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Catching up with the Joneses and Borrowing Constraints - An Agent-based Analysis of Household Debt

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Abstract

We study an Agent-based model of household-bank relationships where households borrow for the purpose of consumption. Desired consumption is driven by households disposable income as well as a social norm of consumption. If households care about their relative position in the economy (i.e. want to catch up with the Joneses), they are willing to take a loan. We conduct several computational experiments, where the absence of the social consumption norm (Joneses effect) functions as control treatment. Varying the strength of the social orientation and prevailing credit constraints, we find that the time path of macroeconomic time series is largely affected by the Joneses effect, while credit constraints determine their volatility. More precisely, we find that a strong Joneses effect has severe consequences for GDP growth and that borrowing constraints can reduce macroeconomic volatility. Since by assumption high-income and low-income households react equally sensitive to the Joneses effect, income distribution is the decisive variable for households social development. That said, access to credit exposes already poor households to find themselves caught in a poverty trap.

Keywords: Household Finance and Consumption; Credit constraints; Agent-based Model; Computational Simulation
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1 Introduction

Most developed economies have experienced an unprecedented rise in household debt in the past two decades. In microeconomic theory a household's decision on whether to borrow and how much is the solution of an intertemporal optimisation problem. Given that the household has unlimited access to financial markets, the optimal time path of lifetime consumption opens the possibility to separate period consumption from period income. Hence a household that wishes to consume more than its period income is free to borrow the necessary money whereas a household with a desired level of consumption falling short of its income is provided with the possibility to invest resulting savings at a positive real interest rate. Most importantly, however, borrowers will never go bankrupt since according to the assumptions of the model, rationality implies that they will always obey their solvency constraint. Borrowing thus remains to be a temporary phenomenon and should not give rise to policy concerns. Not surprisingly, in such a world credit constraints only prevent households from realising both their individual but also an aggregate welfare optimum (Zeldes, 1989; Bacchetta and Gerlach, 1997; Ludvigson, 1999; Rubaszek and Serwa, 2012).

This approach with its emphasis on borrowings as a temporary phenomenon is obviously unable to explain the evidence of continually rising household debt with a rising number of insolvencies. And indeed financial markets are far from being complete - even in the light of financial innovations. Hence a rational household should very well take a risk of becoming insolvent into account. This holds true even if borrowers can finally expect a release from their residual debt because in most countries debt release does not follow immediately. Rather, the insolvent household has to live on some minimum income for quite a period. Therefore alternative explanations are needed which abandon the strict rationality assumption. That households are at the most boundedly rational has been already put forward by Simon (1959) and recently been confirmed by numerous studies (e.g. Ariely (2009)).[1] In line with bounded rationality is the idea that individual behaviour might significantly be influenced by social variables (Akerlof and Kranton (2000), Cynamon and Fazzari (2008)). For the case of the US, Cynamon and Fazzari (2008) explain the increase in household debt by a change in consumption norms.

In our paper we take up this literature and argue that social influences play an important role for household borrowing. In doing so we assume that each individual household seeks to catch up with other households' consumption habits. Abel (1990) modelled such a "catching-up

[1] Campbell (2006) on the other hand argues that households cannot cope with the complexity of their financial decision problem given the myriad of financial products.

with the Joneses" behaviour by linking individual consumption to a lagged average of aggregate consumption. We take up this approach and examine the role of the Joneses effect as a driver of (excessive) indebtedness. In such a setting credit constraints imposed by the banking sector obtain a rather different role: Whereas they undermine optimal behaviour in the life-cycle approach, in our model they exert disciplinary effects upon otherwise excessive household borrowing. In particular we are interested in finding answers to the following questions:

- Given that all households in the economy follow a social orientation like catching up with the Joneses, do we observe differences in resulting household borrowing behaviours with a considerable number of households borrowing excessively?
- How can borrowing constraints discipline households in the sense of protecting them from default and how does this vary for different preferences of consumption?
- How does this in turn affect macroeconomic variables?

The first question is of interest since according to the evidence household debt is concentrated among lower income households (e.g. Barba and Pivetti (2009); Cynamon and Fazzari (2013)). Hence a social norm that is generally obeyed in a society might have different effects depending on the size of income. The second question is interesting since the possibility of household insolvency is still rather underresearched. To the best of our knowledge, it has particularly not been explored in the context of consumption norms. And lastly, we are interested in macroeconomic variables since we want to shed light on potential macroeconomic risks resulting from household debt.

We approach these questions using an Agent-based computational (ABC) model. In line with the above specified criticism of the conventional model, these models aim to overcome restrictive assumptions such as rational expectations, the optimising representative agent and the conjecture that all markets clear (Fagiolo and Roventini, 2012). ABCs are characterised by a bottom-up perspective thus focusing on interactions of a multitude of heterogeneous agents at the micro level. Individual behaviour is determined by simple behavioural decision rules which lead to nonlinear coupling. In our model heterogeneity regarding individual incomes serves as a prerequisite for the Joneses effect.

So far household borrowing has not been a primary focus of ABC models. Rather, existing agent-based models typically neglect the link between households and banks and examine credit relationships between banks and firms instead. Delli Gatti et al. (2005) and Delli Gatti et al.

(2009) study business fluctuations and their relations to bankruptcy avalanches. Moreover, a growing number of ABC models focus on the role of banks for macroeconomic stability (Ashraf et al., 2011) and on contagion in the financial system (Battiston et al., 2007, 2012). Delli Gatti et al. (2009, 2010) and Assenza et al. (2007) seek to explain the financial accelerator in an agent-based economy and Stiglitz and Gallegati (2011) focus on monetary aspects of the system.

The remainder of the paper is structured as follows. In the subsequent chapter, we present an agent-based model being composed of households (2.1), a financial sector (which comprises commercial banks and a central bank) (2.2), and a government (2.3). In section 3.1, we simulate the model for different scenarios (computational experiments) in order to examine the research questions specified above. After describing the computational experiments (3.1) as well as parameter settings (3.2), section 3.3 presents the simulation results of the respective scenarios. The paper concludes with a summary.

