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Keeping up with the Joneses, the neighbors and the richest

Can time-varying keeping up parameters explain the relationship between income inequality and household debt?

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Abstract

Many OECD countries have experienced a large increase in household debt during the last two decades. Simultaneously, income inequality has risen in most of the western world. This trend has been particularly notable in the US. Evidence from PSID and SCF shows that it is the lower income households that have had the largest increase in debt-to-income in this period. We suggest that the increase in household debt among the lower income households can be explained by a keeping up effect, i.e. that households compare their consumption relative to the consumption of others. We have tested this effect in a life-cycle model with three different alterations and conclude that it is plausible that there is a relationship between income inequality and the increase in debt-to-income for the lower income households.

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Any faults and flaws that remain are fully the responsibility of ours.

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1 Introduction

Income inequality has increased in a majority of the OECD countries between 1985 and 2008 (OECD, 2011). Simultaneously, household debt increased in several of these countries (OECD, 2006). This trend has been particularly notable in the US. Table 1 shows the evolution of debt, income and debt-to-income ratios for four groups with different education levels. We have taken education as a proxy for permanent income due to the high correlation between the two variables.[1]

TABLE 1
Change in debt, income and debt-to-income between 1985 and 2002.

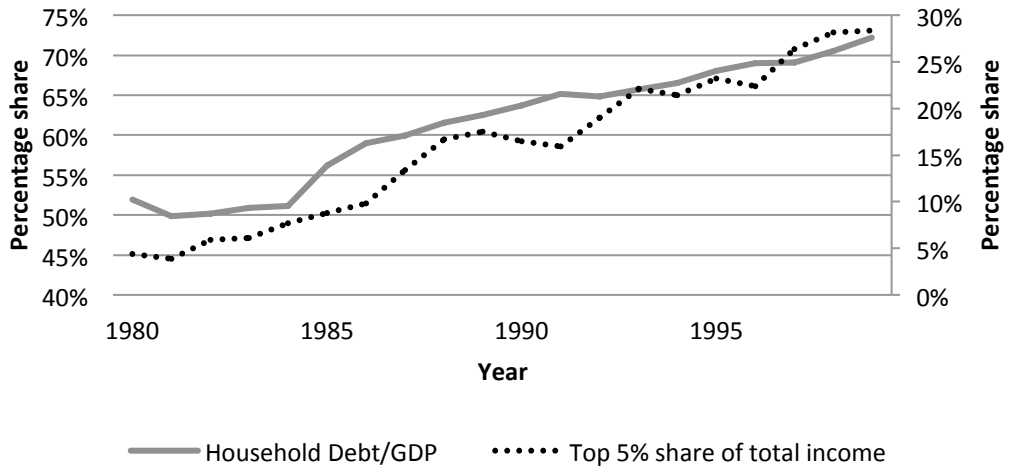
Group	*Change in debt*	*Change in income*	*Change in debt-to-income*
1	53%	-3%	58%
2	38%	8%	27%
3	36%	14%	19%
4	35%	20%	13%

Source: Debt data is from Survey of Consumer Finances from the years 1989 and 2001. Income data is from PSID from the years 1985-1989 and 1998-2002.
Group one consists of people with education less than high school (HS), group two with HS degree, three with some college, four with at least college degree.

Table 1 shows that even though group one saw their average income decrease between 1985 and 2002 they still had the greatest increase in debt of the four groups. Figure 1 depicts changes in income inequality (measured as top 5 % richest share of total income) and household-debt to GDP between 1980 and 2002. This indicates a positive correlation between rising debt-to-income and income inequality.

[1] Education has been used as a proxy for permanent income in many research papers, among others Boix (2003), because it is highly correlated with income and largely permanent for agents above age 25. Data from Bureau of Labor Statistics and the Current Population Study shows a strong correlation between educational attainment and income. Furthermore, Lemieux finds in his paper from 2006 that most of the increase in wage inequality between 1973 and 2005 is due to an increase in the return to post-secondary education, something which further supports the use of education as a proxy for income inequality in our setting.

FIGURE 1: Growth in household debt and top 5% share of total income



Source: Incomes from PSID. Debt-to-income ratios from Flows of Funds database, Federal Reserve Board. Income excludes capital gains.

Data from Current Population Survey (CPS), the Panel Study of Income Dynamics (PSID), and the Consumer Expenditure Survey (CEX) between 1967-2006 shows that while income inequality has increased in the US, consumption inequality seem to be unchanged (Heathcote, Perri and Violante, 2010). When studying consumption and income data for the four income groups we also come to the conclusion that income inequality has increased more than consumption inequality, see Appendix 1. This observation, combined with rising debt levels, points to the possibility that households with lower incomes have increased their credit-financed consumption. This leads to the question: what is the relationship between income inequality and household debt?

The basic standard consumption model cannot explain the observations made in data. We try to explain data by introducing a keeping up with the Joneses parameter in the standard consumption model. This parameter captures external habit formation in consumption, i.e. that individuals make their consumption decisions with respect to average consumption in the economy. Specifying a utility function with a keeping up with the Joneses parameter is supported both at the micro level, where evidence suggest that media has increased the role of conspicuous consumption (Schor, 1998), and at the macro level where it has been able to explain empirical observations in stock prices (Abel, 1990, Gali, 1994 and Campbell and Cochrane, 1999). We use this utility function to model the relationship between income inequality[2] and household debt in a life-cycle framework with income heterogeneity. We calibrate the model to US data for

[2] In this paper we only look at income from labor and transfers minus taxes and abstract from incomes from assets. Thus we do not account for income inequality caused by assets, but only for income inequality that arises from differences in labor income.

two periods between the years 1985 and 2002. The results suggests that a keeping up parameter is an interesting mechanism in explaining the increase in debt-to-income between 1985 and 2002.

The rest of the paper is organized as follows: Section 2 presents previous research. Section 3 explains our model, Section 4 discusses the data, followed by the results in Section 5 and a discussion and conclusion in Section 6 and 7.

2 Previous Research

Previous relevant research includes the literature on consumption theory, income inequality and household debt. In this section we present an overview of the research field.

Keynes (1936) suggested that consumption decisions were based on one's current income level. He stated that marginal propensity to consume is less than one but larger than zero. Further, as people get richer, they do not consume all of the extra money earned, thus average propensity to consume decreases with income. With a more equal income distribution consumption would thus increase and vice versa. This was a departure from classical economics since less emphasis was put on the interest rate as a determinant of consumption, and income distribution was instead proposed as a key for understanding consumption behavior. However, new aggregate data on consumption and income from the 1870's to 1940's, put forward by Simon Kuznets (1942), showed that consumption to income was relatively stable over a long time horizon, despite changes in income.

Modigliani and Brumberg (1954) shed new light on the consumption puzzle. Following the ideas of Fisher they elaborated the micro foundations of consumer theory. Fisher (1930) proposed that consumption choice was related to lifetime income, instead of current. When deciding on how much to consume people faced an inter-temporal budget constraint and maximized lifetime satisfaction by smoothing consumption over the lifetime. Modigliani and Brumberg presented the life-cycle hypothesis, with the idea that income would vary over an individual's lifetime, for example one would earn less after retiring, but by saving, income could be moved from one period to the next. Further, they pointed out that consumption depended on both income and wealth. As wealth and income would grow constantly, so would the average propensity to consume. Friedman (1957) further developed this line of theory when introducing the concept of permanent-income. In what has become standard consumer theory, he argued that income consists of a permanent and a transitory part, the former being what the consumer expects to persist and the latter a non-persistent income shock. According to Friedman, consumption

depends on the permanent income part and consumers will borrow and save to smooth consumption in response to changes in the transitory income. Since in the long run the variation in income would come from the permanent part, one would observe a constant average propensity to consume, which explains the data put forth by Kuznets.

In line with these later theories, an increased household debt level would be the result of fewer borrowing restrictions, i.e. that people are able to smooth their consumption in a better way. Hence, in contrast to Keynes ideas, consumption, saving and borrowing would not depend on the income distribution. Later, Laibson (1997) introduced time-inconsistency into consumption theory, i.e. that due to present consumption bias, the agent has a problem in committing to the time-zero optimal consumption path. People will thus be more patient in the long run than in the short-run.

