporate veil. Similar results were found by Sumner (2004), based on a 'Feldstein specification' and a life-cycle specification of the aggregate consumption function for the United Kingdom. Poterba (1991) and Monogios and Pitelis (2004) report evidence of a significant corporate veil for different Anglo Saxon countries. While the aforementioned studies rely on aggregate time series data, Baker et al. (2007) use household survey data from the Current Expenditure Survey (CEX) and trading records from a discount brokerage. They find strong evidence in favour of a corporate veil.

At a practical level the notion that corporate financing decisions do affect aggregate demand, and hence the current account, seems to be widely accepted. Feldstein (2010), for example, discussing the "Japanese saving crisis", suggests that a decline in corporate net savings would lead to a decrease of the current account balance, given low household saving and persistent government deficits. On the other hand, the rise of corporate net saving and cash hoarding at the global level has been identified as a contributing factor to the 'global saving glut' prior to the Great Recession and as an impediment to recovery from it (The Economist, 2005). Pettis (2013) forcefully argues that the persistent current account surpluses of China and Germany, the two countries with the largest current account surpluses worldwide, are not primarily the result of household thriftiness, but rather of low wages and household income leading to weak aggregate consumption relative to domestic

production.

Focusing on the case of China, Pettis (2013, ch. 4) explains how low wage growth, financial repression and other hidden transfers from households to the corporate and government sectors have constraint household income and consumption and contributed to the persistent current account surplus. Similarly, Lin et al. (2010, p. 1) note that the strong rise in corporate saving in China reflects distortions arising from the transition process from a planned to a market economy and that "(t)hese distortions exacerbate China's income inequality, causing domestic consumption to remain a small share of GDP." Yang (2012, p. 125) attributes the dramatic increase in the current account in China since the early 2000s to the concurrence of China joining the World Trade Organisation in 2001, a declining labour share of income and "a set of institutional rules that centered on export promotion and that favored firms and government over the household sector."

European Commission (2010, p. 13), looking at Germany's increased export orientation during 2000-2007, argues that "corporate savings were raised by reducing the compensation of labour" as part of a strategy to make available internal funds necessary to reduce the debt stocks accumulated during the preceding New Economy boom. Moreover, evidence is presented of corporate liquidity build-up, *i.e.*, an accumulation of liquid assets, by the German corporate sector, similar to the insurance strategy pursued by many Asian corporations following the 1997 crisis. Perhaps even more importantly, the shareholder value orientation of German companies is typically far less pronounced than in the Anglo Saxon countries. The backbone of the German business sector is the so-called *Mittelstand*, consisting of medium-sized firms which are not publicly listed, often family owned and conservative in their financing decisions. This may explain why the strongly rising returns on capital throughout the 2000s have been used by these firms to raise corporate saving, and not so much to raise payments to shareholders and top managements, as has been the case in the Anglo Saxon countries. Since the household and government sectors did not increase their net borrowing, the rise in corporate net lending has been the flipside of the increasing trade and current account surplus of Germany.

Only a few studies have analysed the macroeconomic implications of changes in factor shares in a systematic way. Karabarbounis and Neiman (2013) document a clear link between the falling labour income share and the rise in corporate saving at the global level and for both developed and emerging economies. They hypothesise that this phenomenon is due to a fall in the price of investment goods relative to wages. As a result, corporations

have increasingly substituted capital for labour. Moreover, under imperfect capital markets, corporate saving is the preferred source from which to finance investment (and, due to differential tax treatment, equity repurchases are preferred to dividends as a means to increase shareholder wealth).

Charpe and Kuehn (2012) discuss the impact of inequality on output and employment theoretically, using a DSGE model. The main result of their model is that a drop in the labour share of income following the decline in the bargaining power of workers lowers consumption and aggregate demand. In an open economy setting, however, the effect of a decline on the labour share on aggregate demand may be reversed due to a (beggar-thy-neighbour) competitiveness effect.

Similarly, various attempts have been made to relate the patterns of aggregate demand to the evolution of the aggregate wage share and to assess the extent to which aggregate demand in particular countries is either 'wage-led' or 'profit-led' (Bhaduri and Marglin (1990); Lavoie and Stockhammer (2012), for theoretical discussions). Recent econometric contributions to this Post Keynesian literature include Hein and Vogel (2008), Onaran et al. (2011), Hartwig (2013). A wage-led pattern of aggregate demand implies that a rise in the wage share is typically linked to a decrease in the current account.

An obvious problem with approaches focusing solely on functional distribution is that they are, by construction, unable to explain the rather strong private consumption demand and secular rise in the consumption-to-GDP ratio in a number of such important countries as the United States or the United Kingdom, where the labour and household income shares have not shown a long-run tendency to rise. What is largely absent in the existing literature is the joint analysis of the implications of personal and functional income distribution on aggregate demand.

3 Trends of inequality, debt and the current account

We argue that changes in functional and personal income distribution have contributed to a significant degree to the built-up of macroeconomic instability in a number of relevant countries prior to the Great Recession. Among the most important indicators of financial fragility are excessive household leverage ratios and current account imbalances. Econometric evidence suggests for the period before the Great Recession that there was a strong

negative link between top-end income inequality (the top 1 or 5 % income share) on the one hand and household saving and national current account balances on the other hand, controlling for a standard set of explanatory variables (Kumhof et al., 2012; Al-Hussami and Remesal, 2012; Alvarez-Cuadrado and Vilalta, 2012; Behringer and van Treeck, forthcoming). This result is consistent with the expenditure cascades hypothesis. Moreover, there is evidence that a decrease in the wage share or an increase in the corporate financial balance leads to an increase in the current account (Lavoie and Stockhammer, 2012; Behringer and van Treeck, forthcoming). Further empirical evidence suggests that a change in the fiscal balance also significantly affects the current account, *ceteris paribus* (Chinn and Ito, 2007). These results are consistent with both the existence of a significant corporate and government veil as well as with macroeconomic theories in the underconsumptionist tradition.

Figures 1 to 3 illustrate these empirical findings in a descriptive manner for the United States, Germany and China. In the United States, top income shares increased dramatically since the early 1980s (Figure 1), and at the same time the private household financial balance decreased (and with it the current account balance), while household leverage rose strongly from around 50 per cent of GDP in 1980 to more than 100 per cent in 2007. The share of private consumption in GDP increased by almost ten percentage points from 1980 to 2007, and residential investment added a further two percentage points of GDP to private household expenditures. While the adjusted wage share decreased somewhat, the share of disposable household income in national income remained roughly constant. The financial balance of the corporate sector increased slightly.

In Germany, by contrast, top household income shares remained almost constant until the Great Recession (Figure 2), even though the rise in the Gini coefficient of household income since the mid-1980s was similar to the rise in the United States. However, the functional income distribution in Germany showed a marked shift to the expense of wages and household disposable income throughout the 1980s and the 2000s, *i.e.*, before and after the rather exceptional period after reunification in 1990. Note that the decline in the adjusted wage share was significantly more pronounced than the decline in household disposable income. This may reflect government transfers, but also the importance of unincorporated businesses in Germany.

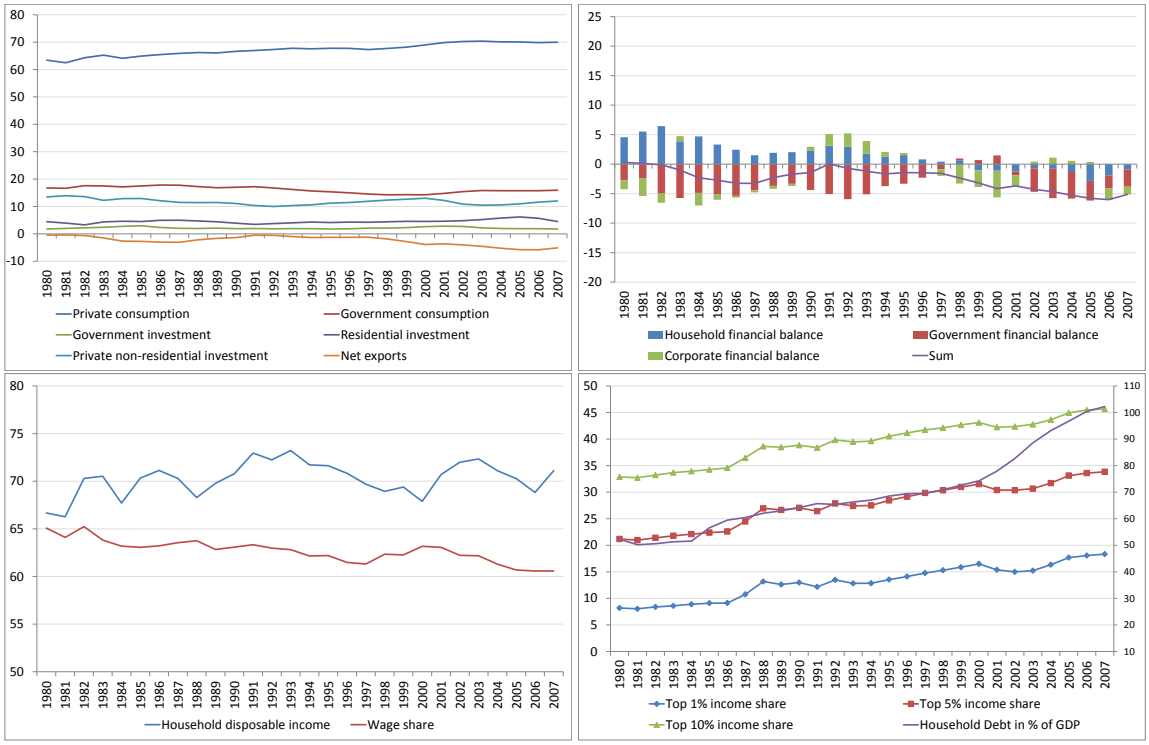

Figure 1: United States; Upper left: GDP expenditure approach; Upper right: Sectoral financial balances; Lower left: GDP income approach; Lower right: Top income shares and household debt. Sources: AMECO, National Income and Product Accounts, Flow of Funds, World Top Incomes Database

During both the 1980s and 2000s, the increase in the current account was driven by the rise in the corporate financial balance. Note that the weak domestic demand was not due to low private business investment in either period, contrary to an argument routinely made by the Organisation of Economic Cooperation and Development (OECD, 2010; OECD, n.d.). Rather, the rising net exports were the result of weak private consumption and residential investment expenditure and low public investment, especially in the 2000s. The increase in the current account balance was primarily driven by the rise in corporate net lending and the reduction in the government deficit, but also by the increase in the private household financial balance, at least in the 2000s. Household leverage decreased during the 2000s, following the rise during the 1990s after reunification.

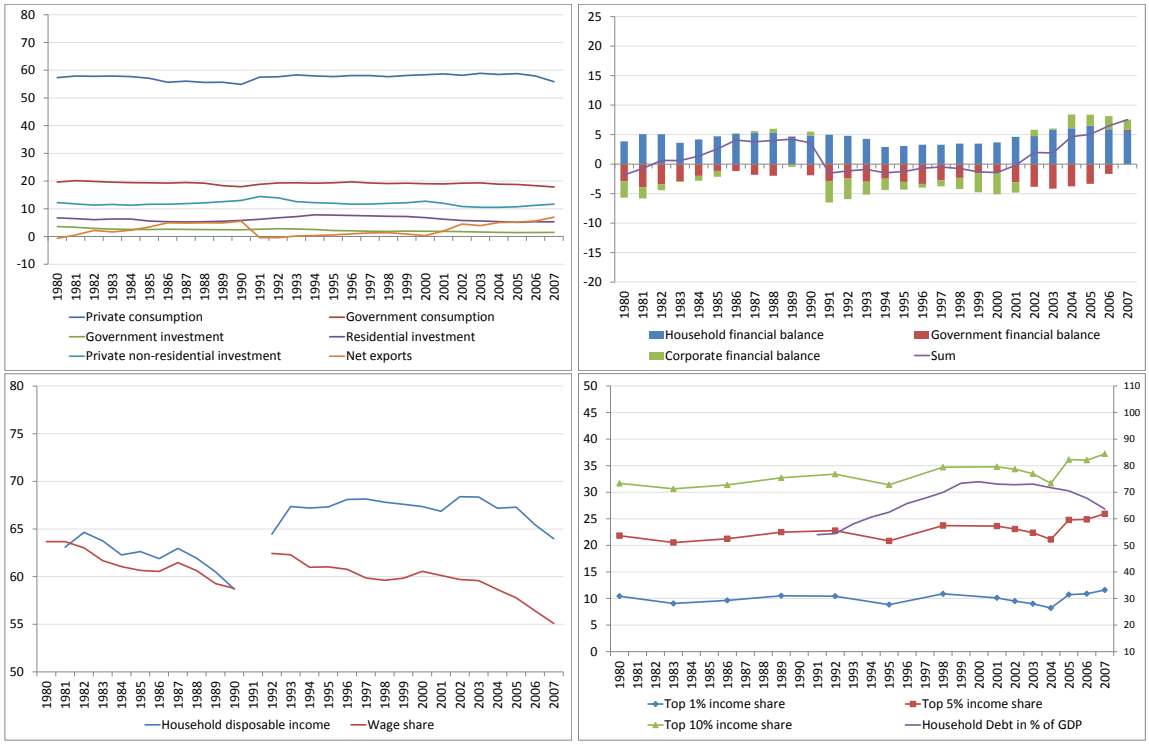

Figure 2: Germany; Upper left: GDP expenditure approach; Upper right: Sectoral financial balances; Lower left: GDP income approach; Lower right: Top income shares and household debt. Sources: AMECO, Bundesbank, World Top Incomes Database

The case of China is in some respects similar to Germany. Although data reliability is a notorious problem, there was a clear and very pronounced downward trend of the share of private consumption in GDP. This was only partly compensated for by the increase in residential investment as a share of GDP. Net exports and the current account balance rose dramatically especially after 2000, reaching respectively 8 and 10 per cent of GDP in 2007. The shares of wages and, even more so, household income in national income have declined spectacularly since the late 1990s. At the same time, top household income shares as well as the Gini coefficient of household incomes have risen substantially.[3] Yet, the private household financial balance has remained roughly constant. The rise in the current account balance since the mid 1990s has been driven by the increase in corporate and government net lending.