2 The Model

In this section we present the main elements of our baseline model. We consider four kinds of agents, namely households, commercial banks, a central bank and a government.

Heterogeneity enters the model through the Joneses effect resulting in disparate consumption patterns. At the beginning of each period each household receives an income and decides on the level of consumption. In the case that desired consumption falls short of available income, the household wishes to save. In the opposite case, the household wants to borrow. As one crucial assumption of our model, current consumption does not only depend on current income but in addition on the consumption behaviour of others (the Joneses effect). Differences between households in this regard result from differences in individual incomes. This assumption is crucial to our analysis because the Joneses effect provides an explanation of why desired consumption may exceed a household's current financial funds and hence requires borrowing. As a further important component of our model we assume that households may be credit constrained thus leading to deviations between desired and actual consumption. Hence the macroeconomic consequences of household borrowing depend on the significance of the Joneses effect as well as on the severity of credit constraints. The first component is determined by the degree of income heterogeneity in the economy, the second component depends on bank behaviour. In this regard we assume that financial supervision which in our model is exercised by the central bank, uses the severity of credit constraints as a policy variable.

Since household borrowing is at the centre of our analysis we keep the sector of firms rather rudimentary. In particular we neglect the issue of firm ownership and hence profit incomes. We assume that labour is the exclusive factor of production. We assume furthermore that in each period firms adjust current production to aggregate demand. This also implies that we abstract from changes in the price level and hence from inflation. As a consequence we do not distinguish between nominal and real variables in the model. The details of the model will be presented successively in the following sections.

2.1 Households

Let $h = \{1, ..., H\}$ be the finite set of infinitely lived individual households. At the beginning of each period household h receives an income Y_{ht} which is composed of a wage income Y_{ht}^{W}, a non-wage income Y_t^{NW} and taxes T_{ht}:

$$Y_{ht} = Y_{ht}^{W} + Y_t^{NW} - T_{ht} \tag{1}$$

Wage income is exogenous to household h following the following simple rule

$$\begin{aligned} Y_{ht}^{W} &= \eta_{ht} Y_t \\ \eta_{ht} &= \eta_{ht-1} + u_{ht} \end{aligned} \tag{2}$$

where Y_t denotes aggregate income (GDP); η_{ht} is the parameter of income distribution and hence, key to the heterogeneity of households. It adds up to one $\sum \eta_{ht} = 1$, where u_{ht} is an idiosyncratic shock uniformly distributed on the support $(0, h_u)$ to account for uncertainties in wage setting.

Non-wage income depends on the household's financial status in the previous period. A household might have accumulated deposits, D_{ht-1}, which increase income through interest rates on deposits ($Y_{ht}^{NW} = i_{Dt-1} D_{ht-1}$). If it took up a loan, L_{ht-1}, interest rate payments reduce disposable income, ($Y_{ht}^{NW} = -i_{Lt-1} L_{ht-1}$). i_{Dt} and i_{Lt} denote the interest rates on deposits and loans, respectively. Moreover, in each period a household has to pay taxes according to $T_{ht} = \tau(Y_{ht}^{W} + i_{Dt-1} D_{ht-1})$.

At the beginning of period t, households receive their income and decide on their desired consumption level $C_t^{\star}$. It is composed of "standard" consumption, the orientation at a reference standard and it is negatively correlated with borrowing and lending rates,

$$C^{\star}_{ht} = \gamma_1 Y_{ht-1} + \gamma_2 \overline{C}_{t-1} - \gamma_3 i_{Dt} - \gamma_4 i_{Lt} \tag{3}$$

where γ_1 denotes the marginal propensity to consume out of earnings, γ_2 reveals how much households care about their relative position, γ_3 and γ_4 denote reaction coefficients for the lending and borrowing rate, respectively. $\gamma_j \in (0,1)$ for $j = 1,2,3,4$.

Following Abel (1990), we choose the average economy-wide consumption per capita of the last period

$$\overline{C}_{t-1} = \frac{1}{H} \sum C_{ht-1} \tag{4}$$

as a proxy for a reference standard against which individuals compare themselves[2]. If desired consumption does not exhaust disposable income, then the household wishes to save which is achieved by accumulating financial assets. In the opposite case the household is willing to borrow. We assume that the maturity of all financial contracts is one period. Moreover, a household that defaults on its debt will be refused a new loan in the following period. Rather, the household will have to repay as much of its debt as is possible. In this regard we assume the existence of a minimum of income which the law guarantees as non-pledgeable. Moreover we assume a consumer friendly insolvency law that foresees total debt release already after one period. Hence after one period households are free to apply for a new loan. Finally we rule out that a household simultaneously holds deposits or cash and borrows money. This appears plausible considering our assumption that the interest rate on loans exceeds that on deposits and that we ignore durable goods. In our model desired and actual consumption may deviate either because the household has defaulted on its debt or because its desired borrowings exceed the amount the bank is willing lend.