One of the first economists to criticize consumer theory for not considering social factors was Veblen (1899). He put forward the concept of conspicuous consumption, the idea that consumption could have the purpose to signal social status, i.e. class and wealth. Duesenberry (1949) introduced Veblen's ideas into mainstream consumption theory. He argued that consumption decisions were not a result of rational planning, but of learning and habit formation. The habit formation process can be explained as when the repetition of a stimulus diminishes the perception of and the responses to it.[3] However, the habit process could be broken without a change in prices or income by the frequency of contact with superior goods i.e. goods that in a better way fulfilled a person's needs. Duesenberry called this the demonstration effect. As consumption expenditures of others increased so would the impulse to increase one's own expenditures. Further, a high standard of consumption would contribute to a high status in society. Therefore, as Veblen suggested, he argued that people's increase in consumption would depend on the ratio of consumption to those that she associates with.

This thought was later elaborated by Abel (1990) who introduced the catching up with the Joneses utility function. In his paper, an agent derives utility depending on her consumption relative to the lagged level of aggregate consumption per capita in the economy. Abel proposed that this could explain

[3] Duesenberry took as an example a person getting a permanent reduction in income. This person will tend to continue consuming in the same way as in previous periods because she is used to doing so. Eventually she will realize that the consumption pattern will force her to give up consumption in the future and therefore she will decrease the consumption. The same stimuli for higher consumption will continue to arrive but she will learn not to react on it.

the equity premium puzzle.[4] Because of the catching up with the Joneses mechanism, individuals are more averse to volatility in consumption, and risk-free bonds therefore became more preferred relative to equity. Jordi Gali (1994) proposed that it is the current and not the lagged average consumption per capita that is relevant for comparison, an effect he referred to as keeping up with the Joneses. Campbell and Cochrane (1999) further developed the catching up with the Joneses model. In their setting an individual will also care about the so-called external habits, i.e. the lagged aggregate consumption per capita in the economy. However, in their framework, the relationship is nonlinear as agents derive utility from consumption that exceeds the habit parameter. Ljungqvist and Uhlig (2000) distinguished catching up with the Joneses from habit formation by the fact that the former leads to a consumption externality, since by increasing your consumption you do not account for the effect that this will have on the utility of other agents. They studied what policy implications this may have and found that the externality allow for positive government intervention. By introducing countercyclical taxes when the economy is booming, one prevents the agents from consuming too much and the economy from getting overheated.

The ideas of Veblen and Duesenberry have also been studied at the micro level. A paper by Chao and Schor (1996) provides empirical support for the existence of status consumption. By examining data on brand buying patterns, prices and quality of certain products, they found that there is little correlation between price and quality, and that most of the status consumption occurred when the product was visible. In 1998, Schor published a book on the same theme, called "The Overspent American". Here she described a new trend in competitive spending where consumers are not only competing with their neighbors and friends, but with the world and society as a whole. This phenomenon is explained by the emergence of advertising and how it is present everywhere in our daily lives. Even the lowest income groups are exposed to luxury consumption, making the need for these products prevalent in all income groups.

Concerning income inequality, Piketty and Saez (2003) studied the change in top income shares in the United States between 1913 and 1998 and found that there has been a significant increase in top income shares since the 1970s, resulting in a general increase in income inequality over the last three decades. Heathcote, Perri and Violante (2010) conducted a thorough study of the cross-section inequality in the United States from 1967 to 2006. They compared data from three widely used surveys; Current Population Survey (CPS), the Panel Study of Income Dynamics (PSID), and the Consumer Expenditure Survey (CEX), and

[4] The Equity Premium Puzzle literature originates in the study "The Equity Premium a Puzzle" by Mehra and Prescott in 1985 where the authors find that the historical US equity premiums was larger than one would expect from neoclassical financial economics.

provided measures of different types of income inequality. The measures showed that wage inequality has experienced a substantial increase during the period.

Related literature tries to explain the reasons behind the increase in income inequality in the US. Lemieux (2006) showed that the increase of education premium for post-secondary education has contributed to the increase in income inequality, especially to the substantial increase in top income shares. Borjas and Ramey (1995) and Roberts (2010) argued that foreign competition and offshoring provide important explanations to the increase in income inequality.

Recently, researchers have tried to evaluate the possible causal relationship between income inequality and household debt. Kreuger and Perri (2005), showed that income inequality has increased both within groups and between groups of the same characteristics (such as education, sex and race) but that consumption inequality has risen less than income inequality during 1980-2003. They argued that the rise in income inequality within groups could be explained by an increased idiosyncratic volatility of labor income. This increases the demand for credit since the agents want to smooth their consumption. They constructed a model with endogenous debt constraints and showed that if the persistence of the income process is kept constant, an increase in income volatility always leads to a smaller increase in consumption inequality within the group that shares income risk. Iacoviello (2008) also studied within group inequality. He constructed a dynamic general equilibrium model with heterogeneous agents that explain the trend of household debt in the US the years 1963-2003. He argued that the debt levels after 1980 have increased because of improved access to credit markets for households that allow them to better smooth consumption over their lifetime. Like Kreuger and Perri, Iacoviello explained the rise in debt levels by an increase in idiosyncratic income shocks that generates higher demand for insurance of falling consumption.

2.1 Our approach

We use a keeping up with the Joneses utility model to investigate a possible relationship between income inequality and household debt, and to explain the increase in household debt-to-income ratios. Previous research with this framework focused on asset pricing (Abel, 1992, Gali, 1994 and Campbell and Cochrane, 1999) and taxes (Ljungqvist and Uhlig, 2000), while there is, to the best of our knowledge, no research relating it to household debt. Like more elderly consumption literature, we propose that income distribution play a role in consumption decisions.

We construct a life-cycle model where lower income households compare their consumption to consumption of agents in the same age cohort and derive utility

from their relative consumption. We use the four groups specified in Table 1 above as income groups in our model, where group one, two and three are referred to as lower income households and group four is referred to as high-income households. Following Gali (1994), we use contemporaneous consumption instead of lagged consumption in our utility specification. A crucial assumption in our setting is that the lower income agents have time-varying keeping up utility, implying that they only care about their relative consumption when young. This can be seen either as time inconsistency, following Laibson (1997), or as a rational investment in conspicuous consumption since signaling status is likely to be more important when working. The time-varying keeping up parameter (hereby referred to as TVK-parameter), implies that as the top incomes grow, and the low-income consumers see their relative consumption levels decrease, the agents feel an urge to increase their consumption as well. This means that the young agents will borrow from themselves when old to be able to catch up. All agents have perfect foresight and there is no uncertainty.

The standard literature constructs dynamic stochastic general equilibrium (DSGE) models. Since we only want to study the relationship of rising income inequality and debt, and because of time limitation, the model is solved as a partial equilibrium. We also introduce two alternative versions of the keeping up utility function: keeping up with the neighbors and keeping up with the richest. Previous research has claimed that agents compare themselves to an average consumer, our first alteration tests if agents compare themselves to their closest neighbors, that is, income group one compare themselves with group two, group two compare themselves to group three and group three compare themselves with group four. The second alteration tests if it is the top consumer that is the target for comparison.

We model debt in two different economies, one where income inequality is lower and one where income inequality is higher. Apart from the magnitude of inequality, all else will be equal. Our hypothesis is that, in a setting with TVK-parameters, the debt-to-income ratios for the low-income households will be higher in an economy with high income inequality than in an economy with low income inequality.

3 Model

This model builds on the general overlapping generation's model (OLG) developed by Samuelson (1956) and Diamond (1965). The agents have perfect foresight and there is no uncertainty. Time is discrete. For simplicity the model abstracts from labor supply decision and capital formation and we use log preferences. Thus, income and substitution effects exactly cancel each other out.

General CRRA preferences also allow differing degrees of risk aversion, but since there is no risk in the model, we can abstract from this.

We model a small open economy with perfect capital markets. Agents enter the model at age 25, retire at 67 and die at 75, which is approximately the mean life expectancy in the US.[5] The economic life is thus 50 years. Each age cohort consists of four representative agents with different education levels, taken as proxy for permanent income.[6] In every period the agent receives an income y_{it}. Agents derive utility from consumption. All agents except the highest income group derive utility from consumption above a specific threshold value, X_{it}

3.1 Consumer problem

The utility functions of the four representative agents are:

$$U_{it} = \sum_{k=25}^{75} \beta^j log(c_{it} - X_{it}) \quad (1)$$

$$U_{4t} = \sum_{k=25}^{75} \beta^j log(c_{4t}) \quad (2)$$

where $i \in \{1,2,3\}$, $t \in \{25,..75\}$ and $j \in \{1,..50\}$

All agents discount future consumption at rate $\beta < 1$. We model three versions of the model; keeping up with the Joneses, the neighbors and the richest. In the first setting the agents care about the average consumption, in the second about the consumption of the income group that is one step up in the income ladder and in the last the consumption of the highest income group.