[3]While data availability is a concern with respect to top household incomes, the estimates reported in Figure 3 are likely downward biased; see Piketty and Qian (2009).

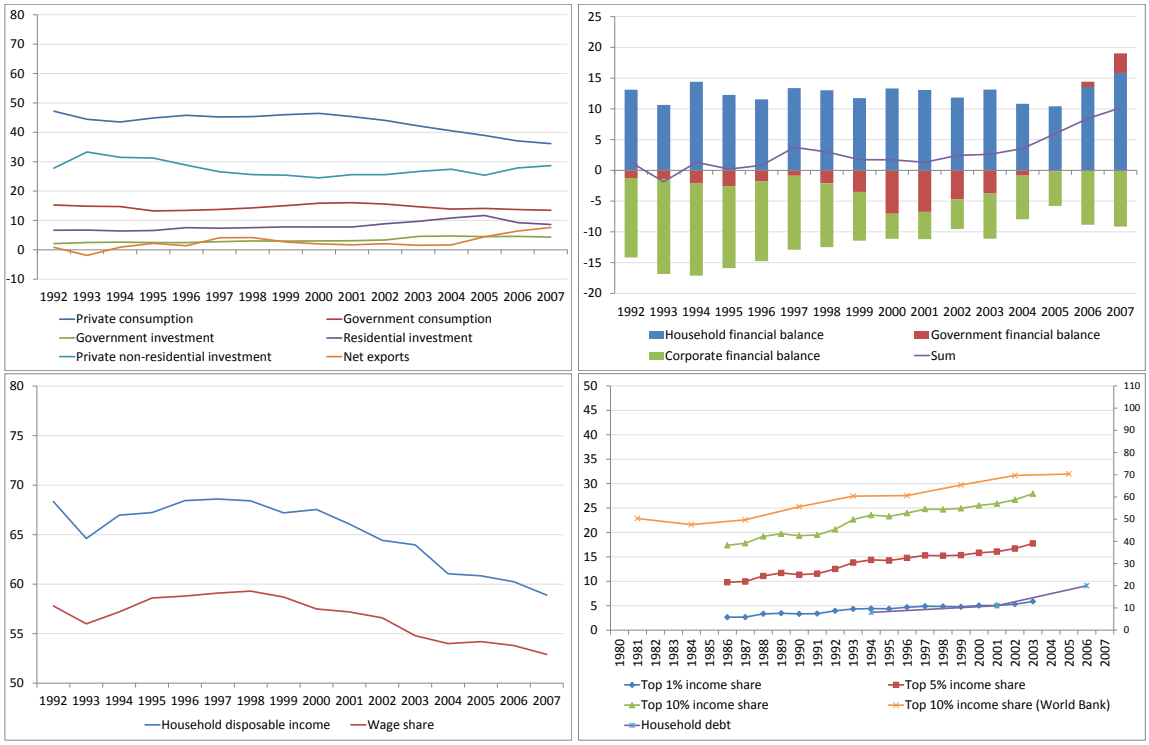

Figure 3: China; Upper left: GDP expenditure approach; Upper right: Sectoral financial balances; Lower left: GDP income approach; Lower right: Top income shares and household debt.
Sources: National Bureau of Statistics, World Top Incomes Database, Zhou et al. (2010)

4 The model

In this section we present the accounting structure and discuss the main behavioural equations of our model. Table A contains a full list of variables and parameters. Table 2 shows the balance sheet matrix for the three model economies as a single complete system. Tables 3, 4 and 5 are the transactions flow matrices for countries A, B, and C. Throughout the exposition, superscript $i = 1, ..., 10$ denotes household income deciles, superscript $j, n, k = A, B, C$ denotes the three countries, subscripts d and s denote demand and supply, respectively, and subscript t is the time index. Variables without the superscript i denote household sector aggregates. The full set of model equations is provided in Appendix B.

4.1 Accounting structure and cross-country linkages

In each country there are three sectors: households, firms, and banks. Households hold two types of assets, domestic bank deposits, m_h^j and domestic corporate equity, $e_d^j p_e^j$, where e_d^j is the number of shares and p_e^j is the price per share. On the liability side, households have loans, l_h^j, from domestic and foreign banks (in domestic currency). Firms issue equities and take on loans, l_f^j, from domestic banks. The gross domestic product, y^j, is equal to the sum of household consumption, c^j, business investment, i^j, and exports, ex^j, minus imports, im^j. Households receive wages, wb^j and dividends, f_D^j, from firms and interest on their deposits from banks. The current account is the sum of net exports and net interest payments received on consumer loans.

Trade linkages are modelled in the following simple way. Starting with basic accounting identities, a country's import and export equations are

$$\begin{aligned} ex^{nj} &= \epsilon^j \cdot im^j / xr^{jn}, \qquad ex^{kj} = \left(1-\epsilon^j\right) \cdot im^j \cdot xr^{jk} \\ ex^j &= ex^{jn} + ex^{jk}, \qquad j,k,n = A,...,C \qquad n = A,...,C \qquad with \qquad j \neq n, \neq k \end{aligned} \tag{1}$$

where ex^{nj} and ex^{kj} are exports from country n and k, respectively, to country j, im^j and ex^j are imports and exports of country j, and xr^{jn} and xr^{jk} are the (exogenous) exchange rates of the country j currency expressed, respectively, in units of the country n currency and of the country k currency. The parameter ϵ^j determines the shares of country j's imports from the two other countries.

Because in our model only households can lend and borrow internationally, we also assume that total imports are a function of household consumption:

$$im^j = \mu \cdot c^j, \qquad j = A,...,C \tag{2}$$

where μ is the demand elasticity of imports.

The current and capital accounts of each country are given by the following expressions:

$$\begin{aligned} ca^j = nx^j + \left[\left(r_{lh}^j \cdot l_{h,d,t-1}^{jn} \cdot xr^{jn}\right) + \left(r_{lh}^j \cdot l_{h,d,t-1}^{jk} \cdot \frac{1}{xr^{jk}}\right) - \left(r_{lh}^n \cdot lh_{h,d,t-1}^{nj}\right) - \left(r_{lh}^k \cdot l_{h,d,t-1}^{kj}\right)\right] \\ j,k,n = A,...,C \qquad with \qquad j \neq n \qquad and \qquad j \neq k \end{aligned} \tag{3}$$

$$ka^j = -\left[\left(l^{jn}_{h,d} - l^{jn}_{h,d,t-1}\right) \cdot xr^{jn} + \left(l^{jk}_{h,d} - l^{jk}_{h,d,t-1}\right) \cdot \frac{1}{xr^{jk}} - \left(l^{nj}_{h,d} - l^{nj}_{h,d,t-1} + l^{kj}_{h,d} - lh^{kj}_{h,d,t-1}\right)\right] \quad (4)$$

$j,k,n = A, ..., C \qquad with \qquad j \neq n \qquad and \qquad j \neq k$

A country's current account balance, given by equation (3), is determined by its net exports and the net interest income on consumer loans received from the rest of the world. The capital account (Equation 4), is the change in loans from country j to the rest of world minus the change in loans to country j from the rest of the world.

4.2 Functional income distribution

The wage share of income is given by

$$wb^j = w^j \cdot y^j, \qquad j = A, ..., C \quad (5)$$

where the wage share of country j, w^j, is exogenously given and determines the economy's total wage bill, wb^j.

The total profits of firms, $f^j_T = y^j - wb^j$, are in part distributed to shareholders and bondholders and in part retained by firms. Undistributed profits are given by

$$f^j_U = f^j_T - r^j_{lf,t-1} \cdot l^j_{f,d,t-1} - f^j_D \quad (6)$$

where $r^j_{lf,t-1}$ is the lagged interest rate on business loans, $l^j_{f,d,t-1}$ are lagged outstanding business loans and f^j_D are firms' dividend payments. Dividends are determined by firms' saving rate, s^j_f:

$$f^j_D = \left(1 - s^j_f\right) \cdot \left(f^j_{T,t-1} - r^j_{lf,t-1} \cdot l^j_{f,d,t-1}\right) \cdot \left(1 + g^j_{t-1}\right) \quad (7)$$

Aggregate household disposable income is equal to the sum of the wage bill and interest and dividend payments received from banks minus interest paid on consumer loans:

$$yd^j = wb^j + f^j_D + r^j_{m,t-1} m^j_{h,d,t-1} - r^j_{lh,t-1} l^j_{h,t-1}, \qquad j = A, ..., C, \quad (8)$$

The sum of undistributed corporate profits and household disposable income is equal to gross national income, *i.e.*, the sum of gross domestic product and net interest payments on consumer loans received from the rest of the world:

$$f_U^j + yd^j = y^j + \left[\left(r_{lh}^j \cdot l_{h,d,t-1}^{jn} \cdot xr^{jn}\right) + \left(r_{lh}^j \cdot l_{h,d,t-1}^{jk} \cdot \frac{1}{xr^{jk}}\right) - \left(r_{lh}^n \cdot lh_{h,d,t-1}^{nj}\right) - \left(r_{lh}^k \cdot l_{h,d,t-1}^{kj}\right)\right] \quad (9)$$
$$j,k,n = A, ..., C \qquad with \qquad j \neq n \qquad and \qquad j \neq k$$

4.3 Corporate finance and investment

Firms can finance their investment expenditures in three ways. They can retain profits, f_U^j, issue new equities, e_s^j, or borrow from domestic banks, $l_{f,d}^j$. The dividend decision is formalised in Equation (7). Furthermore, we assume that a constant fraction of investment is financed via new equity issues:

$$e_s^j = es_{s,t-1}^j + x^j \cdot i_{t-1}^j / p_e^j \quad (10)$$

Finally, the remaining financing gap is closed by borrowing from the banks:

$$l_{f,d}^j = l_{f,d,t-1}^j + i^j - f_U^j - \left(e_s^j - e_{s,t-1}^j\right) \cdot p_e^j \quad (11)$$

Investment follows a simple investment function, whereby the rate of growth of the capital stock depends on a constant, γ_1^j, and the rate of capacity utilisation, u^j:

$$g^j = \gamma_1^j + \gamma_2^j \cdot u^j \quad (12)$$

4.4 Personal income distribution

Aggregate household disposable income is distributed across deciles in the following way:

$$yd^{i,j} = wb^{i,j} + \beta_{t-1}^{i,j} \cdot f_D^j + r_{m,t-1}^j \cdot m_{h,d,t-1}^{i,j} - r_{lh,t-1}^j \cdot l_{h,t-1}^{i,j}, \qquad i = 1, ..., 10; j = A, ..., C, \quad (13)$$

While dividends depend on the share of each decile, $\beta^{i,j}$, in total corporate equity, f_D^j and net interest income on the deposits and outstanding loans of each decile, the wage distribution is treated as exogenously given:

$$wb^{i,j} = \delta^{i,j} \cdot wb^j, \qquad i = 1, ..., 10; j = A, ..., C \tag{14}$$

4.5 Household demand for consumption and borrowing

The specification of the consumption function is an extension of the expenditure cascades model proposed by Frank et al. (2010). It is assumed that the uppermost income decile consumes only on the basis of its own disposable income and accumulated wealth, *i.e.*, in accordance with the life-cycle model:

$$c^{1,j} = o^{1,j} \cdot v_h^{1,j} + \kappa \cdot \left(1 + g^j\right) \cdot yd_{t-1}^{1,j}, \qquad j = A, ..., C \tag{15}$$

where $v^{1,j}$ is net worth of the first household decile, $yd_{t-1}^{1,j}$ is its lagged disposable income, and g^j is the growth rate of the economy. The parameters $o^{1,j}$ and κ represent the marginal propensities to consume out of wealth and disposable income, respectively.

The lower deciles emulate the consumption of their reference group. Following the behavioural insight that status comparisons are predominantly upward-looking, we define the social reference group of each decile as the next highest decile in the income distribution. The desired consumption of the bottom nine deciles is then given by:

$$\begin{aligned} c_{de}^{i,j} &= o^{i,j} v_h^{i,j} + \kappa \left[1 - \left(\alpha_0 - \alpha_1^j\right)\right] (1 + g^j) yd_{t-1}^{i,j} + \left(\alpha_0 - \alpha_1^j\right) \left(1 + g^j\right) c_{t-1}^{i-1,j}; \\ & i = 2, ..., 10 \; j = A, ..., C \end{aligned} \tag{16}$$

Besides the wealth term, the consumption function for the bottom nine deciles is a weighted average of a 'Keynesian' absolute income effect (desired consumption depends on own income) and a 'Duesenberryian' effect (desired consumption depends on other households' consumption). The relative importance of absolute and relative income effects depends on the weighting parameters α_0 and α_1^j. α_0 is the same for all countries and might be called the 'natural rate of imitation': It is grounded in the quest for status in terms

of positional goods which may be seen as independent of country-specific institutions. By contrast, α_1^j is a penalty term which reflects country-specific factors reducing the extent to which households seek to emulate their more affluent peers. These include in particular the provision of public goods (education, health care, etc.), the degree of households' insurance against status loss in the labour market (unemployment benefits, labour force participation, employment mobility, gender pay gap), and indirectly the reactivity of monetary and fiscal policy to unemployment. For instance, households with highly firm-specific skills, prevalent in Germany, may react to rising inequality with higher precautionary savings (Carlin and Soskice, 2009). Hence, the penalty term, α_1, for Germany will be relatively high. Moreover, consumption emulation may be restricted by households' access to credit, which is captured by an indicator function, see Equation (20).