Depending on their financial status, we can distinguish three types of households. For the respective types the following is true:

- **Type 1**: $D_{ht-1} = L_{ht-1} = BG_{ht} = 0$, where D_h stands for the household $h's$ deposits, L_h for its loans and BG_h for its cash holdings, $h = 1, ...H$. If the households starts period t with zero wealth but also with zero debt, its disposable income equals its wage income minus taxes according to

[2] Galí (1994) incorporates reference consumption in a static CAPM model and a multiperiod asset pricing model.

$$Y_{ht} = (1-\tau)Y_{ht}^{W}. \tag{5}$$

For a household with zero previous wealth but also with zero debt, actual and desired consumption as defined by equation (.....), deviate whenever this household now wants to borrow and if its loan demand exceeds what the bank is willing to lend as a maximum, i.e.,

$$C_{ht} = \begin{cases} C_{ht}^{\star} & if \quad Y_{ht} \geq C_{ht}^{\star} \\ C_{ht}^{\star} & if \quad C_{ht}^{\star} > Y_{ht} \ \& \ L_{ht}^{d} \leq L_{ht}^{\max} \\ Y_{ht} + L_{ht}^{\max} & if \quad L_{ht}^{d} > L_{ht}^{\max}. \end{cases} \tag{6}$$

Loans are required if desired consumption exceeds disposable income, hence

$$L_{ht}^{d} = C_{ht}^{\star} - Y_{ht} \geq 0, \tag{7}$$

If loan demand exceeds the maximum amount of credit the bank is willing to lend to the household, it is credit constrained and obtains $L_{ht}^{\max}$.

$$L_{ht} = min(L_{ht}^{d}, L_{ht}^{\max}). \tag{8}$$

If on the other hand, this household does not want to spend its entire disposable income on consumption but wants to save and hence accumulate wealth, this can be achieved by opening a bank deposit account which we assume to be interest-bearing or by holding cash. Hence in our model money serves a store-of-value function.

$$D_{ht} + BG_{ht} = Y_{ht} - C_{ht}^{*} \text{ if } Y_{ht} - C_{ht}^{*} > 0 \tag{9}$$

Desired cash holdings are assumed to be a fixed proportion, $\kappa < 1$, of deposits, i.e.,

$$BG_{ht} = \kappa D_{ht} \tag{10}$$

.[3] implying for desired deposits (9):

$$D_{ht} = \frac{Y_{ht} - C^*_{ht}}{1+\kappa}$$

- **Type 2**: $D_{ht-1} > 0$ and hence $BG_{ht-1} > 0$, and $L_{ht-1} = 0$. The household's disposable income equals its wage income plus earnings from interest rates on deposits after tax payments

$$Y_{ht} = (1-\tau)(Y^W_{ht} + i_{Dt-1}D_{ht-1}). \tag{11}$$

Again, actual and desired consumption as given by equation (....) deviate if this household wants to borrow more than the bank is willing to lend:

$$C_{ht} = \begin{cases} C^\star_{ht} & if \quad C^\star_{ht} \le Y_{ht} + D_{ht-1}(1+\kappa) \\ C^\star_{ht} & if \quad C^\star_{ht} > Y_{ht} + D_{ht-1}(1+\kappa) \,\& L^d_{ht} \le L^{\max}_{ht} \\ Y_{ht} + D_{ht-1}(1+\kappa) + L^{\max}_{ht} & if \quad L^d_{ht} > L^{\max}_{ht} \end{cases} \tag{12}$$

with

$$L^d_{ht} = C^\star_{ht} - Y_{ht} - D_{ht-1} \ge 0. \tag{13}$$

$$L_{ht} = min(L^d_{ht}, L^{\max}_{ht}) \tag{14}$$

Deposits and cash holdings are desired whenever

$$D_{ht} + BG_{ht} = Y_{ht} - C^\star_{ht} - D_{ht-1} - BG_{ht-1} > 0 \tag{15}$$

- **Type 3**: $D_{ht-1} = BG_{ht-1} = 0$ and $L_{ht-1} > 0$. Disposable income equals wage income minus interest payments for loans after taxes

$$Y_{ht} = (1-\tau)Y^W_{ht} - L_{ht-1}i_{Lt-1}. \tag{16}$$

In determining actual consumption we take into account that a household may not be able to repay its loans. This is the case whenever its disposable income falls short of borrowings.

[3] According to a study of the Deutsche Bundesbank from 2010 ("Wie kommt das Bargeld ins Portmonee?") $\kappa \le 0.05$ in Germany.

In this case the household In this case actual household consumption is given by

$$C_{ht} = \begin{cases} C^{\star}_{ht} & if \quad C^{\star}_{ht} \leq Y_{ht} - L_{ht-1} \\ Y_{ht} - L_{ht-1} & if \quad C^{\star}_{ht} > Y_{ht} - L_{ht-1} \geq Y^{np}_{t} \\ Y^{np}_{t} & if \quad C^{\star}_{ht} > Y_{ht} - L_{ht-1} < Y^{np}_{t} \end{cases} \tag{17}$$

We assume that non-pledgeable income is a fixed proportion, θ, of the households disposable income:

$$Y^{np}_{t} = \theta Y_{ht} \quad with \quad 0 < \theta < 1 \tag{18}$$

If the household succeeds in meeting its financial obligations and if desired consumption still does not exhaust disposable income, then this household will even be able to save and accumulate deposits and cash according to

$$D_{ht} (1 + \kappa) = Y_{ht} - L_{ht-1} - C^{\star}_{ht} \geq 0 \tag{19}$$

Defaulting households will not be granted a new loan in the period in which they are unable to repay their debt.

$$L_{ht} = 0 \quad if \quad Y_{ht} - L_{ht-1} \leq Y^{np}_{t} \tag{20}$$

In the following section we present the financial sector and the conditions at which households can borrow and accumulate deposits and cash.

2.2 The Financial Sector

The financial sector is composed of commercial banks and the central bank. For simplicity we summarize a possibly high number of individual banks into a consolidated banking sector to be called "the bank" henceforth.