The keeping up with the Joneses-parameter is given by:

$$X_{it} = \alpha_{it}\bar{c}_t$$

where α is the TVK-parameter that indicates how much the agent cares about keeping up. The time index on the TVK-parameter indicates that it is time-varying. This parameter is positive while the agent is working and zero when retired. Thus, the agents will borrow from themselves when old to be able to catch up when young. $\bar{c}_t$ is the average consumption. The agents relate their consumption to the consumption of agents of the same age. 25 year olds compare themselves to other 25 year olds, and so on.

The keeping up with the neighbors-parameter X_{it} is specified, for the three groups respectively, as:

[5] US Census Bureau, 2012.
[6] As in Table 1, group one consists of people with education less than high school (HS), group two of people with HS degree, group three people with some college, group four people with at least a college degree.

$$X_{3t} = \alpha_{it} c_{4t}$$

$$X_{2t} = \alpha_{it} c_{3t}$$

$$X_{1t} = \alpha_{it} c_{2t}$$

The keeping up with the richest-parameter X_{it} is specified as:

$$X_{it} = \alpha_{it} c_{4t}$$

3.2 Budget Constraint

Low and high-income agents have the same budget constraints. Income is given and heterogeneous. Agents can consume, save or borrow in every period. The variable s_t represents savings and can either be negative or positive. In every period the agents pay back the loan or use the saving from the previous period. Agents enter and leave the economy without being indebted. Accordingly, agents maximize utility subject to the following budget constraints:

(3) $$c_{i25} + s_{i25} = y_{i25}$$

(4) $$c_{it} + s_{it} = y_{it} + (1 + r) s_{it-1} \qquad \text{where t} \in \{26, 27, \dots, 74\}$$

(5) $$c_{i75} = y_{i75} + (1 + r) s_{i74}$$

3.3 Optimization

Households maximize lifetime utility (1) or (2) subject to constraints (3), (4) and (5) by choosing consumption in each period. Below are the Lagrangian and the first order conditions.

The Lagrangian for the lower income households is

$$\ln(c_{i25} - X_{i25}) + \beta \ln(c_{i26} - X_{i26}) + \cdots + \beta^{49} \ln(c_{i74} - X_{i74}) + \beta^{50} \ln(c_{i75} - X_{i75})$$
$$+\lambda_1(y_{i25} - s_{i25} - c_{i25}) + \lambda_2(y_{i26} + s_{i25}(1 + r) - s_{i26} - c_{i26}) + \cdots$$
$$+\lambda_{50}(y_{i74} + s_{i73}(1 + r) - s_{i74} - c_{i74}) + \lambda_{51}(y_{i75} + s_{i74}(1 + r) - c_{i75})$$

giving the first order conditions:

$$u'(c_{i25}) = \frac{1}{c_{i25} - X_{i25}} - \lambda_1 = 0$$

$$u'(c_{i26}) = \frac{\beta^1}{c_{i26} - X_{i26}} - \lambda_2 = 0$$

...

$$u'(c_{i75}) = \frac{\beta^{50}}{c_{i75} - X_{i75}} - \lambda_{51} = 0$$

Solving for c_{i25} gives:

$$c_{i25} = \frac{1}{1+\beta+\beta^2+\cdots+\beta^{50}}\left[(y_{i25} + \frac{y_{i26}}{(1+r)^1} + \cdots + \frac{y_{i74}}{(1+r)^{49}} + \frac{y_{i75}}{(1+r)^{50}}) - \beta X_{i25} - \beta^2 X_{i26} - \cdots - \beta^{50} X_{i75} + \frac{X_{i26}}{(1+r)^1} + \cdots + \frac{X_{i75}}{(1+r)^{50}}\right]$$

Knowing that

$c_{i26} = \beta(c_{i25} - X_{i25})(1+r) + X_{i26}$

$c_{i27} = \beta(c_{i26} - X_{i26})(1+r) + X_{i27}$

...

$c_{i75} = \beta(c_{i74} - X_{i74})(1+r) + X_{i75}$

we can obtain values for c_{i26},..., c_{i75}

The Lagrangian for the high-income households is

$$\ln(c_{4,25}) + \beta \ln(c_{4,26}) + \cdots + \beta^{49} \ln(c_{4,74}) + \beta^{50} \ln(c_{4,75})$$
$$+\lambda_1(y_{4,25} - s_{4,25} - c_{4,25}) + \lambda_2(y_{4,26} + s_{4,25}(1+r) - s_{4,26} - c_{4,26}) + \cdots$$
$$+\lambda_{50}(y_{4,74} + s_{4,73}(1+r) - s_{4,74} - c_{4,74}) + \lambda_{51}(y_{4,75} + s_{4,74}(1+r) - c_{4,75})$$

giving the first order conditions:

$$u'(c_{4,25}) = \frac{1}{c_{4,25}} - \lambda_1 = 0$$

$$u'(c_{4,26}) = \frac{\beta}{c_{4,26}} - \lambda_2 = 0$$

...

$$u'(c_{4,75}) = \frac{\beta^{50}}{c_{4,75}} - \lambda_{51} = 0$$

Solving for $c_{4,25}$ gives:

$$c_{4,25} = \frac{1}{1+\beta+\beta^2+\cdots+\beta^{50}}\left[(y_{4,25} + \frac{y_{4,26}}{(1+r)^1} + \cdots + \frac{y_{4,74}}{(1+r)^{49}} + \frac{y_{4,75}}{(1+r)^{50}})\right]$$

Knowing that

$c_{4,26} = \beta(c_{4,26})(1+r)$

$c_{4,27} = \beta(c_{4,27})(1+r)$

…

$c_{4,75} = \beta(c_{4,75})(1+r)$

we can obtain values for $c_{4,26}$,…, $c_{4,75}$

4 Data

To study our hypothesis we need data on income, debt and consumption. The ideal would be one panel data set with these components over a long period of time in order to study several generations. Since such a data set is not available, it has to be collected from three data sets. For income and consumption we use data from the Panel Study of Income Dynamics (PSID) and the Consumer Expenditure Survey (CEX) collected by Heathcote, Perri and Violante (2010). We use the most inclusive sample of the provided data sets, sample A, which is created to represent the entire US population. This is essentially the cleaned version of the raw data. Observations have only been dropped if there is no information on age for either the head or the spouse, if there is positive labor income but zero annual hours worked and if the hourly wage reported is less than half the corresponding Federal minimum wage of that year. In the consumption data set Heathcote et al. have dropped expenditures that are unrealistic as well as households that are flagged as "incomplete income reporters". These are households that have failed to report values for major sources of income or information about taxes paid. The debt data comes from Survey of Consumer Finances (SCF), which is the most inclusive data set on household debt in the US. We have inflated and weighted this raw data. All data are expressed in year 2000 USD. We use the Bureau of Labor Statistics CPI-U series (all items) as price deflator.

Heathcote, Perri and Violante (2010) compare the three micro data sets PSID, CEX and CPS. They conclude that the data sets are comparable and overall tell a consistent story. There is however some differences between the data sets. In CEX the unit of analysis is households while in the PSID it is family unit, i.e. persons living together that are often related by blood, marriage or adoption.

Furthermore, all labor market statistics in the PSID refer to family unit head or spouse but in the CEX also other adult household members are included.[7]

To ensure comparability between the data sets and the two periods, we study the change in family size for each of the education group. Table 14 in Appendix 3 shows that the average family size has been relatively constant in the data sets.

Furthermore, we compare the share of households with zero debt in the two periods. If the share differs considerably this could be an indication of a change in borrowing restrictions between the periods. We find that it has decreased somewhat. In 1983 the share of households with zero reported debt was 28 percent, in 2002 the same share was 24 percent. This could indicate that the borrowing restrictions have decreased somewhat, however the change is relatively small.

4.1 Four income groups

We use level of education as a proxy for permanent income. The data sets originally included 17 education levels, which we pooled into four education groups (referred to as income groups). The first group consists of people with no or some high school degree, the second group people with a high school degree, the third group people with some college, and the fourth group people with a college degree or more. The reason for studying education groups instead of groups based on income is that people tend to move in and out of different income groups during their lifetime. We have removed women from all groups since the labor participation rate for females has increased during the period we are studying. Including them in the sample would have made the income groups less comparable.