Households are assumed to finance a fixed fraction, $\nu^{i,j}$, of their consumption expenditures by credit, which can be from domestic as well as foreign banks. The total credit demand of households is given by

$$l_{h,d}^{i,j} = l_{h,d,t-1}^{i,j} + \nu^{i,j} \cdot c^{i,j}, \qquad i = 1, ..., 10 \; j = A, ..., C \tag{17}$$

Households' credit demand from foreign banks (in country n) is given by

$$l_{h,d}^{i,nj} = l_{h,d,t-1}^{i,nj} + \left(ex^{nj} * xr^{jn}\right) \cdot \psi^{i,j}, \qquad i = 1, ..., 10 \; j,n = A, ..., C; j \neq n \tag{18}$$

where $\psi_0^{i,j} = l_{h,d,t-1}^{i,j} / l_{h,d,t-1}^{j}$ is the share of household i's debt in aggregate consumer credit.

4.6 Credit supply and household assets

We also assume that households face a financing constraint beyond which the banking sector will no longer provide credit for consumption purposes.[4] In this case, the Duesenberrian term will be switched off. This is formalised by means of indicator functions: $z_1^{i,j}$ which takes a value of 1 when the finance constraint is not binding, and a value of 0 once it becomes binding as well as $z_2^{i,j}$ which works the other way around. Specifically, once the leverage ratio of a given household decile reaches a certain threshold, the finance constraint becomes binding. Formally,

[4] In Kumhof et al. (2012), credit supply restrictions are incorporated in workers' budget constraint.

$$c_c^{i,j} = o^{i,j} \cdot v^{i,j} + \kappa \cdot \left(1 - \left(\alpha_0^j - \alpha_1^j\right)\right) \cdot \left(1 + g^j\right) \cdot yd_{t-1}^{i,j}, \quad i = 2, ..., 10 \; j = A, ..., C \tag{19}$$

$$z_1^{i,j} = \begin{cases} 1 & \text{if} \quad l_{h,t-1}^{i,j}/yd_{t-1}^{i,j} \leq \pi^{i,j} \\ 0 & \text{if} \quad l_{h,t-1}^{i,j}/yd_{t-1}^{i,j} > \pi^{i,j} \end{cases}, \qquad z_2^{i,j} \text{ the other way around} \tag{20}$$

$$c^{i,j} = z_1^{i,j} c_{de}^{i,j} + z_2^{i,j} c_c^{i,j}, \qquad c^j = \sum_{i=1}^{10} c^{i,j} \tag{21}$$

Additionally, we require that households service their debt at all times out of their disposable income.

Households' net worth is given by the sum of net worth of the previous period, current saving, $s^{i,j} = yd^{i,j} - c^{i,j}$ and capital gains, cg^{ij}:

$$v_h^{i,j} = v_{h,t-1}^{i,j} + s^{i,j} + cg^{ij}, \qquad v_h^j = \sum_{i=1}^{10} v_h^{i,j} \tag{22}$$

$$cg^{ij} = \left(p_e^j - pe_{e,t-1}^j\right) \cdot e_{d,t-1}^{i,j}, \qquad cg^j = \sum_{i=1}^{10} cg^{i,j} \tag{23}$$

Households can hold their wealth either in domestic bank deposits or in the form of equities (Table 2). Portfolio choice is based on the relative rates of returns on equities and bank deposits, following Godley and Lavoie (2007):

$$e_d^{exp,i,j} = \left(\lambda_0^{i,j} - \lambda_1^{i,j} \cdot r_m^j + \lambda_2^{i,j} \cdot r_{e,t-1}^j\right) \cdot v^{exp,i,j} - \lambda_3^{i,j} \cdot yd^{exp,i,j}, \quad e_d^{exp,j} = \sum_{i=1}^{10} e_d^{exp,i,j} \tag{24}$$

The demand for equities depends on an autonomous component, $\lambda_0^{i,j}$, and $\lambda_1^{i,j}$ and $\lambda_2^{i,j}$ reflect the sensitivity of the demand for equities with respect to the interest rate on deposits, rm^j, and the rate of return on equities from the previous period, re_{t-1}^j. Since households wish to remain liquid irrespective of the return on equity, $\lambda_3^{i,j}$ reflects the transactions demand for money.

Stock prices simply follow a random walk, and interest rates are exogenous, but time-variate. We assume that lending rates are equal to deposit rates, *i.e.*, banks do not make profits. Banks fully accommodate firms' and households' demand for loans, with the exception described by Equation (20), *i.e.*, the model has the usual endogenous money property ('loans create deposits'). Because banks make consumer loans internationally, non-zero capital account balances are possible and intermediated through the banking system, but they are fully driven by the current account.

5 Calibration

In this section we describe a relatively simple way of calibrating the model to real-world data, most importantly its starting values and parameters.

5.1 Accounting and starting values

Figures 4 to 6 show the components of GDP, the functional income distribution, sectoral financial balances and debt-income ratios for the three model economies. In contrast to Section 3, macroeconomic variables are now adjusted to match the accounting setup of the theoretical model. For instance, we do not explicitly model the government sector but distinguish only the household sector and the non-household sector, as we discuss below. The basic procedure is then as follows: Firstly, model adjusted data helps to define the parameters and the starting values of the endogenous variables. We then run the model and follow the trajectory of the most important endogenous variables as a baseline scenario. If the model produces a realistic baseline simulation, it can also be employed for scenario analysis. We can then ask how specific variables of interest, in particular the current account and household debt, would have developed, if shocks to the functional and personal income distribution had not occurred.

We calibrate the starting values to 1982 for country A ('United States') and 1996 for countries B ('Germany') and C ('China') to ensure that the current account balances of the three model economies sum to zero. A further motivation for choosing different starting dates is that inequality has started to increase strongly in the early 1980s in the United States, but only since the mid-1990s in Germany and China. It was also at that time when Germany's current account recovered after the reunification shock and China emerged as

global player in international trade relations.

5.1.1 Components of GDP and functional income distribution

As mentioned above, one important process is to aggregate the firm and government sector into one sector, which we call the 'corporate sector'. Of course, we do not consider the separation of the government and corporate sectors to be irrelevant, and this is one of the possible extensions left for future research. However, conflating corporate and government sectors seems well justified especially in the case of China, with its large share of state ownership in the corporate sector, see Pettis (2013, ch. 4). Gross domestic product is the sum of 'consumption', 'investment' and net exports. Net exports are taken directly from the national accounts. 'Consumption' comprises total household expenditure as measured in the national accounts (private consumption plus residential investment). 'Investment' is calculated as the residual obtained from subtracting our consumption measure as defined above and net exports from the gross domestic product as measured by the national accounts. Household disposable income is calculated as the sum of the household financial balance from the national accounts and our measure of consumption. The financial balance of the 'corporate sector' is equal to the difference between the actual current account and the actual household financial balance. Corporate disposable income is then calculated as the sum of the corporate financial balance and our measure of investment as defined above. As a matter of simplification we chose an initial net foreign position of zero for all countries.[5] Hence, the initial current account equals net exports as the flows of debt-service payments between countries are zero. Furthermore, GDP equals national income.

5.1.2 Personal income distribution and decile-specific balance sheets

Starting values for decile-specific disposable income are obtained from CBO (2010), the German Socio-Economic Panel (SOEP, see Gerstorf and Schupp, 2012) and Li (2002). Stocks of decile-specific assets and liabilities are calculated as follows. Debt-income ratios are obtained from the Survey of Consumer Finances for the United States and from the

[5]The actual net foreign position of the United States was significantly negative in 1982 and that of Germany was close to zero. We do not have reliable data for China. But note that by definition global foreign wealth positions must add up to zero. Therefore reproducing real-world data with respect to the net foreign assets is an almost impossible task in a three-country model.

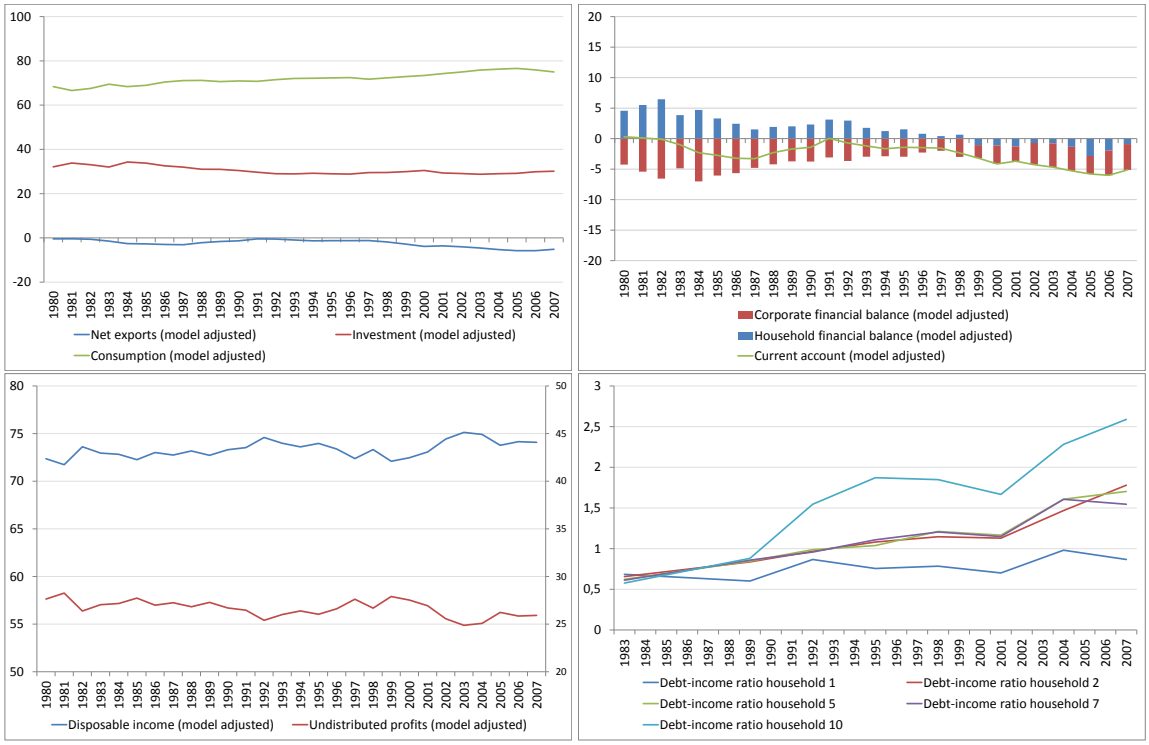

Figure 4: United States, model adjusted; Upper left: GDP expenditure approach; Upper right: Sectoral financial balances; Lower left: GDP income approach; Lower right: Debt-income ratios for selected deciles.

German Socio-Economic Panel for Germany. These are multiplied with our decile-specific measures of disposable income, giving us the starting values for the decile-specific stock of debt. The aggregate stock of household debt in each country is obtained as the sum of debt of the household deciles. The stock of aggregate and decile-specific assets is calculated in a similar fashion. First, we multiply aggregate net worth-to-income ratios with our measure of disposable income to obtain the aggregate net worth. To obtain the household level measures of net worth we use information on the wealth distribution from Wolff (2010) for the United States and our own calculations based on SOEP for Germany. Aggregate deposits held by households are computed as the sum of outstanding domestic consumer and business loans, taken from the Flow of Funds (Federal Reserve System and Deutsche Bundesbank).

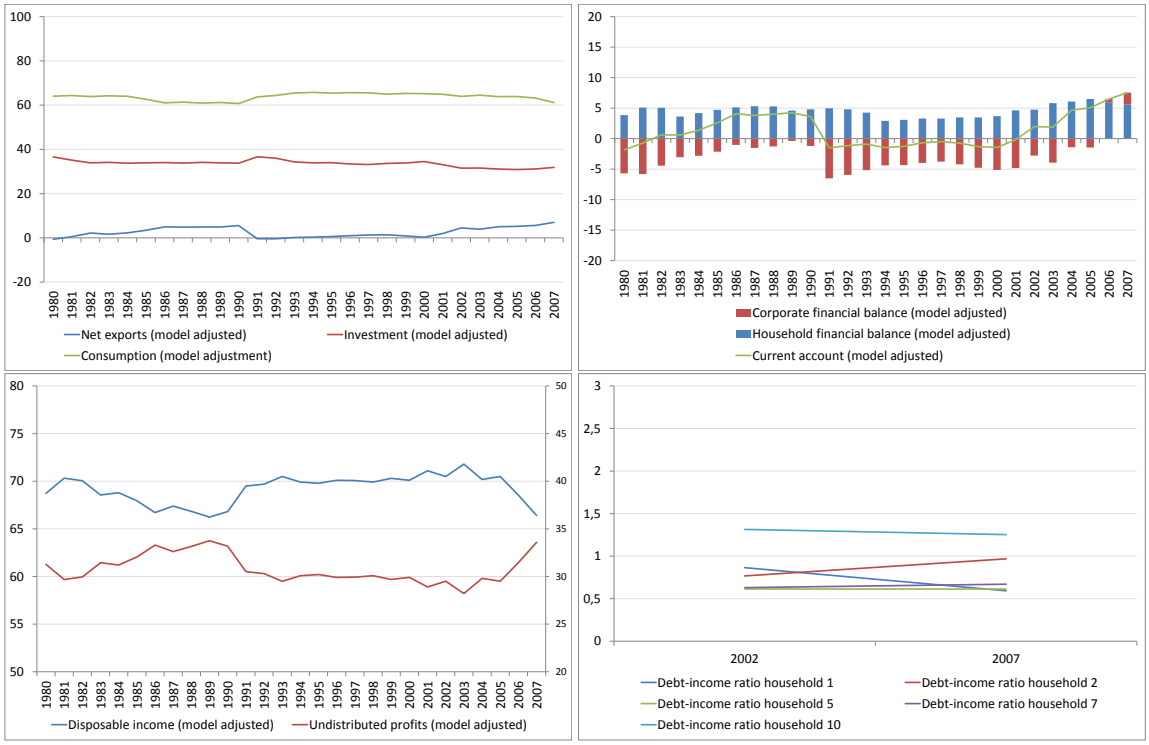

Figure 5: Germany, model adjusted; Upper left: GDP expenditure approach; Upper right: Sectoral financial balances; Lower left: GDP income approach; Lower right: Debt-income ratios for selected deciles.