The commercial bank grants loans to private households as well as to the government. By assumption loans are extended at the beginning of each period and have to be repayed at the beginning of the next period. Bank lending is financed by household deposits and loans from the central bank. A further simplification in our model concerns the role of bank equity. Arguably, bank equity has gained a crucial importance for constraining bank risk-taking behaviour in the aftermath of the financial crisis and we do not want to downplay its significance. Rather, we are interested in keeping the supply side of the model as simple as possible, which includes simplifying assumptions concerning the composition of household incomes. We therefore assume that the commercial bank is not in private ownership but is owned by the central bank. Hence any net profit earned by the commercial bank directly goes to the central bank. Given this assumption, we assume that the bank plans at the beginning of each period and in doing so has to obey the following balance sheet constraint:

$$L_t^s + B_t^s = D_t^d + F_t^d \tag{21}$$

where L_t^s denotes total bank loan supply to households, B_t^s denotes the supply of loans to the government, D_t^d stands for the bank's demand for deposits and F_t^d represents its demand for central bank loans. In deciding on its balance sheet composition we assume that the bank fixes interest rates on loans, i_{Lt}, and deposits, i_{Dt}, does so by accepting the key interest rate, i_{Ft}, set by the central bank as a guideline. Since the key interest rate is only of minor importance for our model we simply assume that it evolves according to the following rule:

$$i_{Ft} = i_{Ft-1} + \phi\epsilon_t \tag{22}$$

with $\epsilon_t = \epsilon_{t-1} + \nu_t$, where ν_t is a random parameter drawn from a normal distribution with support $\nu \sim N(0, \sigma_\nu^2)$. We assume that households have to pay an interest rate on their loans which exceeds the key interest rate whereas the government will not be charged with a positive markup, i_{Bt}. The interest rate on deposits may equal the key interest rate or may be lower but never higher than the key interest rate. This leads to the following interest rate pattern:

$$\begin{aligned} i_{Lt} &= \sigma i_{Ft} \quad \sigma \geq 1 \\ i_{Dt} &= \Psi i_{Ft} \quad \Psi \leq 1 \\ i_{Bt} &= i_{Ft}. \end{aligned} \tag{23}$$

At the given interest rate on deposits, the bank accepts any deposit size offered by households. Hence we have

$$D_t^d = \sum_{h=1}^{H} D_{ht}. \tag{24}$$

Deposit contracts have a formal and factual duration of one period which excludes withdrawals within the period. The bank's lending behaviour depends on whether there exists a risk of default or not. By assumption public debt bears no risk at all. By consequence, the bank is willing to always satisfy public loan applications

$$B_t^s = B_t. \tag{25}$$

This is not the case for household borrowings, however. As a crucial assumption we consider a bank which is not indifferent with respect to default but has an interest in avoiding such a situation for reasons which will become clear when we turn to the central bank. For the moment we take the bank's aversion towards default as given. In our model the bank seeks to avoid default by imposing credit lines on individual households. Each credit line is based on the insight that default occurs whenever

$$L_{ht}\left(1 + i_{Lt}\right) > Y_{ht+1}$$

that is whenever the contractual repayment obligation exceeds household income. Since the bank is not allowed to charge the borrower's entire income but only the seizable part $Y_{ht} - Y_{ht}^{np}$, a loss from default is even higher amounting to

$$\mathfrak{L}_{ht} = L_{ht}\left(1 + i_{Lt}\right) - \left(Y_{ht+1} - Y_{ht+1}^{np}\right)$$

If the bank wants to avoid any loss at all, contractual repayments will not be allowed to exceed whatever the bank can seize in case of default, i.e.,

$$L_{ht}\left(1 + i_{Lt}\right) \leq \left(Y_{ht+1} - Y_{ht+1}^{np}\right).$$

Unfortunately the bank does not know future household incomes and will therefore have to apply some proxy. In this regard we assume that the bank takes the household's previous income as a guideline. By consequence, a bank seeking to avoid any loss at all would choose as a credit line

$$L_{ht}^{\max} \leq \frac{\left(Y_{ht-1} - Y_{ht-1}^{np}\right)}{1 + i_{Lt}}. \tag{26}$$

We assume that the bank differs from this worst case rule by taking into account that for any individual household the probability of default will be so much the higher the lower this household's income is compared to the average income earned in the economy. This leads to the following rule:

$$L_{ht}^{\max} = \lambda \frac{\left(Y_{ht-1} - Y_{ht-1}^{np}\right)}{1 + i_{Lt}} \tag{27}$$

where

$$\lambda = \begin{cases} \lambda_1 & \text{if} \quad \frac{Y_{ht-1}}{\frac{1}{H}\sum Y_{ht-1}} < 1 \\ \\ \lambda_2 > \lambda_1 & \text{if} \quad \frac{Y_{ht-1}}{\frac{1}{H}\sum Y_{ht-1}} \geq 1 \end{cases} \tag{28}$$

where, as will be explained below, the size of λ represents a policy parameter chosen by the central bank.

In light of existing credit lines the bank's lending behaviour towards households is given by:

$$L_t^s = \min\left(L_{ht}^d, L_{ht}^{\max}\right) \tag{29}$$

Taking the balance sheet constraint into account, the bank will plan a demand for central bank loans whenever desired lending will not be fully covered by deposits.

At the beginning of each period the bank realises a cashflow according to

$$CF_t^B = x_{Ht} + B_{t-1}\left(1 + i_{Ft-1}\right) - \sum D_{ht-1}\left(1 + i_{Dt-1}\right) - F_{t-1}\left(1 + i_{Ft-1}\right) \tag{30}$$

$$x_{Ht} = \sum_{h=1}^{H} x_{ht} \tag{31}$$

where x_{ht} denotes actual individual repayments from lending to private households and x_{Ht} its aggregate level. Facutal individual repayments are determined as follows:

$$x_{ht} = \begin{cases} L_{ht-1}\left(1 + i_{Lt-1}\right) & if \quad (1-\theta)\,Y_{ht-1} \geq L_{ht-1}\left(1 + i_{Lt-1}\right) \\ \\ (1-\theta)\,Y_{ht-1} & if \quad (1-\theta)\,Y_{ht-1} < L_{ht-1}\left(1 + i_{Lt-1}\right) \end{cases} \tag{32}$$

If actual repayments fall short of what had been contractually agreed, the bank's cashflow can become negative. This is equivalent to a situation in which the bank is unable to meet all its financial obligations thus leading to insolvency. However, as has been explained above, the bank is in the ownership of the central bank, and hence any loss will be absorbed appropriately thus leaving the banking sector intact.