4.2 Time periods

All analysis will be based on assuming steady state qualities of the data, since the model has neither uncertainty nor any capital formation process. We want to model debt in two different time periods, one period with lower income inequality and one period with higher income inequality.

Data on income is available from the years 1967-2002. We choose to study two periods of the same length, the first being 1985-1989 and the second 1998-2002. The first one is chosen in order to have a period where income inequality was lower than in the second period and to include the first year of comparable debt

[7] A family unit head is defined as the oldest male, at least 16 years old, with the most financial responsibility. If this person is female and she has a husband in the family unit, then he is selected as head.

data, 1989. The second period ends in year 2002, which is the last year from which we have available income data.

For debt we have comparable data from 1989 and every third year up until 2010.[8] We choose to study debt in year 1989 and 2001. This is the first and last year that we obtained comparable data to match with our income data.

For consumption we have available data between the years 1980-2007. We choose to study the same period as for income, 1985-1989 and 1998-2002. It is preferable to compare several years in order to diminish the impact of year specific effects. However, due to lack of data, we can only use one year of debt data.

4.3 Household income

For household income, we use data from PSID. The survey has been conducted at least once a year since 1968 and contains values on income and other household characteristics. The data set used for this particular survey is compiled by Heathcote, Violante & Perri (2010). Since we do not have wealth data, the model does not consider income from assets. We therefore study household labor income after taxes and transfers. The PSID data set includes a great variety of income measures, where disposable income is the most appropriate since it includes earnings (labor income plus 50 percent of self-employment income) after tax and transfers, and also total asset income. Since we do not account for wealth, financial assets are removed from the income measure. Due to data limitations it is removed before tax, making the measure somewhat biased. However, this is likely to result in a bias towards lower income inequality, which does not favor our research question.[9] We use the income data to construct income profiles that are used as input in our model to generate debt and consumption levels. In the first period between 1985 and 1989 we have 12,516 observations and in the second period we have 9,523 observations.

4.4 Household debt

The data on household debt comes from Survey of Consumer Finances (SCF), which is a survey conducted every third year and is sponsored by the Federal Reserve Board and the Department of Treasury. The data set includes information on income and education as well as detailed information on household debt. We have weighted the raw data from the surveys in order to

[8] There is also data available from 1983 and 1986, but these surveys differ from the ones done in later years.

[9] Since higher income groups tend to have higher wealth. This is discussed in a paper by Diamond, et al. (2006) where they conclude that wealth is higher among high-income groups. However, the spread also tends to be higher as income increases.

correct for irregularities such as nonresponse and deviations from known population totals. For more information about the weights and how they are constructed we refer to Kennickell and Woodburn (1999).[10] The debt data is used for comparison with model output. In 1989 we have 11,380 observations and in 2001 19,499 observations.

4.5 Consumption

The Consumer Expenditure Survey (CEX) is the only US data set that provides detailed information about household consumption expenditures and is collected by the Bureau of Labor Statistics by the Census Bureau. There is consistent data from 1980. We use data from the quarterly interview survey and transform it to annual data. The consumption data is used for comparison with the model output. In the first period between 1985 and 1989 we have 25,894 observations and in the second period we have 32,591 observations.

5 Simulated Scenarios

To test whether our model is able to account for the main stylized fact observed in the data, we calibrate the model to an initial steady state economy. The first economy will be like the US before 1989. We compare the model outputs to a second steady state economy, which resembles the US after 1998, where income inequality is higher. Once we have derived parameter values for the first economy, the model generates debt and consumption values for the first and the second economy. We use Matlab to calibrate the model for 50 periods, each period representing one year. We assume that income is exogenous and that the income levels are the only difference between the two economies. Each period in the model represents one year in the real world.

5.1 Profiles

We construct income and consumption profiles for the four income groups. We find the profiles for the first period by a simple OLS-regression.

$$dispinc = \beta_0 + \beta_1 age + \beta_2 age^2 + \beta_3 age^3 + \beta_4 age^4 + \beta_5 educ\_period1$$

$$+\beta_6 educ\_period2 + \beta_7 period2$$

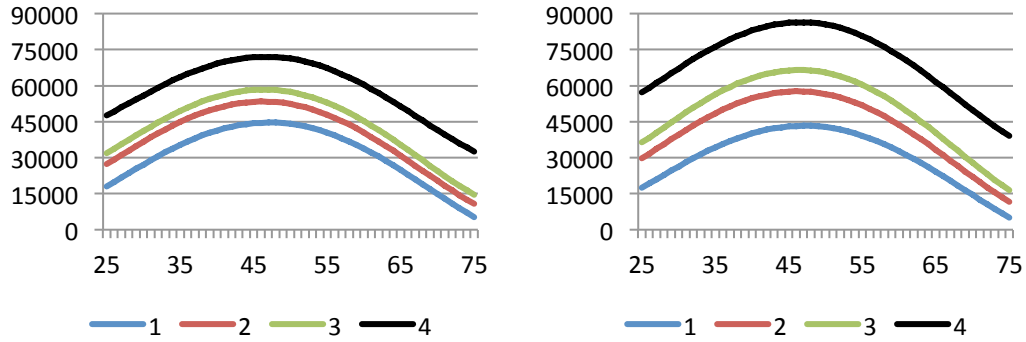
We do this regression for each of the four income groups. We include an age variable in order to see how the income changes over age, and age taken to the power of two, three and four to allow for a curvature of the profile. $educ\_period1$ and $educ\_period2$ are interaction variables including an education dummy specifying the respective income groups and period dummies for each of the two

[10] Unlike PSID and CEX the SCF data set was not weighted, the weight variable was, however, available in the raw data set.

economies that we are comparing. The variable *period*2 is a dummy variable for period two (1998-2002). The first period (1985-1989) is the base in this regression.

During the periods studied the labor market participation of women has changed, in order to have comparable groups in the two periods we therefore choose not to include women in the analysis. Since we want to isolate the effect of an increase in income inequality, the incomes should change only by level, and not by curvature. In order for the profile curvature to remain fixed, we estimate the average changes in incomes for the four groups between the two time periods. Comparing the means shows that the incomes for group four increased by 20 percent between these periods, for group three incomes increased by 14 percent, for group two by 8 percent and for group one average income decreased by 3 percent. We use these measures to estimate the profiles for the second period. Figure 2 shows the income profiles for the first period, to the left, and the second period, to the right. The figures show that using education as a proxy gives four different income profiles where the level of income increases with education.

FIGURE 2: Income profiles, 1985-1989 and 1998-2002.



The X-axis represents ages and the Y-axis represents incomes in USD.

We use the income profiles as input in the model and compare the model output of debt-to-income with the means estimated from data to see whether our model can replicate the actual data.

5.2 Keeping up with the Joneses

Most previous research has looked at catching up with the Joneses (Abel, 1990 and Ljungqvist and Uhlig, 2000) where agents compare their consumption to the average consumption in the previous period. In our setting, however, the effect is assumed to be more or less direct and agents compare themselves with the

average consumption in the same period, in line with the research by Gali (1994). [11]

As a first test, we set all TVK-parameters to zero to evaluate how well a baseline OLG model without a TVK-parameter can match the real world data (see Table 3). The results from this baseline model show that the debt-to-income ratios in the first economy are exactly the same as in the second economy, since the growth in incomes are symmetrical all over the agents' life-cycles. This indicates that a baseline OLG-model cannot explain the increase in debt-ratios.

When introducing TVK-parameters into the model we set the parameters to match the debt-to-income ratios for the year 1989, reported in Table 2, column two. β is calibrated to 0.9673 to match the debt-ratio for group four. This is plausible since the benchmark value is between 0.95 and 0.97. The three TVK-parameters are then calibrated to match the respective debt-ratio for the three lower income groups. The TVK-parameters are positive as long as the agents work, but when they retire at age 67 we set the parameters to zero. Table 3 shows the calibrated parameter values. We set the real interest rate r to a benchmark value at 0.02, which is in line with US data during this period.

TABLE 2
Debt-to-income ratios from data

Group	*1985-1989*	*1998-2002*	*Difference*
1	0.581	0.917	58%
2	0.829	1.060	28%
3	0.962	1.146	19%
4	1.304	1.475	13%

Source: Debt data from Survey of Consumer Finances 1989 and 2001, and income data from PSID.