Aggregate stock market wealth is then calculated as aggregate wealth less deposits plus consumer loans so that each household decile's net worth is the sum of deposits and equity less its loans. For China we use data from Zhong et al. (2010) for aggregate wealth as well as for decile-specific values of wealth to calculate decile-specific values of stock market wealth.

5.2 Exogenous variables and parameters

5.2.1 Exchange and interest rates

We use exogenous, but time-varying interest rates. Data for short-term interest rates is from the OECD Economic Outlook for the U.S. and Germany. For China, we use lending rates of financial institutions for China, provided by the People's Bank of China. Due to

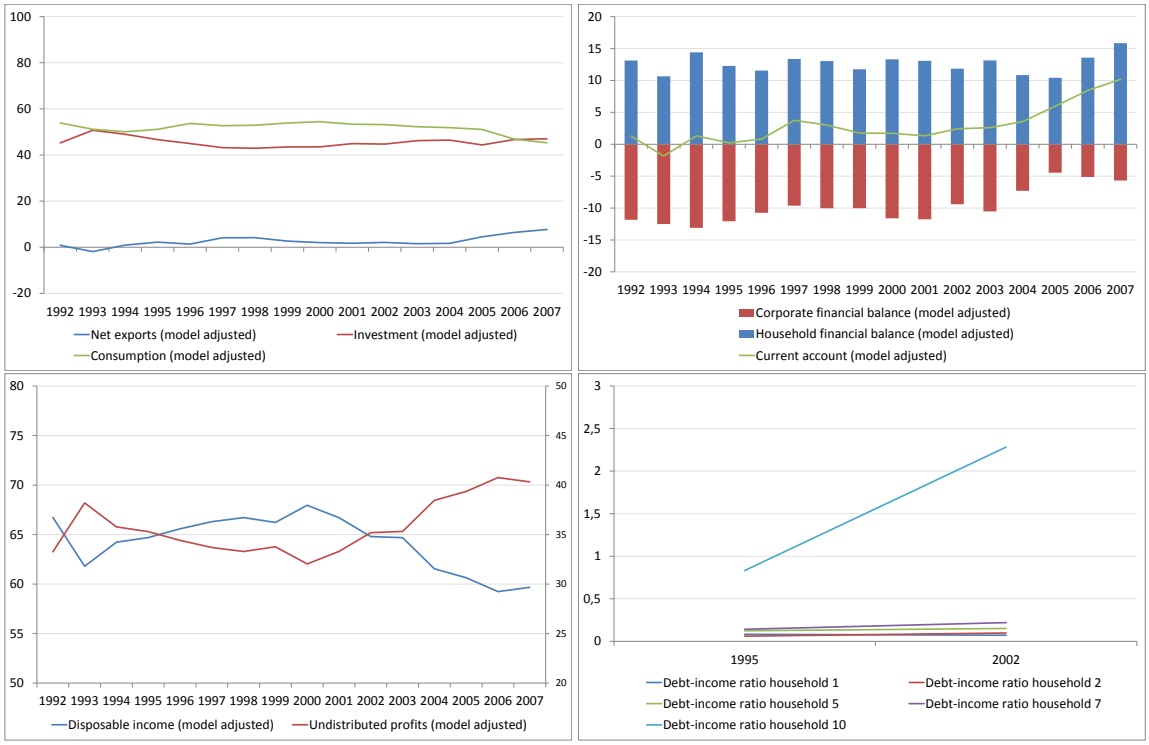

Figure 6: China, model adjusted; Upper left: GDP expenditure approach; Upper right: Sectoral financial balances; Lower left: GDP income approach; Lower right: Debt-income ratios for selected deciles.

time series limitations a time mapping was used to fill the entire simulation period with data.[6]

The exchange rates used for the simulations are based on real-world bilateral exchange rates and the special drawing rights (SDR) held with the IMF. This allows us to use exogenous but time-variate exchange rates in a comparable manner.[7]

[6] A typical problem with German data is how to deal with the structural break linked to German reunification. A typical problem for China is data availability. In both cases, therefore, the need arises to map shorter, reliable time series on the entire simulation period. At any rate, this should provide a more realistic picture than assuming constant exogenous interest rates, as is done in most of the SFC literature; see Godley and Lavoie (2007).

[7] One of the paper's obvious extensions would be to endogenonize exchange rates. However, in the case of China, the use of exogenous exchange rates might not be so far from reality.

5.2.2 The country-specific rate of consumption emulation

The 'natural' rate of imitation, α_0, is certainly not observable but by construction it should be the same for all countries as we use country-specific penalty terms, $\alpha_1^j,\ j = A, \ldots, C$, to take into account the different institutional environments. These penalty terms are subtracted from the natural rate to yield the effective rate of imitation. Based on the GSOEP, Drechsel-Grau and Schmid (2013) provide a convincing panel data regression analysis which allows for an estimation of Germany's effective rate of imitation. By backward calculation we obtain a natural rate of imitation equal to 0.85.[8]

The computation of the country-specific penalty terms rests on two pillars: (1) labor market arrangements and (2) public infrastructure.[9] The first pillar describes labor market mobility and firm-specific skills using data on the incidence of long-term unemployment and average job tenure in each country. As firm-specific skills put an obstacle to matching workers quickly to appropriate jobs, we expect workers with more firm-specific skills and lower employment mobility to save a higher proportion of their income during times of rising income inequality, as this increases the risk of persistent status loss. Hence, a more flexible labor market (e.g. U.S. compared to Germany) is expected to reduce the penalty term for the rate of imitation.

The second pillar is public infrastructure, which we approximate with health care expenditures, social transfers, the number of private schools per one million population and the level of education tuition fees. For instance, the lower public per capita expenditures on health care, the lower the penalty term for the rate of consumption imitation. The expenditure and transfer proxies are adjusted for the wealth of the country (measured by GDP) as well as for demographics. Social transfers are measured as a share of GDP adjusted for demographics. Finally, the number of private schools per one million inhabi-

[8] Based on the Euclidean norm of our proxy variables the German penalty term equals 0.69, which yields an effective rate of imitation of 0.16. This is within the range $[0.15, 0.20]$ suggested by Drechsel-Grau and Schmid (2013) as an estimate of the effective rate.

[9] Being aware that our approach only represents one of several feasible ways to approximate the imitation parameters in the consumption function, we point out that a possible extension could include survey-based information of households' personal sentiment with respect to their income. Related questions in standard surveys are aiming at the amount of household income sufficiently high enough to cover expenditures to participate in the local economic environment, for instance: "According to your actual situation, please estimate how much household living expenses per month are needed to maintain a minimum living standard?" (taken from China Household Income Project Survey 1995-2002).

tants and annual tuition fees are positively related to emulation: Most households wish to send their children to the best schools possible. This can be achieved both through paying high tuition fees, and by living in those (expensive) neighborhoods where the best schools are located. When income inequality increases and rich households spend more money on housing and schooling, households below the top of the distribution face a difficult trade-off between saving less for retirement and sending their children to lower quality schools. See Frank et al. (2010) for further explanations.

5.2.3 Households' consumption constraint

The threshold π in Equation (16) is calibrated based on the IMF Financial Reform Index, see Abiad et al. (2008). According to Figure 4 the maximum debt-to-income ratio of all household deciles in the U.S. in 2007 is 2.59 while the U.S. financial reform index for 2007 is 1.00. Hence we multiply all values from the IMF database with 2.59. This allows us to consider country-specific degrees of financial market development and deregulation. In this way we obtain a constant threshold of 2.34 for Germany, while the U.S. threshold increases from 2.21 to 2.59 during the simulation period. For China, we obtain relatively low values. Here, the threshold increases from 0.47 to 1.27.

5.2.4 The distribution of dividend income

Equity prices are determined by a random walk with relatively low volatility. A possible extension of the model would be the inclusion of more complex and realistic stock price mechanisms. However, in this paper we do not address such issues as excess volatility or asset price inflation. As discussed above, the stock market endogenizes the distribution of shares among households, given by the parameters $\beta^{i,j}$ in Equation (13). We use standard values of the portfolio choice parameters $\lambda_0^{i,j}$, $\lambda_1^{i,j}$, $\lambda_2^{i,j}$, and $\lambda_3^{i,j}$ in Equation (24), following Dallery and van Treeck (2011).

5.2.5 Unemployment, potential output, and capacity utilisation

The rate of capacity utilisation affects the rate of capital accumulation via the investment function in Equation (12). We use a simple mechanism to ensure realistic values of capacity utilisation in our simulations, by linking changes in unemployment to changes in

output according to Okun's law. Equation (32) in the Appendix says that the deviation between potential and real output, $\overline{y}^j - y^j$, is closely related to the deviation of current unemployment, ξ^j, from its long-run average. The latter is calculated as the average of actual unemployment between 1982 and 2007, our period of interest. We thus obtain baseline values for potential output which we can then use as an exogenous variable for the scenario analysis. With the rate of capacity utilisation endogenous, the expansionary output effects of a fall in, e.g., the personal saving rate will be amplified via an accelerator effect. Autonomous capital stock growth (γ_1^j in Equation 12) is calibrated in such a way as to match the actual average GDP growth rates during the period of interest.

6 Simulation results

As mentioned above, the purpose of the following simulation is to analyze the quantitative effects of rising inequality, both personal and functional, on the current account in different institutional environments. The simulation period is from 1982 (U.S.) respectively 1996 (China, Germany) until 2007.[10] It covers the pre-crisis period during which stark shifts in income distribution could be observed in all three economies under consideration. In particular, we shock the following variables according to data taken from the national accounts and household surveys:

- *The distribution of the wage bill* : Although survey data is often not fully comparable and different reference years have to be used, we have reliable survey data for the shares of all income deciles for at least two data points in all countries (Figures 4 - 6). We can thus shock the entire personal income distribution[11] in each of the three countries. Most importantly, the top 10% income shares for the U.S., Germany and China increased from, respectively, 30%, 24% and 27% to, respectively, 39%, 27% and 32%. Compare the parameter list in Appendix A for the changes of the entire distributions.

- *The aggregate wage share* : Data taken from the national accounts suggest that the adjusted wage share in the U.S., Germany and China declined from, respectively, 64%, 61% and 59% to, respectively, 61%, 55% and 53%.

[10] In order to obtain the same number of simulated periods, Chinese and German data is time-scaled.

[11] We use the distribution of household disposable income according to survey data in order to approximate the wage differentials.

- *Distributed profits* : We shock the share of profits which is distributed to households in such a way as to (partly) adjust for the different trends of wages and household disposable income observed in the data (Figures 4 - 6).

- *The accumulation rate* : As a matter of comparability, we have to make sure that the national GDPs do not vary widely between the baseline scenario and the alternative scenario. This requires corrections of autonomous capital stock growth of -0.5%, +0.2%, +0.5% for the U.S., Germany and China, respectively.[12]

Figures 7 - 10 as well as Appendix D present the simulation results. Both illustrations include scenario values following income shocks. On the one hand, this is to compare the scenario values with the model adjusted data and thus to determine if the model can replicate the stylized facts from Section 3 (Appendix D). On the other hand, a scenario analysis is conducted to investigate how the relevant macroeconomic variables would have changed in the absence of income shocks (Figure 7 - 10).

Before discussing the results in detail, some computational aspects should be mentioned. First, we conducted several robustness checks to ensure stock-flow consistency.[13] Second, we also run the simulation for a much longer period than illustrated below to ensure that steady state solutions are found.[14] Third, one might ask why the saddle paths, in particular in Appendix D, do not always show strictly smooth convergence towards the steady state solution as is usually the case in SFC models. Two reasons can be mentioned for this: firstly, the variety of exogenous time series information loaded into the model such as interest and exchange rates; and secondly, the implementation of financing constraints for consumers which, if binding, can produce temporary non-linearities on the saddle paths.

[12] Besides empirical realism, a further rationale for this correction is to eliminate the so-called paradox of debt, a familiar phenomenon in demand-led stock-flow models: A decrease (increase) in the personal saving rate, leading to a higher household demand for credit, can paradoxically result in a falling (rising) aggregate household debt-to-income ratio, if the output effects of a change in the saving rate are large.

[13] The equality of assets and liabilities on national bank balances and the identity of the current and capital accounts are not explicitly modeled, but are implied as a 'missing equation', as long as the accounting structure is consistently modeled.

[14] In this case we use reasonable but arbitrary parameter values without the extensive calibration described in Section 5.

6.1 Can the model replicate stylized facts?

To answer this question, we compare the model adjusted data from Figures 4 - 6 with the scenario values from our simulations. The results from the scenario analysis are reported and discussed in detail in Subsection 6.2 (Figures 7 - 9). Appendix D summarizes the information from Figures 4 - 9. It should be emphasized at the outset that the model cannot be expected to replicate perfectly the real world data from Figures 4 - 6 for the simple reason that our model treats the three economies as a single closed system. For example, the model forces the current account balances of the three countries to sum up to zero, whereas this is obviously not the case in the real world.