The **central bank** provides the economy with banknotes and coins (cash) and does so with the intention to ensure financial stability. At the pre-set key interest rate, i_{Ft} it satisfies the bank's refinancing demand F_t^d and it covers any excess of the bank's payment obligations over revenues by channelling additional cash into the economy. Hence the central bank's supply of cash changes according to

$$BG_t^s - BG_{t-1}^s = \left(F_t^d - F_{t-1}^d\right) + CF_t^- \tag{33}$$

where CF_t^- represents a negative bank cashflow. This implies that excessive household lending with a high number of defaulting households will consequently lead to a correspondingly higher supply of cash. By contrast we assume that any positive bank cashflow will be transferred directly to the government thus acting as an additional revenue.

Of course by receiving complete a complete bail-out in case of insolvency, the bank would never have an incentive to take aspects of households' creditworthiness into account when deciding on loans. In order to prevent moral hazard, the bank is obliged to impose on each individual household a credit constraint the severity of which is determined by the central bank thus yielding the parameter λ as a policy variable.

2.3 The Government

Government expenditures consist of goods and services as well as of interest payments, which are financed by income taxes, transfers from the central bank and by borrowing.

$$B_t - B_{t-1} = G_t + B_{t-1} i_{F_{t-1}} - \left(T_{Ht} + CF_t^+\right) \tag{34}$$

where CF_t^- represents a positive bank cashflow and with

$$T_{Ht} = \sum_{h=1}^{H} T_{ht} \tag{35}$$

By assumption the size of government expenditures is exogenously given and constant over time, which renders public borrowing as the residual.

$$G_t = G \tag{36}$$

As mentioned above, (23), the government receives bonds at a preferential interest rate equal to the key interest rate.

In the following chapter we show how micro level interaction aggregates on a macro level.

2.4 Macroeconomics

We now turn to examining how household debt affects the dynamics of GDP development as well as the time path of aggregate consumption. We assume that firms seek to adjust current production flexibly to current aggregate demand, and that deviations follow exclusively from random shocks

$$Y_t = Y_t^d + \rho_t \tag{37}$$

where ρ_t denotes a temporary stochastic shock which is uniformly distributed on the support $\left[\underline{\rho}, \overline{\rho}\right]$ with the following property: $\sum \rho_t = 0$.
Aggregate demand is composed of aggregate private consumption and exogenously given public expenditures:

$$Y_t^d = \sum_{h=1}^{H} C_{ht} + \overline{G} \tag{38}$$

Taking equation (37) and equation (38) together renders as the time path for aggregate production

$$Y_t = \sum_{h=1}^{H} C_{ht} + \overline{G} + \rho_t \tag{39}$$

The following section provides the simulation results, revealing the consequences from different degrees of the Joneses effect as well as the importance of credit constraints in this respect.

3 Simulation

3.1 Computational experiments

Now that we have presented the model, we conduct various computational experiments in order to test the impact of the "Joneses effect" combined with different credit lines. As described above, the Joneses effect represents the degree to which households want to "catch up with the Joneses" and adjust their consumption behaviour to a reference standard of consumption. In a first experiment we examine in which way the Joneses effect stimulates household consumption and in doing so requires borrowing. As one crucial element of our model we have assumed that households can go bankrupt if they are unable to repay their debt. Hence in the absence of binding credit constraints we should expect a positive correlation between the strength of the Joneses effect and a rising number of household insolvencies. We should furthermore expect that rising insolvencies have a negative impact on the time path of GDP. In a second experiment we study the influence of credit constraints as a possibility to stabilise the development of household

debt and GDP in light of an effective Joneses effect. In particular we are interested how the strength of the Joneses effect interacts with the degree of tightness of credit constraints.
In what follows we briefly describe the parameter settings for the different scenarios.

3.2 Parameter settings

The model is simulated over 2000 periods for each scenario plus a burn in of 100 periods to account for the initialization of the model. In order to facilitate the clarification of the interaction between the Joneses effect and credit lines we have specified a baseline scenario in table 1. Further scenarios are represented in table 2.

Number of Banks	1
Number of Households	200
γ_1 - "Standard consumption"	0.8
γ_2 - "Joneses effect"	0.15
γ_3 - Impact of the lending rate on consumption	0.05
γ_4 - Impact of the borrowing rate on consumption	0.05
θ - Parameter for pledgeable income	0.4
ϕ - Parameter for the shock in the policy rate	1
σ - Parameter for the lending rate	1.2
Ψ - Parameter for the borrowing rate	0.6
λ_1 - Credit line parameter for the richer half	0.7
λ_2 - Credit line parameter for the poorer half	0.2
$\overline{G}$ - Government expenditure	100

Table 1: Inital parameter values[4]

While, scenario 1.1, 1.2 and 1.3 abstract from credit lines completely, scenario 2.1, 2.2 and 2.3 introduce "loose" credit lines, moving on to scenarios 3.1, 3.2 and 3.3, where households face "tight" credit constraints. The columns of table 2 represent differences in household behaviour induced by the Joneses effect, ranging from weak to strong social orientation. Note that we are primarily interested in the significance of the Joneses effect compared to the impact of current income. Therefore, for each household the overall propensity to consume remains the same over all scenarios under scrutiny.