TABLE 3
Calibrated Parameter Values - Keeping up with the Joneses

Parameter	*Interpretation*	*Value*
β	Discount factor	0.9673
α_1	TVK-parameter, group 1	0.0144
α_2	TVK-parameter, group 2	0.1182
α_3	TVK-parameter, group 3	0.1049

[11] The average consumption in each period is found by an iterative estimation process, until our estimate of average consumption exactly equals the model output.

When introducing the TVK-parameters, there is a major change in debt-to-income levels for the low-income groups, compared to the baseline model. Table 4 reports the values from the model with TVK-parameter values.

TABLE 4
Debt-to-income ratios from model
Keeping up with the Joneses

Group	*1985-1989*	*1998-2002*	*Difference*
1	0.581	0.591	1.72%
2	0.829	0.843	1.69%
3	0.962	0.955	-0.73%
4	1.304	1.304	0.00%

A baseline OLG model with keeping up to the Joneses utility shows that, in line with our hypothesis, the debt-to-income ratios for group one and two are larger in the economy with higher income inequality than in the economy with lower income inequality. In accordance with data it is now the first group, followed by the second group, who experienced the largest increase in debt-to-income between the periods. However, our model cannot explain the full increase in debt-to-income ratios and we do not get the expected result for group three. For group four the results are the same as in the baseline model, since they do not have a TVK-parameter.

Figure 3 and Figure 4 (see Appendix 4) show the output from our Matlab calibration.

5.3 Keeping up with the neighbors

In this second alteration the agents will compare themselves with their closest neighbors. Table 5 presents the calibrated parameter values.

TABLE 5
Calibrated Parameter Values – Keeping up with the neighbors

Parameter	*Interpretation*	*Value*
β	Discount factor	0.9673
α_1	TVK-parameter, group 1	0.0147
α_2	TVK-parameter, group 2	0.1082
α_3	TVK-parameter, group 3	0.0731

Table 6 presents the debt-to-income ratios from the model with keeping up to the neighbors utility. Figure 5 and Figure 6 (see Appendix 4) show the output from our Matlab calibration.

TABLE 6
Debt-to-income ratios from model
Keeping up with the neighbors

Group	*1985-1989*	*1998-2002*	*Difference*
1	0.581	0.588	1.20%
2	0.829	0.852	2.77%
3	0.962	0.979	1.77%
4	1.304	1.304	0.00%

In this setting the debt ratio of group two and three is better explained but the debt-ratio for group one is lower than when the comparison is made with the average consumer.

5.4 Keeping up with the richest

In our third alteration we want to evaluate how the results change if we use consumption of the highest income group as relative consumption value. Table 7 reports the parameter values for the calibration and Table 8 reports the model outputs.

TABLE 7
Calibrated Parameter Values – Keeping up with the richest

Parameter	*Interpretation*	*Value*
β	Discount factor	0.9673
α_1	TVK-parameter, group 1	0.0101
α_2	TVK-parameter, group 2	0.0826
α_3	TVK-parameter, group 3	0.0731

TABLE 8
Debt-to-income ratios from model
Keeping up with the richest

Group	*1985-1989*	*1998-2002*	*Difference*
1	0.581	0.596	2.58%
2	0.829	0.875	5.55%
3	0.962	0.979	1.77%
4	1.304	1.304	0.00%

When changing the relative consumption value from the consumption of the neighbors to the consumption of the rich, we see that the levels in period two are slightly better matched for group one and two. Just like in the previous setting, group three care about the consumption of group four and the results will be the same. The debt-to-income ratios in the second economy are, however, still highly underestimated.

Figure 7 and Figure 8 (see Appendix 4) show the output from our Matlab calibration.

Table 9 below displays a comparison of the debt-to-income ratios in the second economy between the three different models with keeping up utility and the baseline model with no keeping up utility and data. It clearly shows that all three models highly underestimate the debt-to-income ratios compared to the data. However, all three models with keeping up utility perform better than the baseline OLG-model. The table further shows that the three setting perform differently well for the three different groups. The model that best captures the debt-to-income ratios in the second economy is keeping up with the richest.

TABLE 9
Debt-to-income ratios in the second economy from data, baseline model and the three keeping up models

Group	*Data*	*(1)*	*(2)*	*(3)*	*(4)*
1	0.917	0.581	0.591	0.588	0.596
2	1.060	0.829	0.843	0.852	0.875
3	1.146	0.962	0.955	0.979	0.979
4	1.475	1.304	1.304	1.304	1.304

(1) Baseline model without keeping up utility, (2) Keeping up with the Joneses, (3) Keeping up with the neighbors, (4) Keeping up with the richest.

We conclude that even though the models with keeping up utility cannot capture the magnitude of debt-to-income in the second economy, it performs better than the baseline OLG-model which suggest that keeping up utility is an interesting mechanism in explaining the increase in debt-to-income between 1989 and 2002 for the three lowest income groups.

Lastly, we compare the debt, consumption and debt-to-income profiles from the model with profiles from data to see how well the model can replicate the life-cycle patterns of the agents, the data profiles can be found in Appendix 5. We find that the debt profiles from the model follows the same pattern as the data profiles, peaking around age 35. The levels, however, are somewhat overestimated. The consumption profiles from the model do not correspond well to the profiles from data. The highest consumption levels in the profiles from the model occur at age 25 and diminish throughout life, whereas in the data the profile is hump shaped and peaks around age 45. Further, the consumption levels from the model are underestimated compared to data. Lastly, the debt-to-

income profiles from the model roughly match the trend in data, but not the magnitude. These results will be discussed in section 6.

5.5 Robustness

To check the sensitivity of our results we perform two robustness checks.

We first checked the sensitivity to changes in the real interest rate, *r*, and finds that changing *r* within the context of the benchmark specification does not alter our findings.

We also test whether the results are sensitive to the period chosen for steady state calibration by calibrating the first period to 1983-1989 and the second period to 1995-2002. The results for all three models are presented in Appendix 6. It shows that the magnitudes are somewhat different. However, the results do not affect the trends in growth between the four income groups and we conclude that our results are robust to changes in calibration periods.

6 Discussion

Even though we only capture a small part of the change in debt-to-income, our calibration shows that there is a plausible relationship between income inequality and household debt. When introducing a keeping up parameter in a standard lifecycle model the debt ratios for the lower income households are higher in the economy with higher income inequality, which is in line with our hypothesis. Our model provides an alternative explanation to the increase in household debt in the last decades and contributes to the previous findings by Krueger and Perri (2005) and Iacoviello (2008).

An interesting result is that one of our new alterations, keeping up with the richest, gave the best results. This suggests that consumers, regardless of income level, compare themselves with the richest in the society, which is in line with the research by Schor (1999). One might further expect that if we would add a TVK-parameter to group four, allowing them to compare their consumption with, for example, the top one percent income earners in the US, we would see a change in their debt-to-income ratios as well.

When comparing the levels of the TVK-parameters between the different income groups we find that group one has the lowest value of their TVK-parameter in all models. This can be interpreted as that they care less about their relative consumption than income group two and three. For group two and three the values of the TVK-parameters are similar. This is perhaps not so surprising, since the levels of the income profiles for these groups are very close (see Figure 10) and both have experienced a similar change in income between the periods (see Table 1).

A concern with the model is the fact that we cannot capture the magnitudes of debt and consumption. There are several possible explanations for the differences in magnitudes between the model and data. The first, and most obvious one, is the simplicity of our model. Since we leave out a number of factors that would make our model more realistic, we cannot expect to capture the magnitudes in real life data. Our main purpose was however to test whether a simple life-cycle model with a TVK-parameter could explain the change in debt patterns that occurred at the same time as income inequality increased. To explain the full data variation in debt, we would need to consider more factors in the economy. It would in that case be preferable to construct a full-scale DSGE model including wealth, a production function and a labor-leisure choice. In a DSGE model with TVK-parameters we would expect that an increased demand of debt would increase interest rates, which in turn, would affect capital accumulation and prices in the economy. Still, we find it likely that the TVK-parameters would have a similar effect in a DSGE model as in the model we use in our thesis. Lastly, one could also include credit constraints in the model. These developments would likely increase the understanding of the different factors that affect debt.