With this caveat in mind, the following observations can be made. While the U.S. consumption-to-GDP ratio is slightly overestimated and the investment-to-GDP ratio slightly underestimated by the model, the current account deficit matches very well with the data, especially at the end of the simulation period. The relatively good matching of the Chinese current account requires that Germany clears a disproportionate part of the U.S. current account deficit and thus results in an overestimation of Germany's current account surplus. As a direct consequence, the level of the German consumption-to-GDP ratio is somewhat underestimated, while the model's investment-to-GDP ratio matches very well with the data. The same applies for the Chinese investment-to-GDP ratio. Only at the end of the simulation period does the model underestimate the Chinese current account surplus, which at the same time requires a small overestimation of the Chinese consumption-to-GDP ratio.

Importantly, the U.S. household financial balance is replicated closely and turns negative in the course of the simulation period. The level of the corporate financial balance is slightly underestimated. With the exception of the German household financial balance, which is continuously overestimated, all other sectoral financial balances of the model match very well with the data. Note that the overestimation of the German household financial balance is in accordance with the overestimation of the current account and thus can be traced back to GDP differentials in the three-country-model. The household disposable income-to-GDP ratios match well with the data.

In accordance with real world data, simulated household debt-to-income ratios are highest in the U.S., at least at the end of the simulation period, and lowest in China (with the somehwat puzzling exception of the 10th decile). Yet, one has to admit that the levels of

the debt-to-income ratios are not realistic throughout, see Figures 7 - 9. This may be due to both the calibration and the functional form of the consumption function, as discussed below. However, for the U.S. we observe that the debt-to-income ratio increases for all income deciles except for the top decile where it decreases. Precisely this trend was observable in pre-crisis years. For Germany the initial level of the debt-to-income ratios is too high, while they significantly lower over time with the exception of the 2nd decile. Similar dynamics can be observed in the data, see Figure 5. In China, indebtedness increases only slightly for all deciles, as can be expected against the background of an underdeveloped financial system. Here, the levels of the simulated debt-to-income ratios match the data very well.[15] Overall the model can replicate the development of a broad range of macroeconomic variables and hence the trends of inequality, debt and the current account as they are described in Section 3. On this basis, we can conduct a scenario analysis which describes the development of relevant macroeconomic variables in contrast to a baseline scenario where the distribution of income is not subject to any shocks.

6.2 A scenario analysis

Figures 7 - 9 plot the deviation between simulated scenario values and the baseline. In the graphs, the ceiling starts from the initial values before shocking the system, *i.e.*, where baseline and scenario values are the same. Given the set of shocks summarised at the beginning of Section 6, these plots describe the corresponding impulse response functions of a broad range of relevant macroeconomic variables. As we will see, most effects are permanent.

Starting with the United States (Figure 7), we observe that the system is dominated by the effects of the rise in personal income inequality. The consumption-to-GDP ratio increases by around 5 percentage points, while the private household financial balance in per cent of GDP declines by around 8 percentage points, and household leverage increases.

[15] Note that the high value of the debt-to-income ratio for the 10th decile was obtained from the best available household survey data for China, but still is somewhat puzzling.

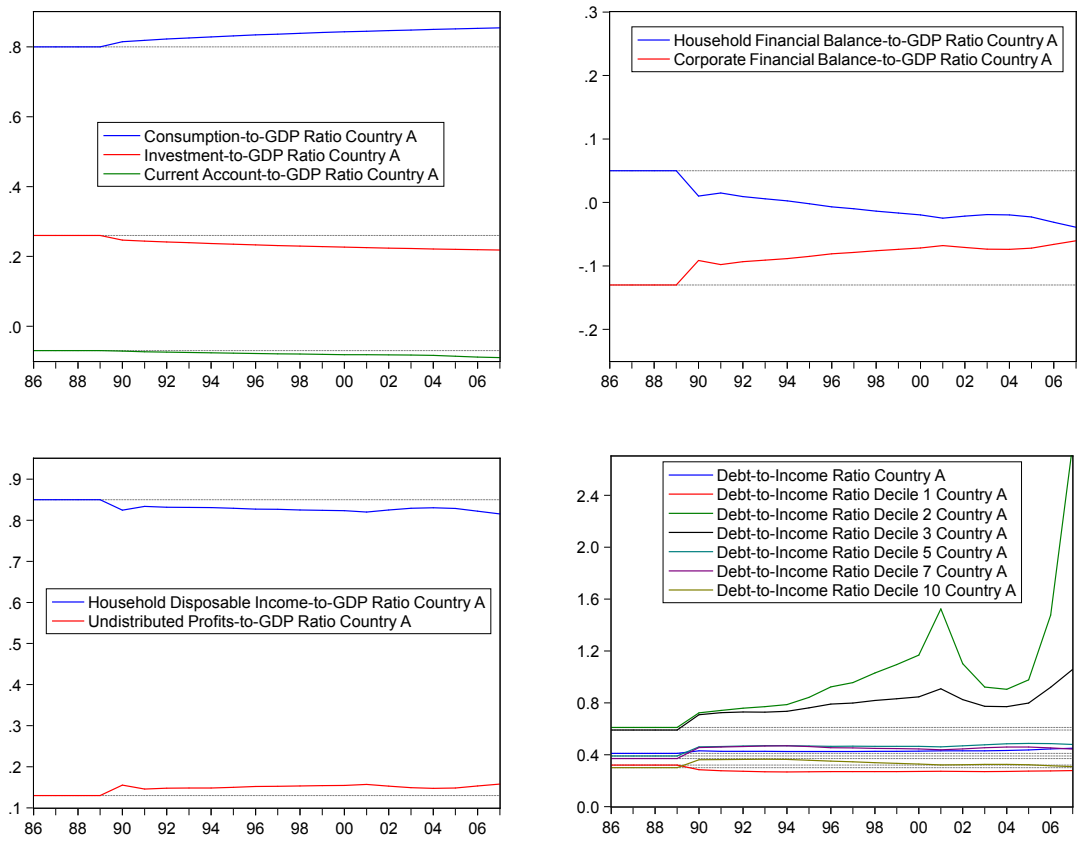

Figure 7: United States, deviation between scenario values and baseline; Upper left: GDP expenditure approach; Upper right: Sectoral financial balances; Lower left: GDP income approach; Lower right: Debt-income ratios for selected deciles.

These effects can be explained by the interplay of the relative income hypothesis with upward-looking status comparisons and the institutional environment in the United States: Downstream households face an enormous pressure to keep up with the additional consumption of top income class households, and the credit system readily accomodates the increased demand for credit. Hence, the permanent rise of (top-end) inequality triggers debt-financed consumption cascades, as explained by Frank et al. (2010). In our open economy setting, the higher private household expenditures translate into an increase in the current account deficit by more than 3 percentage points of GDP. The investment-to-GDP ratio falls residually. Household income decreases only slightly as a share of GDP,

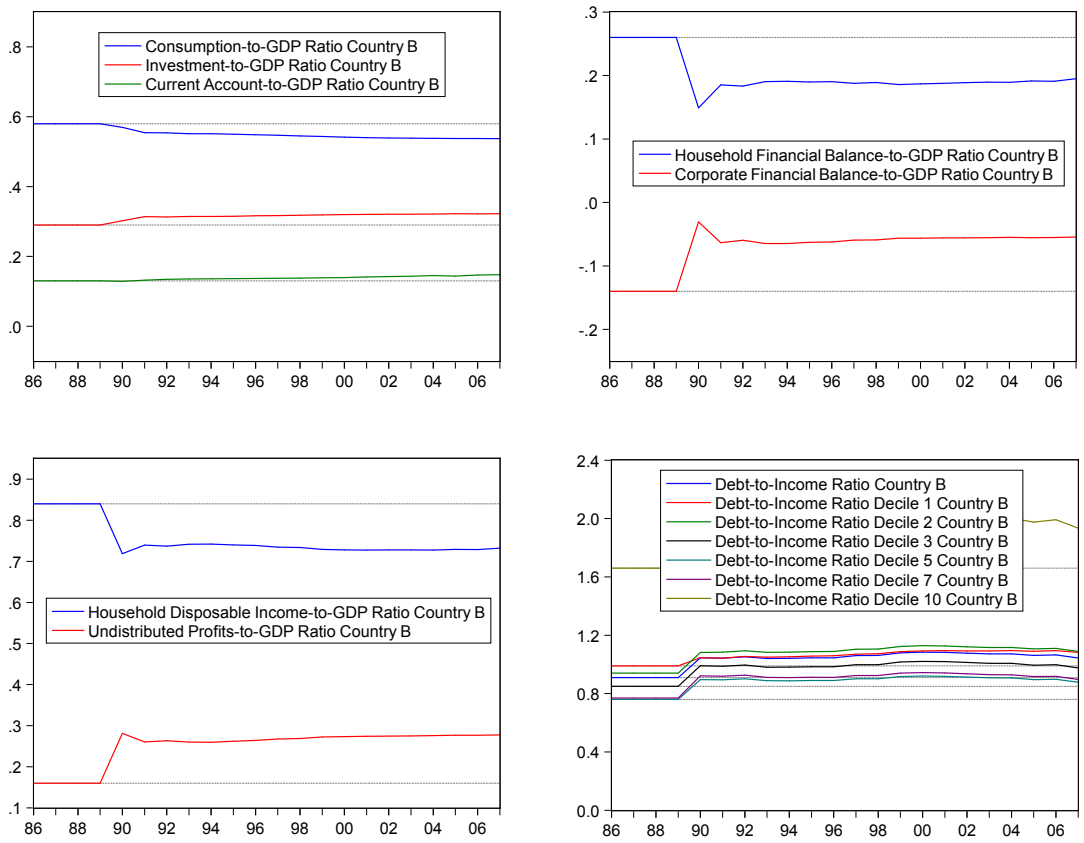

Figure 8: Germany, deviation between scenario values and baseline; Upper left: GDP expenditure approach; Upper right: Sectoral financial balances; Lower left: GDP income approach; Lower right: Debt-income ratios for selected deciles.

reflecting the limited change in functional income distribution in the U.S. The debt-to-income ratios of all household deciles increase, except for the top decile. Interestingly, by far the strongest increase occurs in the second and third deciles. This result is due to the specific form of the consumption function used in our model: Since households are assumed to emulate the consumption of the next highest income group, the decline in saving and increase in debt will be strongest in those deciles experiencing the strongest decline in relative income. However, in the United States inequality increased especially at the very top, and far less in the lower parts of the income distribution. Yet, the fact that our model

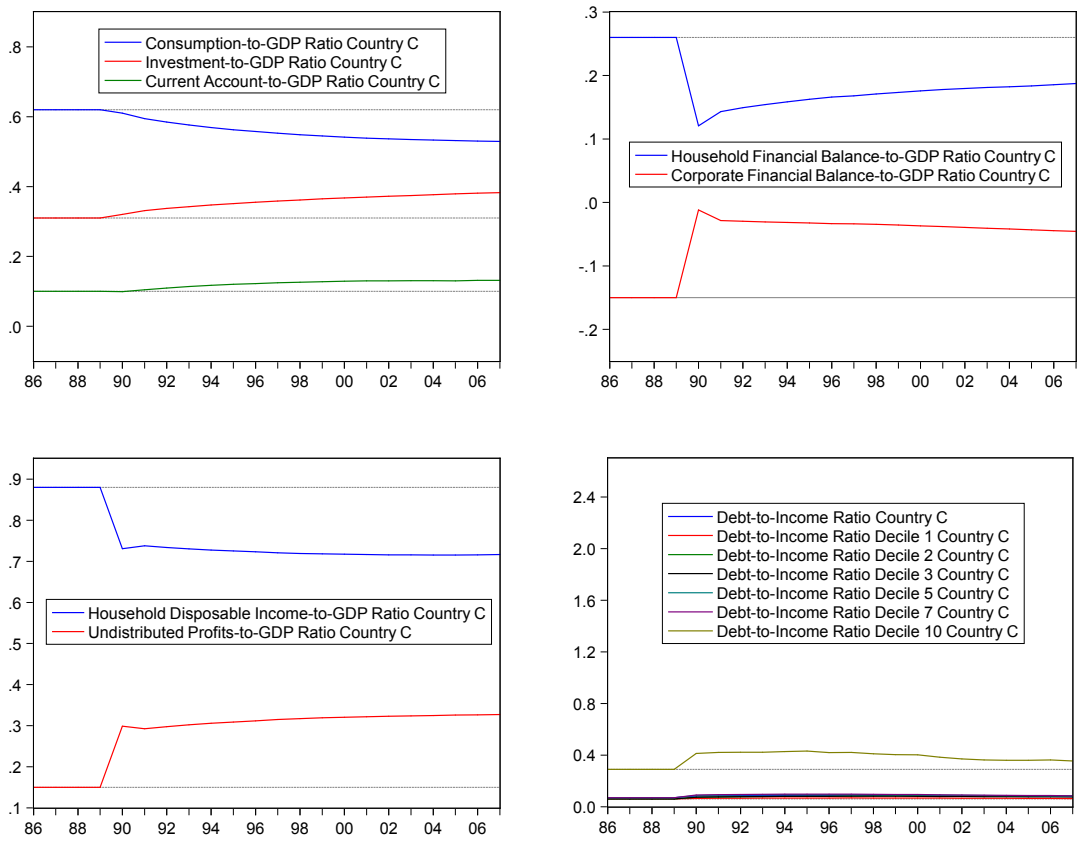

Figure 9: China, deviation between scenario values and baseline; Upper left: GDP expenditure approach; Upper right: Sectoral financial balances; Lower left: GDP income approach; Lower right: Debt-income ratios for selected deciles.

overestimates the leverage of deciles 2-4 while underestimating the leverage of decile 7-10 reveals that the interaction of households' status seeking and country-specific institutions is not yet fully understood. Turning to the simulation results for Germany, we find that the shock to the functional distribution of income plays a much more prominent role. The consumption-to-GDP ratio decreases by around 4 percentage points compared to the baseline, the rise in household debt is far more limited than in the U.S., and the current account increases by around 2 percentage points of GDP. The functional income distribution changes rather strongly at the expense of households.