	$\gamma_1 = 0.95$; $\gamma_2 = 0$	$\gamma_1 = 0.8$; $\gamma_2 = 0.15$	$\gamma_1 = 0.4$; $\gamma_2 = 0.55$
$L^{max} = \infty$	1.1	1.2	1.3
$\lambda_1 = 0.7$, $\lambda_2 = 0.2$	2.1	2.2 = Baseline scenario	2.3
$\lambda_1 = 0.07$, $\lambda_2 = 0.02$	3.1	3.2	3.3

Table 2: Parameter variation for different scenarios

3.3 Results

3.3.1 The model economy without credit constraints

Absence of the Joneses effect (scenario 1.1 =2.1 =3.1) In the absence of the Joneses effect and given that the propensity to consume is smaller than one, households can always realise desired consumption. In this case we should expect that aggregate consumption and aggregate production gradually converge to their long-run equilibrium values determined by the size of government expenditures and the aggregate propensity to save. As can be seen from figure 2, loan demand is zero, while households accumulate deposits and hence earn an interest income them. The time path of aggregate consumption is relatively stable and increasing. Occasional periods of falling consumption follow exclusively from negative shocks in wages. As can be seen from table 4, aggregate consumption is largest when households ignore a social orientation and hence display a Keynesian consumption function. Note, that shocks in income have a strong influence on both the volatility in aggregate consumption as well as the dynamics of the time path of GDP (figure 1, scales are adjusted for the purpose of comparative analysis across scenarios).

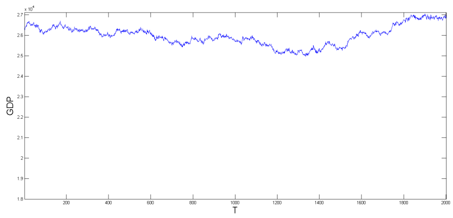
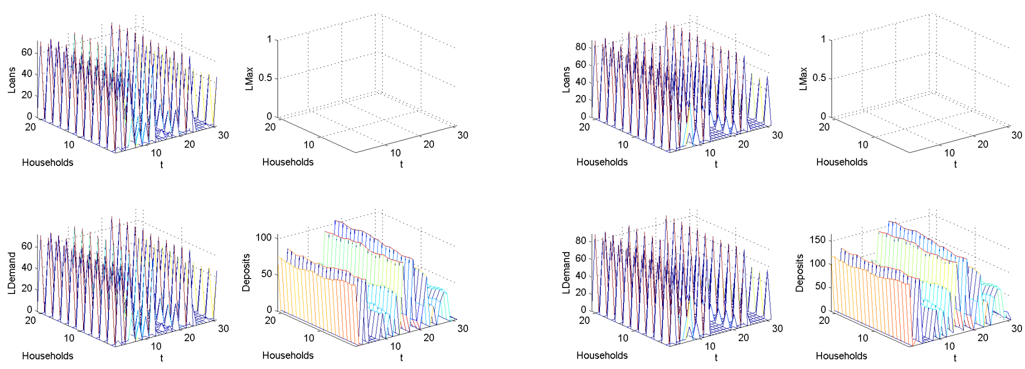


Figure 1: Without Joneses effect



(a) Weak Joneses effect (scen. 1.2)

(b) Strong Joneses effect (scen 1.3)

Figure 2: Lending Variables, “without credit constraints”, $\gamma_2 = 0.15$ and $\gamma_2 = 0.8$

Scenario	median L_t	$\sum L_t$
$1.1 = 2.1 = 3.1$	0	0
1.2	813,2	1 040 700
1.3	5174,8	3 845 500
2.2	163,1	153 860
2.3	836,3	439 890
3.2	63,1	42 992
3.3	119,4	78 442

Table 3: Household debt

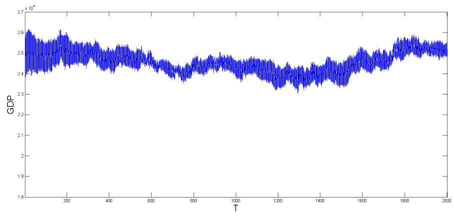
Scenario	Y_t (mean)	σY_t	C_t (mean)	σC_t
$1.1 = 2.1 = 3.1$	25989	482,13	25904	418.74
1.2	24561	656,67	24476	644,94
1.3	21289	1327,2	21204	1310
2.2	24303	528,5	24218	525,07
2.3	20217	950,16	20133	949,47
3.2	24620	517,97	24176	517,78
3.3	20122	940,53	20035	937,27

Table 4: Macroeconomic time series

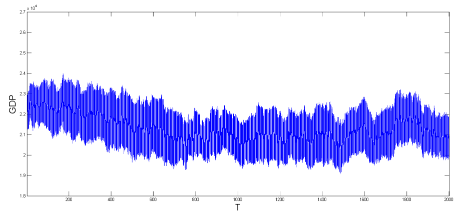
Accounting for a Joneses effect (scenario 1.2 and 1.3) We now assume that households want to keep up with their neighbours and hence take up debt if desired consumption exceeds disposable income. In the absence of binding credit constraints, households' demand for loans is fully satisfied unless they had gone bankrupt in the previous period. We observe that aggregate household debt is very high (see table 3) and increases over time the degree of which is positively correlated with the strength of the Joneses effect. Compared to a situation without the Joneses effect, aggregate consumption no longer follows a continually rising trend towards equilibrium but may fall temporarily (table 4). To understand this result observe that in our model the Joneses effect acts asymmetrically in the sense that households earning an income above average consume less than without social orientation. Arguably, households with an income below average consume more if they want to keep up with the Joneses, however, among this class of households we also find those which regularly go bankrupt, which implies that the size of their consumption expenditures is constrained to non-pledgeable income at least for one period. This effect has a particularly high dampening effect on consumption if the Joneses effect is high.