To make the simulation more realistic it would be preferable to model a real transition. Among the main caveats with our model and the setting are our steady state assumptions and the fact that we are not considering a transition period. These assumptions are made for simplicity and to make the analysis more clear. In order to solve for a transition we would need to look at a longer time period and consider the agents' expectations about the future. In our setting we instead solve for two separate steady states or economies. Due to data limitation we had to solve for two steady states that are quite closely related in time. However, one positive aspect with looking at these two periods is that debt constraints in the economies are likely to be more similar than if we looked at a longer time span.

Moreover, the model is contingent on a crucial assumption, namely that the lower income groups want to borrow from themselves when old in order to consume more when young. However, we find this assumption plausible since research on time-inconsistency shows that people are less patient in the short-run. It is also likely that time-inconsistency varies with the level of education with lower educated people being more time-inconsistent. Further, this can also be analyzed as a rational investment in conspicuous consumption since signaling status is likely to be more important when working. Being in working age, compared to being retired, tend to include more situations where signaling status is important, such as applying for jobs, being promoted, finding a partner, buying a house and applying for a mortgage.

For further research it would be interesting to evaluate the external validity of the model by looking at different countries. As mentioned above, this trend is apparent in the majority of the OECD countries, something that motivates an expansion of the study to include by including more countries. It would also be interesting to allow for different types of debts in the model, such as mortgage debt and consumption debt, to see if the mechanism differs between these types of loans. Further, one could introduce taxation to the model and study the impact of different taxes on debt levels in an economy with keeping up preferences. Lastly, in our setting, the agents care about the consumption of other agents of the same age, however, one could test for other alternatives, for example that an agent compares herself to an average consumer in a certain age span.

7 Concluding remarks

Our hypothesis is that, in a setting with TVK-parameters the debt-to-income ratios for the lower income households will be higher in an economy with high income inequality than in an economy with low income inequality, ceteris paribus.

We can confirm our hypothesis, for all of the three lowest income groups in the settings with keeping up with the richest and keeping up with the neighbors. In the setting with keeping up to the Joneses, the hypothesis is only confirmed regarding the lowest income groups, group one and two. However, none of the models can fully capture the magnitudes of debt-to-income in the second economy.

In conclusion, the results suggest that keeping up utility is an interesting mechanism in explaining the increase in debt-to-income between 1989 and 2002 for the lower income groups. For further research it would be interesting to make the model more realistic by constructing a full DSGE-model. This would further increase the understanding of the different factors that drive debt.

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Appendix 1. Difference in consumption and income inequality in data

TABLE 10
Consumption as a percentage of group 4's consumption

Group	*1985-1989*	*1998-2002*	*Difference*
1	57%	55%	-5%
2	74%	71%	-3%
3	86%	82%	-4%
4	100%	100%	--

TABLE 11
Income as a percentage of group 4's income

Group	*1985-1989*	*1998-2002*	*Difference*
1	49%	40%	-19%
2	66%	59%	-9%
3	76%	72%	-5%
4	100%	100%	--

TABLE 12
Consumption as a percentage of group 4's consumption

Group	*1983-1989*	*1996-2002*	*Difference*
1	57%	55%	-4%
2	74%	71%	-4%
3	86%	83%	-4%
4	100%	100%	--

TABLE 13
Income as a percentage of group 4's income

Group	*1983-1989*	*1996-2002*	*Difference*
1	50%	39%	-23%
2	67%	60%	-11%
3	77%	72%	-6%
4	100%	100%	--

Appendix 2. Step-By-Step Derivations

For the lower income households

Log utility function:

$E(U) = log\ \beta^j(c_{it} - X_{it})$

where $i \in \{1,2,3\},\ t \in \{25,..75\}$ and $j \in \{1,..50\}$

For three periods:

$$\ln(c_{i25} - X_{i25}) + \beta \ln(c_{i26} - X_{i26}) + \cdots + \beta^{49} \ln(c_{i74} - X_{i74}) + \beta^{50} \ln(c_{i75} - X_{i75})$$
$$+\lambda_1(y_{i25} - s_{i25} - c_{i25}) + \lambda_2(y_{i26} + s_{i25}(1+r)^1 - s_{i26} - c_{i26}) + \cdots$$
$$+\lambda_{50}(y_{i74} + s_{i73}(1+r) - s_{i74} - c_{i74}) + \lambda_{51}(y_{i75} + s_{i74}(1+r)^{50} - c_{i75})$$

First order conditions:

$$u'(c_{i25}) = \frac{1}{c_{i25} - X_{i25}} - \lambda_1 = 0$$

$$u'(c_{i26}) = \frac{\beta^1}{c_{i26} - X_{i26}} - \lambda_2 = 0$$

…

$$u'(c_{i75}) = \frac{\beta^{50}}{c_{i75} - X_{i75}} - \lambda_{51} = 0$$

By also taking the derivative of s_{it} and by substitution we get:

$$\frac{\frac{1}{c_{i25} - X_{i25}}}{\frac{\beta}{c_{i26} - X_{i26}}} = (1+r)^1$$

…

$$\frac{\frac{\beta^{49}}{c_{i74} - X_{i74}}}{\frac{\beta^{50}}{c_{i75} - X_{i75}}} = (1+r)^{50}$$

By solving for c_{i26},…, $c_{i75}$and inserting c_{i26} into c_{i27} and so forth we get:

$$c_{i26} = \beta(c_{i25} - X_{i25})(1+r)^1 + X_{i26}$$

$$c_{i27} = \beta^2(c_{i25} - X_{i25})(1+r)^2 + X_{i27}$$

…

$$c_{i75} = \beta^{50}(c_{i25} - X_{i25})(1+r)^{50} + X_{i75}$$

Inserting into the inter-temporal budget constraint

$$c_{25t} + \frac{\beta^1(c_{i25} - X_{25t})(1+r)^1 + X_{i26}}{(1+r)^1} + \frac{(\beta^2(c_{i25} - X_{i25})(1+r)^2) + X_{i27}}{(1+r)^2} + \cdots$$

$$+ \frac{(\beta^{50}(c_{i25} - X_{i25})(1+r)^{50}) + X_{i75}}{(1+r)^{50}} = y_{i25} + \frac{y_{i26}}{(1+r)^1} + \cdots + \frac{y_{i75}}{(1+r)^{50}}$$

Solving for c_{i25} gives:

$$c_{i25} = \frac{1}{1+\beta+\beta^2+\cdots+\beta^{50}}\Big[(y_{i25} + \frac{y_{i26}}{(1+r)^1} + \cdots + \frac{y_{i74}}{(1+r)^{49}} + \frac{y_{i75}}{(1+r)^{50}}) - \beta X_{i25} - \beta^2 X_{i26} - \cdots - \beta^{50} X_{i75} + \frac{X_{i26}}{(1+r)^1} + \cdots + \frac{X_{i75}}{(1+r)^{50}}\Big]$$

We can now solve for c_{i26},..., c_{i75} knowing that

$c_{i26} = \beta(c_{i25} - X_{i25})(1+r)^1 + X_{i26}$

$c_{i27} = \beta^2(c_{i25} - X_{i25})(1+r)^2 + X_{i27}$

...

$c_{i75} = \beta^{50}(c_{i25} - X_{i25})(1+r)^{50} + X_{i75}$

For the high-income households

Log utility function:

$E(U) = log\ \beta^j(c_{4t})$

where $t \in \{25,..75\}$ and $j \in \{1,..50\}$

For three periods

$$\ln(c_{4,25}) + \beta \ln(c_{4,26}) + \cdots + \beta^{49} \ln(c_{4,74}) + \beta^{50} \ln(c_{4,75})$$
$$+\lambda_1(y_{4,25} - s_{4,25} - c_{4,25}) + \lambda_2(y_{4,26} + s_{4,25}(1+r) - s_{4,26} - c_{4,26}) + \cdots$$
$$+\lambda_{50}(y_{4,74} + s_{4,73}(1+r) - s_{4,74} - c_{4,74}) + \lambda_{51}(y_{4,75} + s_{4,74}(1+r) - c_{4,75})$$

giving the first order conditions:

$$u'(c_{4,25}) = \frac{1}{c_{4,25}} - \lambda_1 = 0$$

$$u'(c_{4,26}) = \frac{\beta^1}{c_{4,26}} - \lambda_2 = 0$$

…

$$u'(c_{4,75}) = \frac{\beta^{50}}{c_{4,75}} - \lambda_{51} = 0$$

By also taking the derivative of s_{4t} and by substitution we get:

$$\frac{\frac{1}{c_{4,25}}}{\frac{\beta}{c_{4,26}}} = (1+r)^1$$

…

$$\frac{\frac{\beta^{49}}{c_{4,74}}}{\frac{\beta^{50}}{c_{4,75}}} = (1+r)^{50}$$

By solving for $c_{4,26}$,…, $c_{4,75}$and inserting $c_{4,26}$ into $c_{4,27}$ and so forth we get:

$$c_{4,26} = \beta(c_{4,25})(1+r)^1$$

$$c_{4,27} = \beta^2(c_{4,25})(1+r)^2$$

…

$$c_{4,75} = \beta^{50}(c_{4,25})(1+r)^{50}$$

Insert into inter-temporal budget constraint

$$c_{4,25} + \frac{\beta^1(1+r)^1 c_{4,25}}{(1+r)^1} + \frac{\beta^2(1+r)^2 c_{4,25}}{(1+r)^2} + \cdots$$

$$+ \frac{\beta^{50}(1+r)^{50} c_{4,25}}{(1+r)^{50}} = y_{4,25} + \frac{y_{4,26}}{(1+r)^1} + \cdots + \frac{y_{4,75}}{(1+r)^{50}}$$