Given that the functional forms of all behavioural equations are identical for the U.S. and

Germany, the very different macroeconomic effects of rising inequality can be explained as follows. Firstly, top income shares increased less in Germany than in the U.S. As a result, the potential altitude of expenditure cascades was lower in Germany than in the U.S. Moreover, due to the specific institutional environment in Germany, the effective rate of imitation in the consumption function is close to 0 (0.16 in Germany vs. 0.62 in the U.S.). Finally, the corporate veil plays an important role in Germany, to the extent that the strong increase in profits has not been passed on to (high income) households to a similar extent as in the U.S. Hence, corporate net lending increases strongly. Therefore, the decline in the household financial balance in percentage of GDP shown in Figure 8 is primarily the result of a lower household income share in GDP. Yet, our model still seems to overestimate the degree of consumption emulation in Germany, given the slight increase in the actual household financial balance throughout the 2000s.

In China, both personal (top-end) income inequality and the functional distribution have been subject to major shocks. Nevertheless, the overall macroeconomic outcomes resemble much more the German case than the U.S. case. The consumption-to-GDP ratio decreases by around 9 percentage points, household leverage barely increases, and the current account increases by around 3 percentage points. Again, the interaction between shifts in income distribution and the institutional environment can be invoked to explain these trends. Even though the effective rate of imitation in the consumption function is much higher for China (0.46), the underdevelopment of financial markets puts a binding limit to the extension of household credit. As a result, consumption cascades do not materialise despite the increase in (top-end) inequality and the higher desired consumption of households. As in the German case, the rising current account surplus of China can be attributed to a large extent to the increasing net lending of the non-household sector. As a matter of simplification, we do not analyse the corporate and government sectors separately.[16]

Up to now, for illustration purposes we have described the country scenarios separately. Of course, effects at the country level are reinforced internationally, since, for instance,

[16]There seems to be an intricate connection between the corporate and government veils in the Chinese case. Given the large influence of the state in the corporate sector and the strong regulation of interest rates, one can observe diproportional returns for (public) shareholders and (private) creditors. Despite the investment boom creditors, roughly representing the household sector, could not take benefit from high interest rates, while the state as shareholder gained high returns on equity, especially in export-oriented companies, see Pettis (2013).

the higher demand for consumption in the U.S. automatically raises the current account of Germany and China, while the weaker consumption in Germany and China has the opposite effect on the U.S. current account. Indeed, one advantage of our model is to capture this interconnectedness in a large-scale complex system.

7 Concluding remarks

In this paper we have developed a three-country stock-flow consistent model to analyze the macroeconomic effects of changes in personal and functional income distribution on macroeconomic stability in terms of household debt and current account imbalances. Our model contains three important features. Firstly, the household sector is separated into deciles, with each decile facing a budget constraint. In addition, the formalization of households' consumption demand builds on the relative income hypothesis and the strength of expenditure cascades is influenced by country-specific institutions. Specifically, we argue that financial market development, labor market institutions and the design of public infrastructure influence the degree of consumption emulation. Secondly, we analyze the effects of both the functional and the personal distribution of income on overall macroeconomic stability. Finally, three stylized economies (calibrated to U.S., German and Chinese data) are modelled as a single complete system so that the effects of changes in income distribution can be analysed from a global perspective.

Our simulations suggest that a rise in (top-end) personal income inequality will generate debt-financed consumption cascades and a current account deficit in the context of largely unregulated financial markets. On the other hand, a pronounced corporate veil or government veil will interact with a fall in household income to produce weak private consumption and a current account surplus. Both types of shocks can occur in the same country at the same time so that it is difficult to predict which effect will dominate, and hence the analysis of institutions is of crucial importance for understanding country-specific regimes. Overall our analysis suggests that changes in income distribution have been an important factor contributing to the current account imbalances prior to the Great Recession of 2008. Of course, our model does not rule out other causes of the crisis such as financial bubbles or loose monetary policy.

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Appendix A

Variables, Balance Sheet and Transaction Flow Matrices

Table 1: Indexation, variables and parameters

	Indexation	
i, j	Household index, i=1,...,10	Country index, j=A,...,C
n, k	Country index, n=A,...,C; $n, k \neq j$ when used together	
h, f	Variables of households	Variables of firms
exp, e	Expected values (Superscript)	Equity (Subscript)
d, s	Demand (Subscript)	Supply (Subscript)
de, c	Desired (Subscript)	Constrained (Subscript)
	Endogenous variables	
$\beta^{i,j}$	Distribution of equity among households	(41)
ca^{j}	Current account	(3)
$cg^{i,j}$	Capital gains	(23)
$cg^{exp,i,j}$	Expected capital gains	(39)
$c^{i,j}$	Consumption	(21)
$c_{de}^{i,j}$	Desired consumption	(16)
$c_{c}^{i,j}$	Constrained consumption	(19)
$e_{d}^{i,j}$	Demand for equities	(28)
$e_{d}^{exp,i,j}$	Expected demand for equities	(24)
e_{s}^{j}	Supply of equities	(10)
ex^{j}	Exports	(1)
f_{D}^{j}	Distributed profits	(7)
f_{T}^{j}	Total profits	(35)
f_{U}^{j}	Undistributed profits	(6)
g^{j}	Accumulation rate	(12)
$g_{yd}^{i,j}$	Growth rate of disposable income	(37)
k^{j}	Capital stock	(33)
i^{j}	Investment	(30)

im^j	Imports	(2)
ka^j	Capital account	(4)
$l_{f,s}$	Global supply of firm loans	(43)
$l^j_{f,d}$	Demand for business loans	(11)
$l_{h,s}$	Global supply of consumer loans	(45)
$l^j_{h,s}$	Supply of consumer loans	(44)
$l^j_{h,d}$	Total demand for consumer loans	(17)
$l^{i,j}_{h,d}$	Total demand for consumer loans, deciles	(17)
$l^{i,nj}_{h,d}$	Demand for foreign consumer loans	(18)
$l^{i,jj}_{h,d}$	Demand for domestic consumer loans	(29)
m_d	Global demand for deposits	(46)
$m^{i,j}_d$	Demand for deposits	(27)
nx^j	Net exports	(48)
p^j_e	Price of equities	(42)
pr^j	Profit rate	(34)
r^j_e	Rate of return on equities	(40)
$s^{i,j}$	Savings	(25)
$sr^{i,j}$	Saving rate	(26)
u^j	Rate of capacity utilization	(31)
$v^{i,j}_h$	Wealth	(22)
$v^{exp,i,j}_h$	Expected wealth	(38)
$wb^{i,j}$	Wage bill	(14)
y^j	GDP	(49)
$yd^{i,j}$	Disposable income	(13)
$yd^{exp,i,j}$	Expected disposable income	(36)
y^j_{pot}	Potential output	(32)

Exogenous Variables

r^j_{lh}	Interest rate on consumer loans	OECD (US and GER); PBC
r^j_{lf}	Interest rate on business loans	OECD (US and GER); PBC
r^j_m	Interest rate on deposits	OECD (US and GER); PBC
xr^{AB}, xr^{CA}, xr^{CB}	Exchange rate currency A/B, C/A, C/B	IMF, own calculations
ξ^j	Deviation from average rate of unemployment	OECD (US and GER); IMF

Parameters

α_0^j	0.85	Natural rate of imitation	Drechsel-Grau and Schmid (2013)
α_1^i	0.23, 0.69, 0.39	Penalty term of imitation	Appendix C
$\delta^{i,j}$	0.30, 0.24, 0.27	Share of aggr. wage bill, decile 1, changes to 0.390, 0.270, 0.320	Data sources for all deciles are
	0.15, 0.15, 0.19	, decile 2, changes to 0.135, 0.145, 0.180	Congressional Budget Office 2010
	0.12, 0.12, 0.14	, decile 3, changes to 0.105, 0.120, 0.135	German Socio-Economic Panel 2011
	0.10, 0.11, 0.11	, decile 4, changes to 0.090, 0.110, 0.105	Li (2002), SWIID Worldbank
	0.09, 0.09, 0.08	, decile 5, changes to 0.080, 0.085, 0.075	
	0.07, 0.08, 0.07	, decile 6, changes to 0.060, 0.075, 0,065	starting values for 1982 rsp. 1996
	0.06, 0.07, 0.05	, decile 7, changes to 0.050, 0.065, 0.045	shocks according to cumulative
	0.05, 0.06, 0.04	, decile 8, changes to 0.040, 0.055, 0.035	changes until 2007, also see figure 4-6
	0.03, 0.05, 0.03	, decile 9, changes to 0.025, 0.045, 0.025	
	0.03, 0.03, 0.02	, decile 10,changes to 0.025, 0.030, 0.015	
ϵ^j	0.30, 0.50, 0.50	Trading relations	calibrated to Three-country world
γ_1^j	0.05, 0.02, 0.09	Autonomous Investment	calibrated to NIPA growth rates
γ_2^j	0.03, 0.03, 0.03	Sensitivity of Investment wrt. capacity utilization	calibrated to NIPA growth rates
κ	0.30	Residual propensity to consume wrt. disposable income	calibrated to Three-country world
$\lambda_0^{i,j}$	0.45	Autonomous expected wealth held in equities	Dallery and van Treeck (2011)
$\lambda_1^{i,j}$	0.2	Interest rate component of portfolio decision	Dallery and van Treeck (2011)
$\lambda_2^{i,j}$	0.0133	Rate of return on equity	Dallery and van Treeck (2011)
$\lambda_3^{i,j}$	0.0001	Transaction demand for money component of portfolio	Dallery and van Treeck (2011)
μ^j	0.10, 0.10, 0.10	Import elasticity	calibrated to Three-country world
ν^j	0.03, 0.02, 0.01	Rate of consumption financed by credit	IMF Financial Reform Index
$o^{1,j}$	0.09, 0.09, 0.06	Marginal propensity to consume wrt. wealth, 1. decile	calibrated to NIPA saving rates
$o^{i,j}$	0.03	Marginal propensity to consume wrt. wealth, all other	calibrated to NIPA saving rates
ω	1.39, 0.77, 3.96	Unemployment-to-output relation according to Okun's law	OLS estimation of growth rate form
$\pi^{i,j}$	2,59 $\times$ Index	Threshold for consumption constraint	IMF Financial Reform Index
s_f^j	0.50, 0.70, 0.80	Retained earnings as percentage of total profits	calibrated to NIPA disposable income
w^j	0.64, 0.61, 0.59	Aggregate wage share	National Accounts (incl. shocks)
x^j	0.025	New-equity-issues-to-investment ratio	Dallery and van Treeck (2011)

Table 2: Balance Sheet Matrix

		Country A			Country B			Country C			
Assets and Liabilities	Currency	Households iA i=1,...,10	Firms A	Banks A	Households iB i=1,...,10	Firms B	Banks B	Households iC i=1,...,10	Firms C	Banks C	Σ
Deposits	A	$+m_d^{i,A}$		$-m_s^A$							0
	B				$+m_d^{i,B}$		$-m_s^B$				0
	C							$+m_d^C$		$-m_s^C$	0
Consumer Loans	A	$-l_{h,d}^{i,A}$		$+l_{h,s}^{AA}$			$+l_{h,s}^{BA}$			$+l_{h,s}^{CA}$	0
	B			$+l_{h,s}^{AB}$	$-l_{h,d}^{i,B}$		$+l_{h,s}^{BB}$			$+l_{h,s}^{CB}$	0
	C			$+l_{h,s}^{AC}$			$+l_{h,s}^{BC}$	$-l_{h,d}^{i,C}$		$+l_{h,s}^{CC}$	0
Business Loans	A		$-l_{f,d}^A$	$+l_{f,s}^A$							0
	B					$-l_{f,d}^B$	$+l_{f,s}^B$				0
	C								$-l_{f,d}^C$	$+l_{f,s}^C$	0
Equities	A	$+e_d^{i,A} * p_e^A$	$-e_s^A * p_e^A$								0
	B				$+e_d^{i,B} * p_e^B$	$-e_s^B * p_e^B$					0
	C							$+e_d^{i,C} * p_e^C$	$-e_s^C * p_e^C$		0
Capital Stock	A		$+k^A$								k^A
	B					$+k^B$					k^B
	C								$+k^C$		k^C
Σ	A	$= v_h^{i,A}$	$= v_f^A$	$= 0$							$= k^A + nfa^A$
	B				$= v_h^{i,B}$	$= v_f^B$	$= 0$				$= k^B + nfa^B$
	C							$= v_h^{i,C}$	$= v_f^C$	$= 0$	$= k^C + nfa^C$

Table 3: Transaction Flow Matrix

Country A

	Households Ai=1,...,10	Firms A		Banks A	
		Current	Capital		
Consumption	$-c^{i,A}$	$+c^A$			0
Investment		$+i^A$	$-i^A$		0
Imports		$-im^A$			$+ex^{jA};\ j=B,C$
Exports		$+ex^A$			$-im^{Aj};\ j=B,C$
GDP (Y)		$y^A = c^A + i^A + nx^A$			
Wages	$+wb^{i,A}$	$-wb^A$			0
Profits	$+f_D^{i,A}$	$-f_T^A$	$+f_U^A$		0
Interest on Deposits	$+r_{m,t-1}^A * m_{d,t-1}^{i,A}$			$-r_{m,t-1}^A * m_{s,t-1}^A$	0
Interest on Consumer Loans	$-r_{lh,t-1}^j * l_{h,d,t-1}^{A,j}$			$+r_{lh,t-1}^j * l_{h,s,t-1}^{A,j}$	0
Interest on Business Loans		$-r_{lf,t-1}^A * l_{f,d,t-1}^A$		$+r_{lf,t-1}^A * l_{f,s,t-1}^A$	0
Change in Deposits	$-\Delta m_d^{i,A}$			$+\Delta m_s^A$	0
Change in Equities	$-\Delta e_d^{i,A}$		$+\Delta e_s^A$		0
Change in Consumer Loans	$+\Delta l_{h,d}^{i,A}$			$-\Delta l_{h,s}^A$	$+/-\Delta l_{h,d}^{A,j};\ j=B,C$
Change in Business Loans			$+\Delta l_{f,d}^A$	$-\Delta l_{f,s}^A$	0
Σ	0	0	0	0	0