	$\gamma_1 = 0.95$; $\gamma_2 = 0$	$\gamma_1 = 0.8$; $\gamma_2 = 0.15$	$\gamma_1 = 0.4$; $\gamma_2 = 0.55$
$L^{max} = \infty$	0	26.5	30
$\lambda_1 = 0.7$, $\lambda_2 = 0.2$	0	14	20
$\lambda_1 = 0.07$, $\lambda_2 = 0.02$	0	14	19

Table 5: Average number of household insolvencies in the different scenarios (median values)

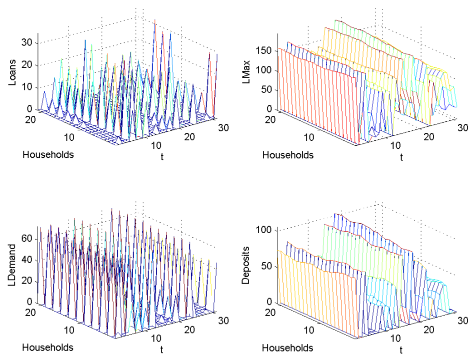


(a) Weak Joneses effect (scen. 1.2)

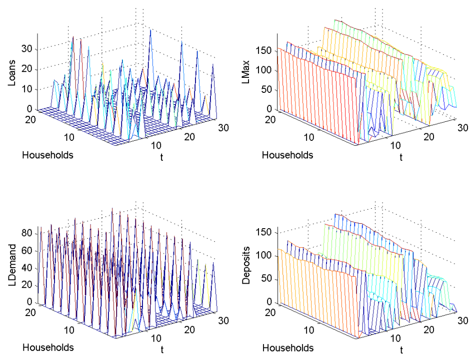


(b) Strong Joneses effect (scen 1.3)

Figure 3: GDP for varying Joneses effects, “without credit lines”



(a) Weak Joneses effect (scen. 2.2)



(b) Strong Joneses effect (scen 2.3)

Figure 4: Lending variables and deposits, “loose credit constraints”

Household bankruptcies together with the provision that fresh loans are possible again after one period, also enhances the volatility of aggregate consumption. In figure 2 we observe a zigzag in borrowing which has feedback effects on aggregate consumption. During the whole simulation households go insolvent repeatedly with an average of 26.5 households going bankrupt each period (see table 5) if the Joneses effect is weak and an average of 30 for a strong Joneses effect. Since GDP is strongly correlated with aggregate consumption in our model we observe the same pattern for both variables (see figure 3 (a,b) and table 4). Note that varying the strength of the Joneses effect does not alter the qualitative pattern of response of borrowing, consumption and GDP.

3.3.2 The model economy with loose credit constraints

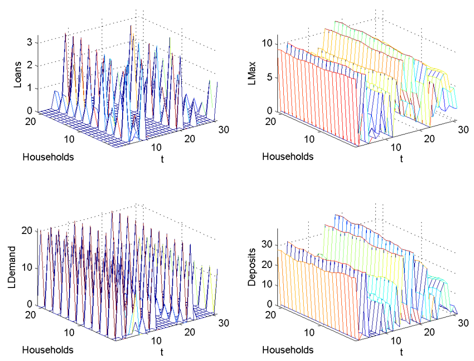
Imposing credit constraints in the model alters the analysis by the fact that household loan demand will not always be fully satisfied, the probability of which is higher for lower than for higher incomes (see equation 27 and 28). Figure 4 shows that loan demand and extended loans deviate.

Accounting for a weak Joneses effect (scenario 2.2) Not surprisingly below-average income households in their desire to catch up with their neighbours are the ones most affected. As described in scenario 1.2, very poor households permanently require a loan. Introducing credit constraints in the analysis acts a measure that prevents households from overborrowing. This lowers the probability that they are unable to repay debt in the following period and therefore, they are less likely to go bankrupt. From (table 3) we can see that aggregate household debt goes down when credit constraints are binding. The average number of households going bankrupt in each period drops to 14 (see table 5).
Those who still file for insolvency do not have to curtail consumption as severely as in the case without credit constraints. This offers an explanation for the evidence that now aggregate consumption as well as GDP are less volatile than in the economy without contraints to borrowing and does not experience an equally strong temporary drop.

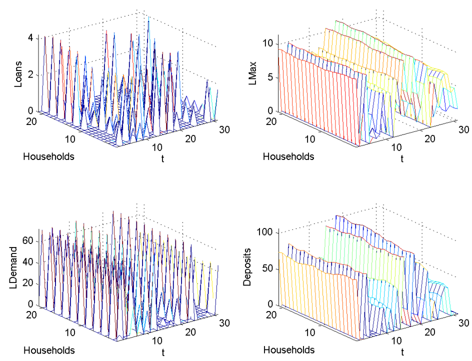
Accounting for a strong Joneses effect (scenario 2.3) Above we have described how a stronger social orientation leads to an increase in loan demand. In this scenario, the increase in loan demand is curtailed by prevailing credit constraints though. We therefore observe a stronger deviation of loans from loan demand (see figure 4) and correspondigly a higher deviation of desired from actual consumption as compared to a weaker Joneses effect. But still aggregate debt is higher, and we also observe on average a higher number of insolvencies (20) as compared to scenario 2.2 (which is still below both scenarios without credit constraints). We have already seen that a strong Joneses effect puts downward pressure on both aggregate consumption and GDP but increases volatility. Credit constraints are unable to reverse this downward development at least not as long as they are not sufficiently severe. Rather from table 4 we can see that the time path of GDP is below all previous scenarios. However, credit constraints dampen volatility. We conclude that there is a strong correlation between the number of insolvencies and volatility of GDP (and aggregate consumption.)