Solving for $c_{4,25}$ gives:

$$c_{4,25} = \frac{1}{1+\beta+\beta^2+\cdots+\beta^{50}}\left[(y_{4,25} + \frac{y_{4,26}}{(1+r)^1} + \cdots + \frac{y_{4,74}}{(1+r)^{49}} + \frac{y_{4,75}}{(1+r)^{50}})\right]$$

We can now solve for $c_{4,26}$,…, $c_{4,75}$ knowing that

$$c_{4,26} = \beta(c_{4,25})(1+r)^1$$

$$c_{4,27} = \beta^2(c_{4,25})(1+r)^2$$

…

$$c_{4,75} = \beta^{50}(c_{4,25})(1+r)^{50}$$

Appendix 3. Change in family size

The table below describes the change in family size between our two model periods, 1985-1989 and 1998-2002. The composition of family size has changed somewhat in the data sets, but the difference is relatively small, which enhances comparability between the two time periods.

TABLE 14
Absolute difference in average family size

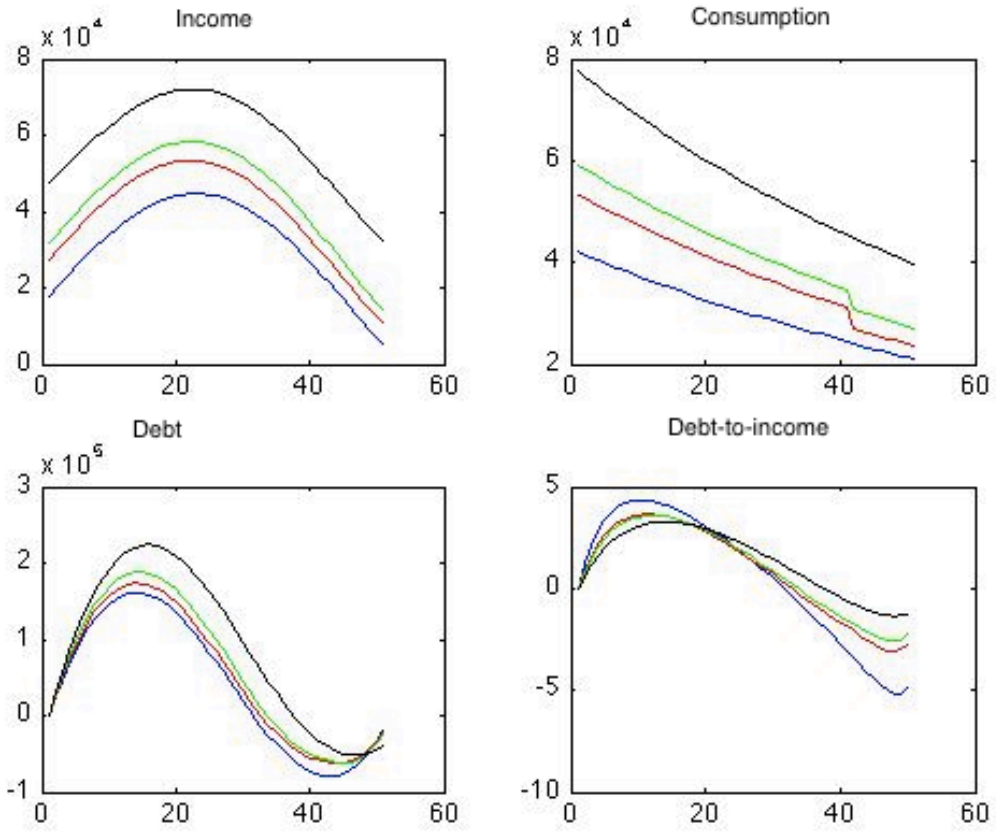
Group	PSID	SCF	CEX
1	-0.130	-0.007	0.224
2	-0.230	-0.115	0.119
3	-0.269	0.026	0.012
4	-0.062	0.011	-0.078

Source: SCF and PSID data.

Appendix 4. Model outputs

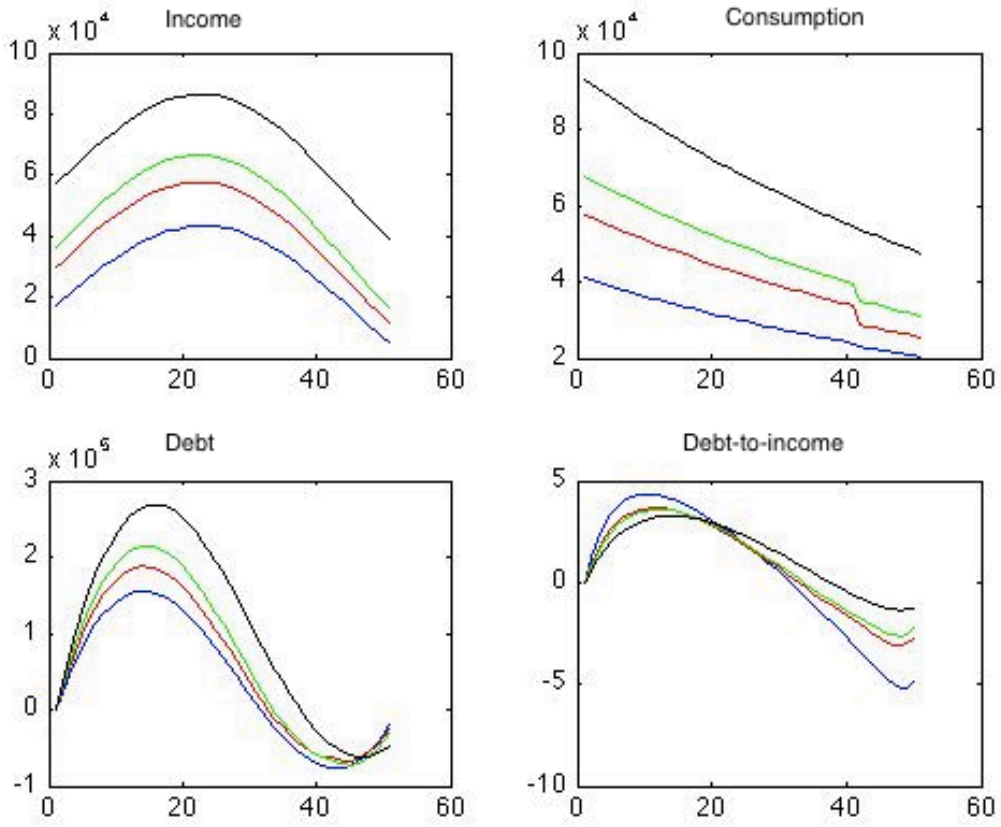
Keeping up with the Joneses

FIGURE 3: Model outputs for the first economy (1985-1989)



The first box from the left shows the income profiles for the four different income groups. The black line represents group four, the green group three, the red group two and the blue line represents group one. Box 2 shows the consumption profiles. Box 3 shows the debt profiles. Debt is positive and savings are negative. The graph shows that he agents borrow from themselves in the future and borrow to consume more when they are young and they have positive TVK-parameters. In all figures, 0 on the x-axis represents age 25, 20 age 45 and 40 age 65. Figure 4 below shows the model outputs for the second economy.