Table 4: Transaction Flow Matrix

Country B

	Households Bi=1,...,10	Firms B		Banks B	
		Current	Capital		
Consumption	$-c^{i,B}$	$+c^{B}$			0
Investment		$+i^{B}$	$-i^{B}$		0
Imports		$-im^{B}$			$+ex^{jB};\ j=A,C$
Exports		$+ex^{B}$			$-im^{Bj};\ j=A,C$
GDP (Y)		$y^{B}=c^{B}+i^{B}+nx^{B}$			
Wages	$+wb^{i,B}$	$-wb^{B}$			0
Profits	$+f_{D}^{i,B}$	$-f_{T}^{B}$	$+f_{U}^{B}$		0
Interest on Deposits	$+r_{m,t-1}^{B}*m_{d,t-1}^{i,B}$			$-r_{m,t-1}^{B}*m_{s,t-1}^{B}$	0
Interest on Consumer Loans	$-r_{lh,t-1}^{j}*l_{h,d,t-1}^{B,j}$			$+r_{lh,t-1}^{j}*l_{h,s,t-1}^{B,j}$	0
Interest on Business Loans		$-r_{lf,t-1}^{B}*l_{f,d,t-1}^{B}$		$+r_{lf,t-1}^{B}*l_{f,s,t-1}^{B}$	0
Change in Deposits	$-\Delta m_{d}^{i,B}$			$+\Delta m_{s}^{B}$	0
Change in Equities	$-\Delta e_{d}^{i,B}$		$+\Delta e_{s}^{B}$		0
Change in Consumer Loans	$+\Delta l_{h,d}^{i,B}$			$-\Delta l_{h,s}^{B}$	$+/-\Delta l_{h,d}^{A,j};\ j=A,C$
Change in Business Loans			$+\Delta l_{f,d}^{B}$	$-\Delta l_{f,s}^{B}$	0
Σ	0	0	0	0	0

Table 5: Transaction Flow Matrix

Country C

	Households Ci=1,...,10	Firms C		Banks C	
		Current	Capital		
Consumption	$-c^{i,C}$	$+c^{C}$			0
Investment		$+i^{C}$	$-i^{C}$		0
Imports		$-im^{C}$			$+ex^{jC};\ j=A,B$
Exports		$+ex^{C}$			$-im^{Cj};\ j=A,B$
GDP (Y)		$y^{C}=c^{C}+i^{C}+nx^{C}$			
Wages	$+wb^{i,C}$	$-wb^{C}$			0
Profits	$+f_{D}^{i,C}$	$-f_{T}^{C}$	$+f_{U}^{C}$		0
Interest on Deposits	$+r_{m,t-1}^{C}*m_{d,t-1}^{i,C}$			$-r_{m,t-1}^{C}*m_{s,t-1}^{C}$	0
Interest on Consumer Loans	$-r_{lh,t-1}^{j}*l_{h,d,t-1}^{C,j}$			$+r_{lh,t-1}^{C}*l_{h,s,t-1}^{C,j}$	0
Interest on Business Loans		$-r_{lf,t-1}^{C}*l_{f,d,t-1}^{C}$		$+r_{lf,t-1}^{C}*l_{f,s,t-1}^{C}$	0
Change in Deposits	$-\Delta m_{d}^{i,C}$			$+\Delta m_{s}^{C}$	0
Change in Equities	$-\Delta e_{d}^{i,C}$		$+\Delta e_{s}^{C}$		0
Change in Consumer Loans	$+\Delta l_{h,d}^{i,C}$			$-\Delta l_{h,s}^{C}$	$+/-\Delta l_{h,d}^{A,j};\ j=A,B$
Change in Business Loans			$+\Delta l_{f,d}^{C}$	$-\Delta l_{f,s}^{C}$	0
Σ	0	0	0	0	0

Appendix B

The complete model

Household Sector

Consumption and relative income hypothesis

$$c^{1,j} = o^{1,j} \cdot v_h^{1,j} + \kappa \cdot \left(1 + g^j\right) \cdot yd_{t-1}^{1,j} \tag{15}$$

$$c_{de}^{i,j} = o^{i,j} \cdot v_h^{i,j} + \kappa \cdot \left[1 - \left(\alpha_0 - \alpha_1^j\right)\right] \cdot (1 + g^j) \cdot yd_{t-1}^{i,j} + \left(\alpha_0 - \alpha_0^i\right) \cdot \left(1 + g^j\right) \cdot c_{t-1}^{i-1,j}, \quad i = 2, ..., 10 \; j = A, ..., C \tag{16}$$

$$c_c^{i,j} = o^{i,j} \cdot v^{i,j} + \kappa \cdot \left(1 - \left(\alpha_0^j - \alpha_1^j\right)\right) \cdot \left(1 + g^j\right) \cdot yd_{t-1}^{i,j}, \quad i = 2, ..., 10 \; j = A, ..., C \tag{19}$$

$$z_1^{i,j} = \begin{cases} 1 & \text{if} \quad l_{h,t-1}^{i,j} / yd_{t-1}^{i,j} \leq \pi^{i,j} \\ 0 & \text{if} \quad l_{h,t-1}^{i,j} / yd_{t-1}^{i,j} > \pi^{i,j} \end{cases}, \qquad z_2^{i,j} \text{ the other way around} \tag{20}$$

$$c^{i,j} = z_1^{i,j} c_{de}^{i,j} + z_2^{i,j} c_c^{i,j}, \qquad c^j = \sum_{i=1}^{10} c^{i,j} \tag{21}$$

Household income

$$yd^{i,j} = wb^{i,j} + \beta_{t-1}^{i,j} \cdot f_D^j + r_{m,t-1}^j \cdot m_{d,t-1}^{i,j} - r_{lh,t-1}^j \cdot l_{h,t-1}^{i,j}, \qquad yd^j = \sum_{i=1}^{10} yd^{ij} \tag{13}$$

$$wb^{i,j} = \delta^{i,j} \cdot wb^j, \qquad wb^j = w^j \cdot y^j \tag{14}$$

Savings, assets and debt

$$s^{i,j} = yd^{i,j} - c^{i,j}, \qquad s^{j} = \sum_{i=1}^{10} s^{i,j} \tag{25}$$

$$sr^{i,j} = s^{i,j}/yd^{i,j}, \qquad sr^{j} = s^{j}/yd^{j} \tag{26}$$

$$\begin{aligned} m_d^{i,j} &= m_{d,t-1}^{i,j} + v_h^{i,j} - v_{h,t-1}^{i,j} - \left(p_e^j - p_{e,t-1}^j\right) \cdot e_d^{i,j} - \left(e_d^{i,j} - e_{d,t-1}^{i,j}\right) \cdot p_e^j + \left(l_{h,d}^{i,j} - l_{h,d,t-1}^{i,j}\right), \\ m_d^j &= \sum_{i=1}^{10} m_d^{i,j} \end{aligned} \tag{27}$$

$$e_d^{i,j} = \beta_{t-1}^{i,j} \cdot e_d^j, \qquad e_d^j = e_s^j \tag{28}$$

$$l_{h,d}^{i,j} = l_{h,d,t-1}^{i,j} + \nu^{i,j} \cdot c^{i,j}, \qquad l_{h,d}^{j} = \sum_{i=1}^{10} l_{h,d}^{i,j} \tag{17}$$

$$l_{h,d}^{i,nj} = (1 + r_{lh}^n) \cdot l_{h,d,t-1}^{i,nj} + \left(ex^{nj} \cdot xr^{jn}\right) \cdot \psi^{i,j}, \qquad \psi^{i,j} = l_{h,d}^{i,j}/l_{h,d}^{j}, \qquad l_{h,d}^{nj} = \sum_{i=1}^{10} l_{h,d}^{i,nj} \tag{18}$$

$$l_{h,d}^{i,jj} = l_{h,d}^{i,j} - l_{h,d}^{i,nj}, \qquad l_{h,d}^{jj} = \sum_{i=1}^{10} l_{h,d}^{i,jj} \tag{29}$$

Households' net wealth

$$v_h^{i,j} = v_{h,t-1}^{i,j} + s^{i,j} + cg^{ij}, \qquad v_h^{j} = \sum_{i=1}^{10} v_h^{i,j} \tag{22}$$

$$cg^{ij} = \left(p_e^j - pe_{e,t-1}^j\right) \cdot e_{d,t-1}^{i,j}, \qquad cg^{j} = \sum_{i=1}^{10} cg^{i,j} \tag{23}$$

Firms

Investment

$$i^j = g^j \cdot k^j_{t-1} \tag{30}$$

$$g^j = \gamma^j_1 + \gamma^j_2 \cdot u^j \tag{12}$$

$$u^j = y^j / y^j_{pot} - \theta \tag{31}$$

$$\left(\overline{y}^j - y^j\right) / \overline{y}^j = \omega^j \underbrace{\left(u^j - \overline{u}^j\right)}_{:=\xi^j} \Leftrightarrow y^j_{pot} = y^j / (1 - \omega^j \cdot \xi^j) \tag{32}$$

$$k^j = k^j_{t-1} + i^j \tag{33}$$

$$pr^j = f^j_T / k^j \tag{34}$$

Firm's income and financing decision

$$f^j_T = y^j - wb^j \tag{35}$$

$$f^j_U = f^j_T - r^j_{lf,t-1} \cdot l^j_{f,d,t-1} - f^j_D \tag{6}$$

$$f^j_D = \left(1 - s^j_f\right) \cdot \left(f^j_{T,t-1} - r^j_{lf,t-1} \cdot l^j_{f,d,t-1}\right) \cdot \left(1 + g^j_{t-1}\right) \tag{7}$$

$$e^j_s = es^j_{s,t-1} + x^j \cdot i^j_{t-1} / p^j_e \tag{10}$$

$$l^j_{f,d} = l^j_{f,d,t-1} + i^j - f^j_U - \left(e^j_s - e^j_{s,t-1}\right) \cdot p^j_e \tag{11}$$

Stock market

$$yd^{exp,i,j} = \left(1 + g_y^{ij}\right) \cdot yd_{t-1}^{i,j} \tag{36}$$

$$g_y^{i,j} = \left(yd^{i,j} - yd_{t-1}^{i,j}\right) / yd_{t-1}^{i,j} \tag{37}$$

$$v_h^{exp,i,j} = v_{h,t-1}^{exp,i,j} + yd^{exp,i,j} + cg^{exp,i,j} - c^{i,j} \tag{38}$$

$$cg^{exp,i,j} = \left(1 + g_{t-1}^{j}\right) \cdot cg_{t-1}^{i,j} \tag{39}$$

$$e_d^{exp,i,j} = \left(\lambda_0^{i,j} - \lambda_1^{i,j} \cdot r_m^j + \lambda_2^{i,j} \cdot r_{e,t-1}^j\right) \cdot v_h^{exp,i,j} - \lambda_3^{i,j} \cdot yd^{exp,i,j}, \qquad e_d^{exp,j} = \sum_{i=1}^{10} e_d^{exp,i,j} \tag{24}$$

$$r_e^j = \left(f_D^j + cg^j\right) / \left(p_{e,t-1}^j \cdot e_{d,t-1}^j\right) \tag{40}$$

$$\beta^{i,j} = e_d^{exp,i,j} / e_d^{exp,j} \tag{41}$$

$$p_{e,t}^j = p_{e,t-1}^j + u_t, \qquad u_t \sim N\left(0, \sigma_p^2\right) \tag{42}$$

Banks

$$l_{f,s} = l_{f,d}^A + l_{f,d}^B \cdot xr^{AB} + l_{f,d}^C / xr^{CA} \tag{43}$$

$$\begin{aligned} l_{h,s}^A &= l_{h,d}^{AA} + l_{h,d}^{AB} \cdot xr^{AB} + l_{h,d}^{AC} / xr^{CA}, \qquad l_{h,s}^B = l_{h,d}^{BB} + l_{h,d}^{BA} / xr^{AB} + l_{h,d}^{BC} / xr^{CB} \\ l_{h,s}^C &= l_{h,d}^{CC} + l_{h,d}^{CA} \cdot xr^{CA} + l_{h,d}^{CB} \cdot xr^{CB} \end{aligned} \tag{44}$$

$$l_{h,s} = l_{h,s}^A + l_{h,s}^B \cdot xr^{AB} + l_{h,s}^C / xr^{CA} \tag{45}$$

$$m_s = m_s^A + m_s^B \cdot xrAB + m_s^C / xrCA \tag{46}$$

$$m_d = l_{h,s} + l_{f,s} \tag{47}$$

Open economy and GDP

$$\begin{aligned} ex^{nj} &= \epsilon^j \cdot im^j / xr^{jn}, \qquad ex^{kj} = \left(1 - \epsilon^j\right) \cdot im^j \cdot xr^{jk} \\ ex^j &= ex^{jn} + ex^{jk} \end{aligned} \tag{1}$$

$$im^j = \mu \cdot c^j \tag{2}$$

$$nx^j = ex^j - im^j \tag{48}$$

$$y^j = c^j + i^j + nx^j \tag{49}$$

$$ca^j = nx^j + \left[\left(r_{lh}^j \cdot l_{h,d,t-1}^{jn} \cdot xr^{jn}\right) + \left(r_{lh}^j \cdot l_{h,d,t-1}^{jk} \cdot \frac{1}{xr^{jk}}\right) - \left(r_{lh}^n \cdot lh_{h,d,t-1}^{nj}\right) - \left(r_{lh}^k \cdot l_{h,d,t-1}^{kj}\right)\right] \tag{3}$$

$$ka^j = -\left[\left(l_{h,d}^{jn} - l_{h,d,t-1}^{jn}\right) \cdot xr^{jn} + \left(l_{h,d}^{jk} - l_{h,d,t-1}^{jk}\right) \cdot \frac{1}{xr^{jk}} - \left(l_{h,d}^{nj} - l_{h,d,t-1}^{nj} + l_{h,d}^{kj} - lh_{h,d,t-1}^{kj}\right)\right] \tag{4}$$