3.3.3 The model economy with tight credit constraints

Accounting for a weak Joneses effect (scenario 3.2) Compared to the scenarios with loose credit constraints, tight credit constraints lead to an even stronger deviation of loan demand from loans (see figure 5). Hence, more households are credit constrained. Unsurprisingly, stricter credit constraints lower aggregate debt. In fact, aggregate debt is lowest in this scenario (apart from the scenario without social orientation.). The average number of insolvencies does not change



(a) Weak Joneses effect (scen. 3.2)

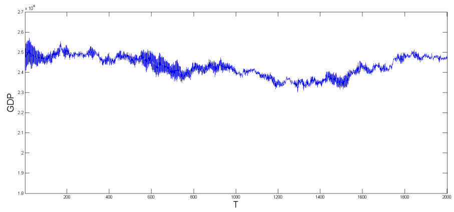


(b) Strong Joneses effect (scen 3.3)

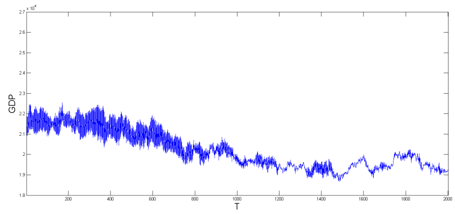
Figure 5: Lending variables and deposits, "strict credit constraints"

compared to scenario 2.2. However, the overall credit loss decreases substantially since it is the class of very poor households which is willing to borrow too much compared to their incomes and hence find themselves credit constrained. By contrast households with a relatively higher income are treated less restrictively when they want to borrow. If previous period income was above average they are downgraded even less (see equation (28)). (Note that all those effects apply for scenario 2.2 as well. Yet, they are less severe with loose credit constraints.) This interplay between poor and richer households may explain why the time paths of aggregate consumption and GDP are very similar to scenario 2.2., though volatility can be found to be a bit less pronounced.

Accounting for a strong Joneses effect (scenario 3.3) Tight credit constraints imply that a strong social orientation explains an even higher deviation of actual household borrowing from its desired level. Indeed aggregate debt is about seven times lower compared to loose credit constraints. Given that credit constraints are independent of the strength of social orientation we should not expect that the time path of aggregate consumption and GDP differs much from scenario 2.3. This expectation is confirmed by table 4 and figures 6 and 7. On average one household less files for insolvency as opposed to the scenario with loose credit constraints. Yet the strength of the Joneses effect leads to a higher number of insolvencies as opposed to the previous scenario with weak social orientation.

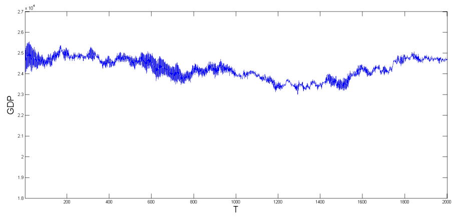


(a) Weak Joneses effect (scen 2.2)

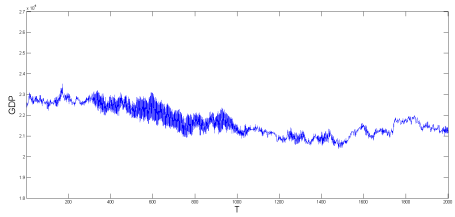


(b) Strong Joneses effect (scen 2.3)

Figure 6: GDP for varying Joneses effects, "loose credit lines"



(a) Weak Joneses effect (scen. 2.2)



(b) Strong Joneses effect (scen 2.3)

Figure 7: GDP for varying Joneses effects, "strict credit lines"

4 Summary and Conclusion

The incorporation of a Joneses effect in the interpretation of Abel (1990) into an otherwise Keynesian consumption function sets households with an income below the average incentives to borrow the size of which correlates positively with the desire to come closer to what is considered as standard consumption. As long as these households remain able to service their loans, the Joneses effect does neither alter the trend of consumption and GDP nor their volatitlity. The situation changes, however, once households default on their debt and are exposed to bankruptcy. In this case the size of their non-pledgeable income constrains the size of what they are able to consume. Since the typical borrower earns a low income and hence borrows excessively in order to keep up with the Joneses, the number of bankruptcies in our model show macroeconomic effects. In such a situation it also plays a role that the Joneses effect acts asymmetrically with above income households consuming less as would be the case for the standard Keynesian consumption function. Hence once households go bankrupt, keeping up with the consumption standard lowers the size and change of consumption and GDP over time. Of further importance is the assumption that households which have gone bankrupt are released from their debt after one period and are again free to borrow. Earning an income below the average, these households continue to have an incentive to take a loan with bankruptcy following suit. Repeated bankruptcies followed by repeated fresh borrowing adds pronounced volatility to both aggregate consumption and GDP.

Both the downward trend in these variables as well as their volatitiliy correlate positively with the Joneses effect. Introducing credit constraints with disposable (lagged) household income determining the maximum of a loan the bank is willing to grant, is a useful tool to dampen GDP and consumption volatility by interrupting the vicious circle of excessive borrowing and bankruptcies. However, credit constraints are unable to reverse the downward trend of GDP and consumption. This again can be explained by the property of our model that it is the class of lower income household that will find themselves credit constrained very easily thus having to adjust their effective consumption downwards.

These results lead us to conclude that credit is no way to allow for a better convergence of living standards in a society. The reason is that loans enable households only temporarily to separate consumption from income possibilities. Once loans have to be repaid the debtor is faced with the situation of having even less available for consumption that would be possible with his wage income. Bankruptcy results as a repeated reality in particular for low income households. On the other hand credit constraints pose no solution because again it is the typical low income household which will be credit constrained and hence will find itself far from being able to come closer to realising what is considered as standard consumption. Notably both easy access to credit as well as credit constraints act as a poverty trap for low income households.

We conclude with remarks on shortcomings of our theoretical analysis pointing out to possible future research. We are well aware that our analysis exhibits several deficiencies. The assumption that households are restrained to minimum consumption for only one period in case of insolvency could be relaxed in future research. One option would be to investigate different durations before releasing households from debt. In doing so, one could account for differences in insolvency laws accross countries.

Moreover, our assumption that all households care about others to the same extent (γ_2 is equal for all households) within the respective scenarios can easily be relaxed. For the purpose of our comparative analysis, this assumption is fundamental and we feel justified working with it. An interessting direction for future research could be to focus on variations in the Joneses effect, possibly for different groups of income.

A further departure of our model from reality is the assumption that households either borrow or save, but never both. Although, simultaneous holdings of assets and liabilities are a widely accepted assumption in the theoretical literature due to complexities of modelling, one should however bear in mind, that in reality it is rather common that households hold both.

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