Appendix C

Proxy Variables for an Institutionally enriched Version of Relative Income Hypothesis

Variable	Country	Source
Long-term unemployment	U.S.	OECD Statistics "Incidence of unemployment by duration"
	GER	OECD Statistics "Incidence of unemployment by duration"
	CHI	Knight and Li (2006)
Job tenure	U.S.	Copeland (2010)
	GER	SOEP, own calculations
	CHI	Urban household survey 1999
Health care expenditures	U.S.	Budget of the US Government 2012, OECD (Pop.)
	GER	Destatis, OECD (Pop.)
	CHI	NBS (Yearbook 2011)
Social transfers	U.S.	Ameco, OECD (Pop.)
	GER	Ameco, OECD (Pop.)
	CHI	NBS (Yearbooks 1996-2011)
Number of private schools per 1 mill. inhabitants	U.S.	NCES, US Census (Pop.)
	GER	Destatis
	CHI	World Bank, NBS
Tuition fees per student	U.S.	OECD Education at a Glance (var. years)
	GER	studies-online.de, own calculations
	CHI	NBS

Appendix D

Simulated scenario values and model ajusted data

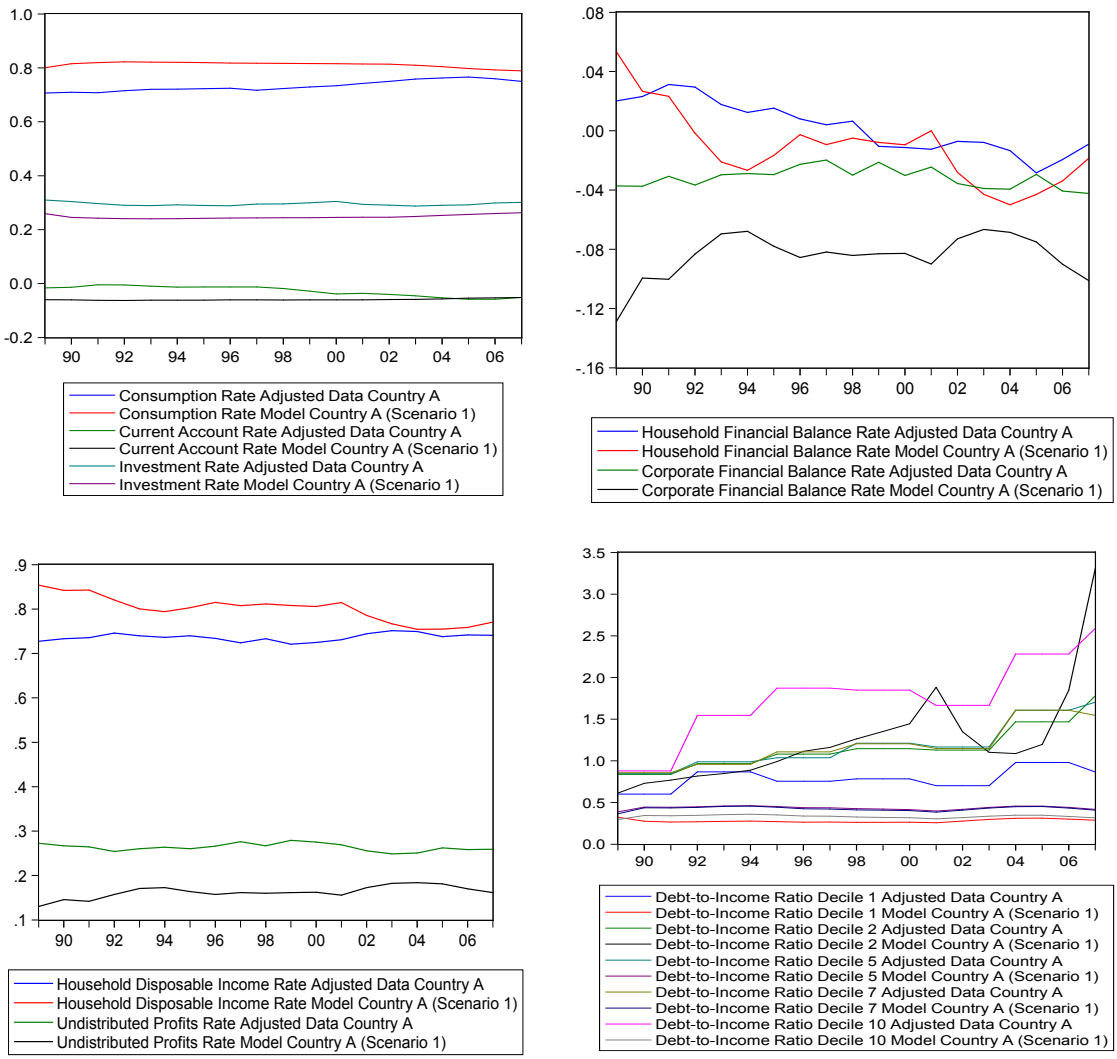

Figure 10: United States, simulated scenario values and model adjusted data; Upper left: GDP expenditure approach; Upper right: Sectoral financial balances; Lower left: GDP income approach; Lower right: Debt-income ratios for selected deciles.

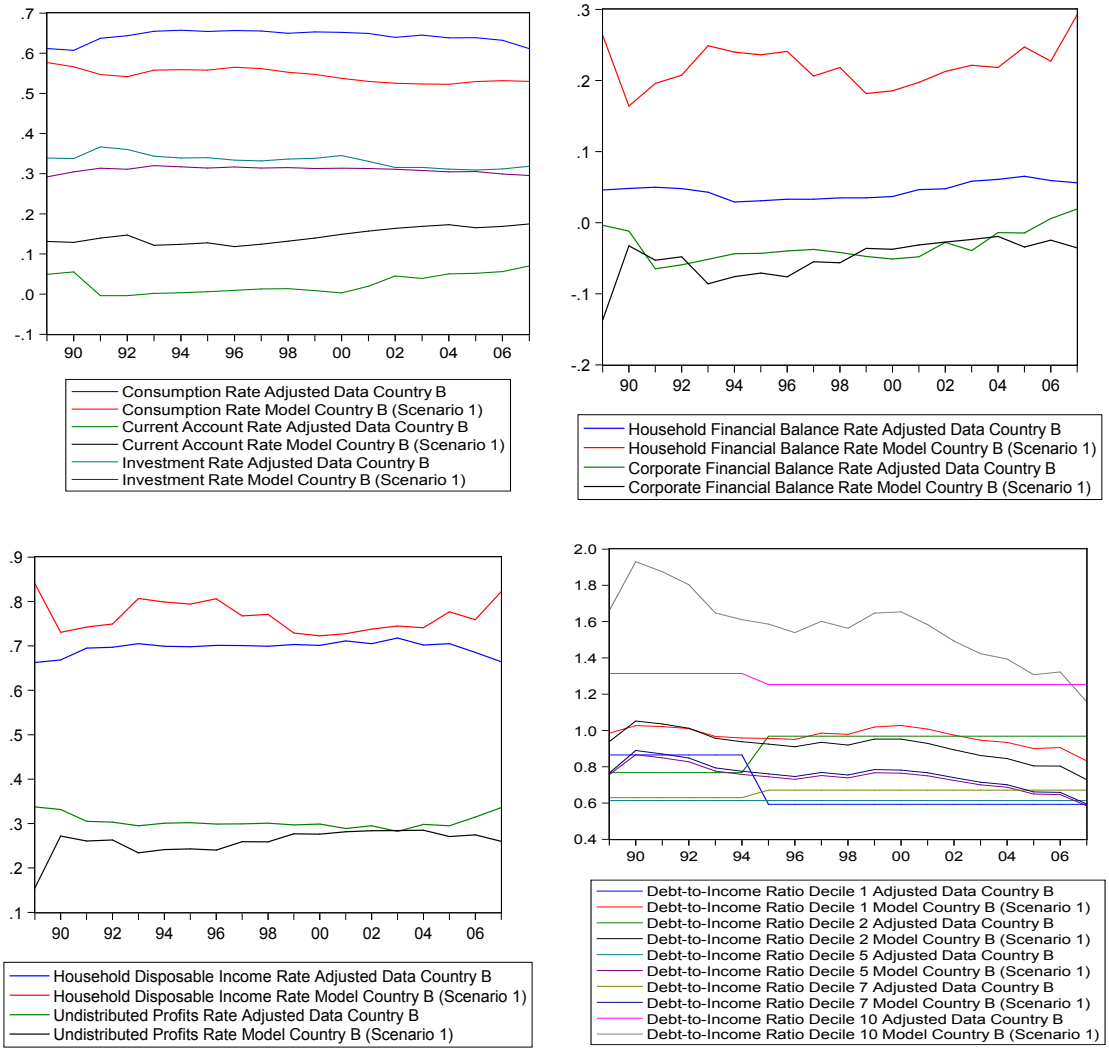

Figure 11: Germany, simulated scenario values and model adjusted data; Upper left: GDP expenditure approach; Upper right: Sectoral financial balances; Lower left: GDP income approach; Lower right: Debt-income ratios for selected deciles.

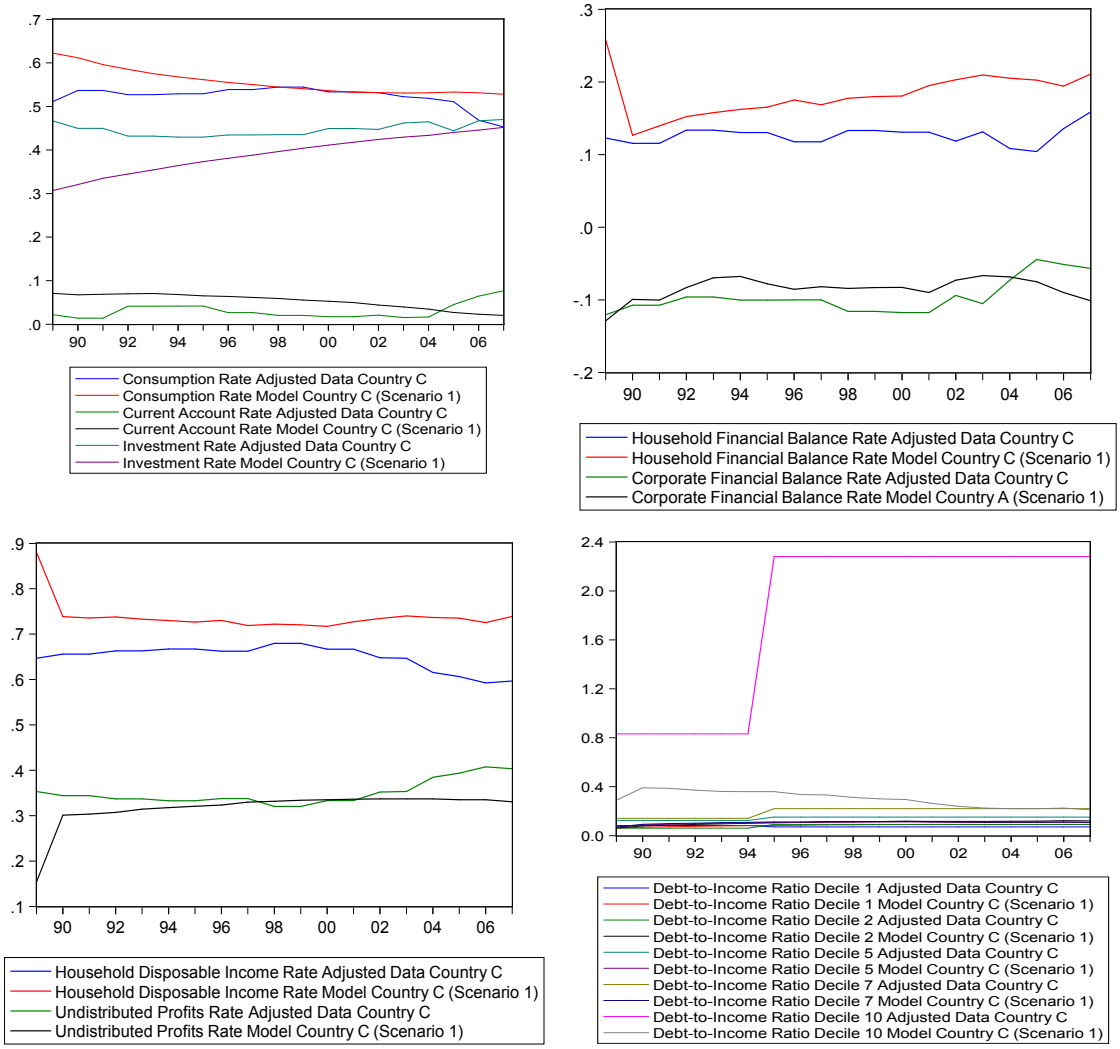

Figure 12: China, simulated scenario values and model adjusted data; Upper left: GDP expenditure approach; Upper right: Sectoral financial balances; Lower left: GDP income approach; Lower right: Debt-income ratios for selected deciles.