FIGURE 4: Model outputs for the second economy (1998-2002)



Keeping up with the neighbors

FIGURE 5: Model outputs for the first economy (1985-1989)

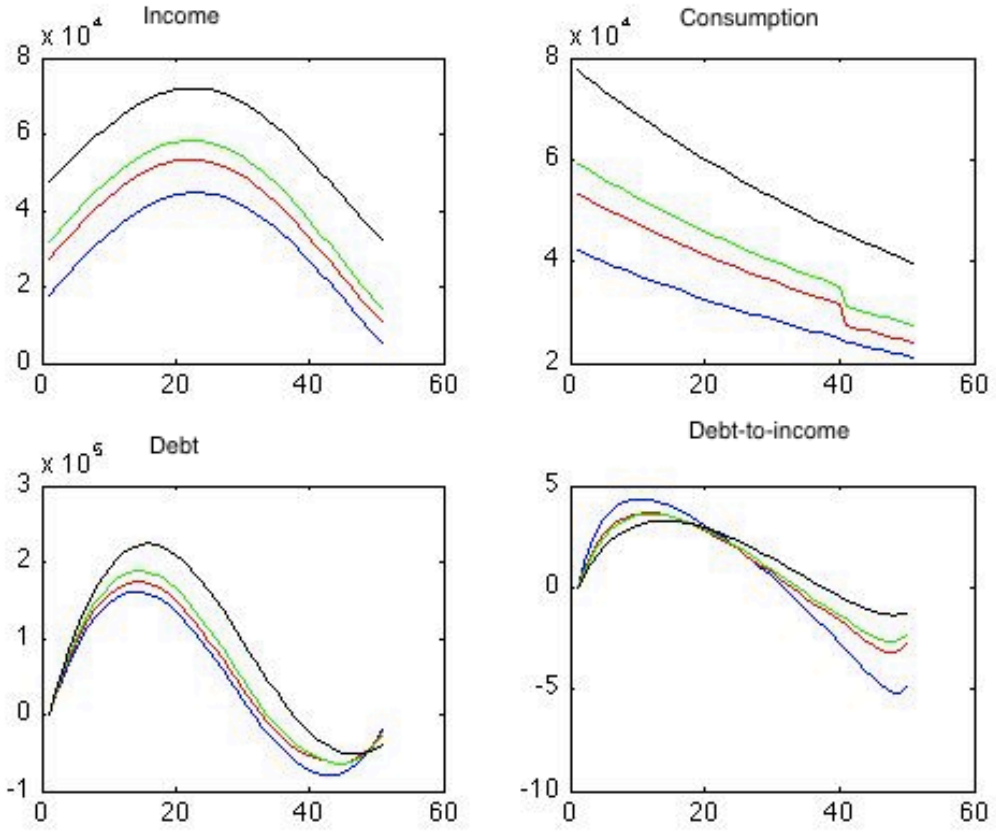
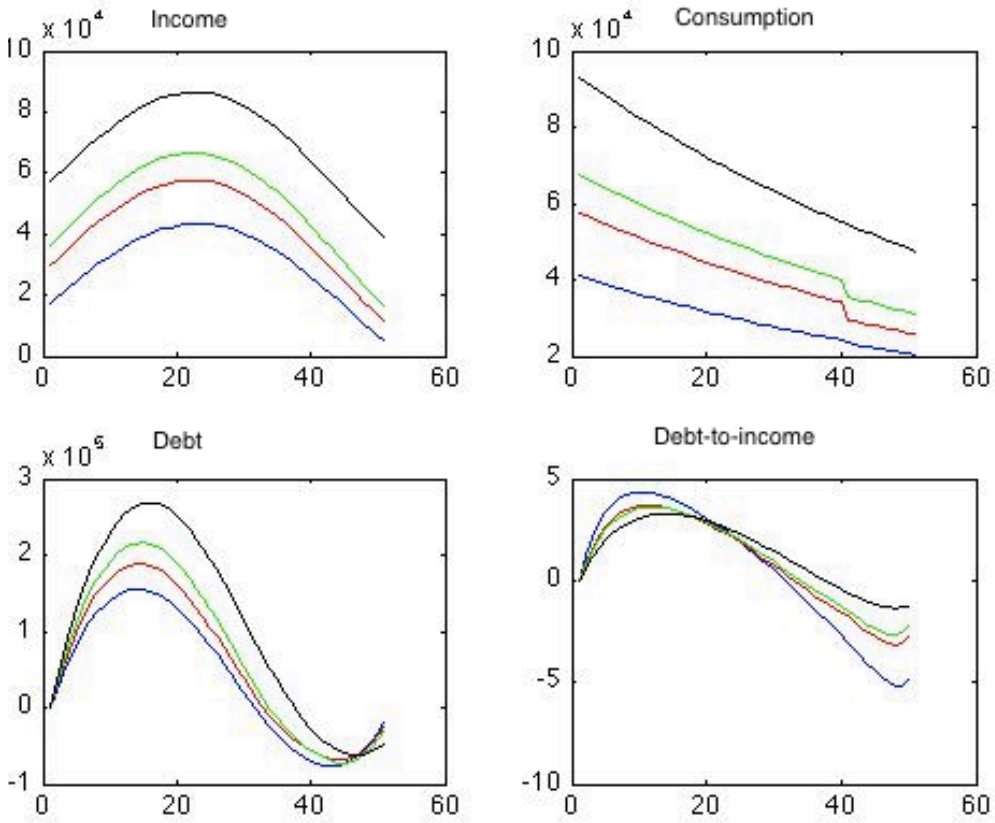


FIGURE 6: Model outputs for the second economy (1998-2002)



Keeping up with the richest

FIGURE 7: Model output for the first economy (1985-1989)

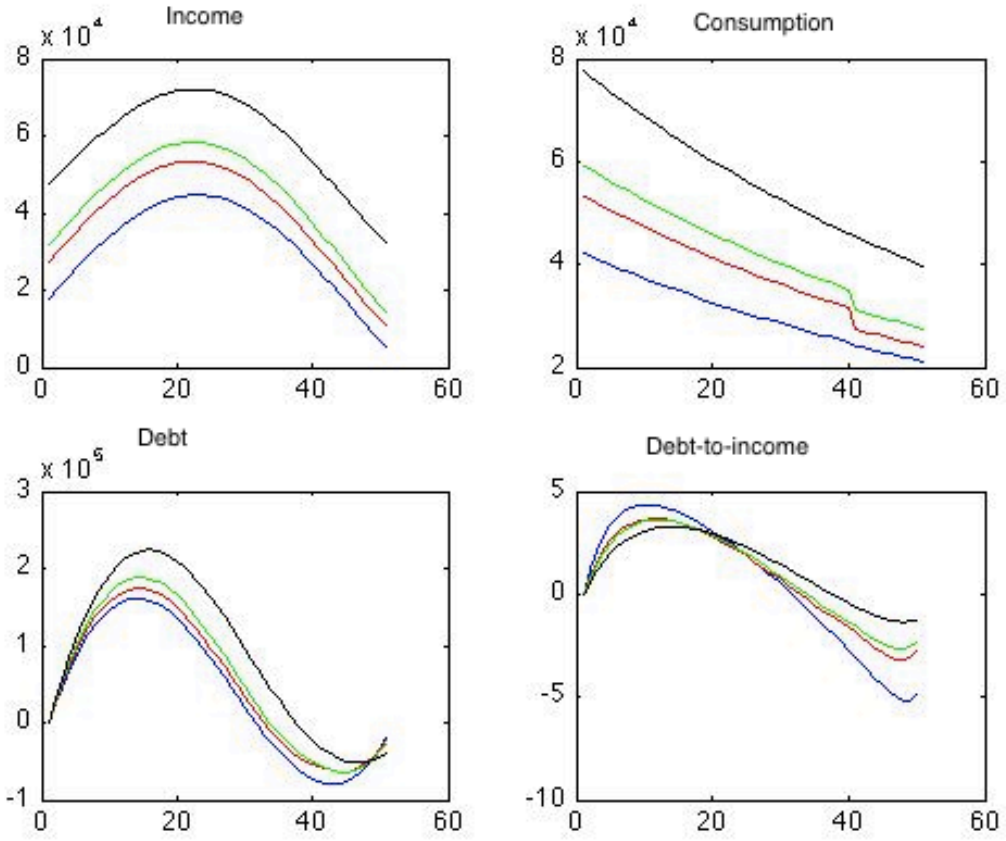
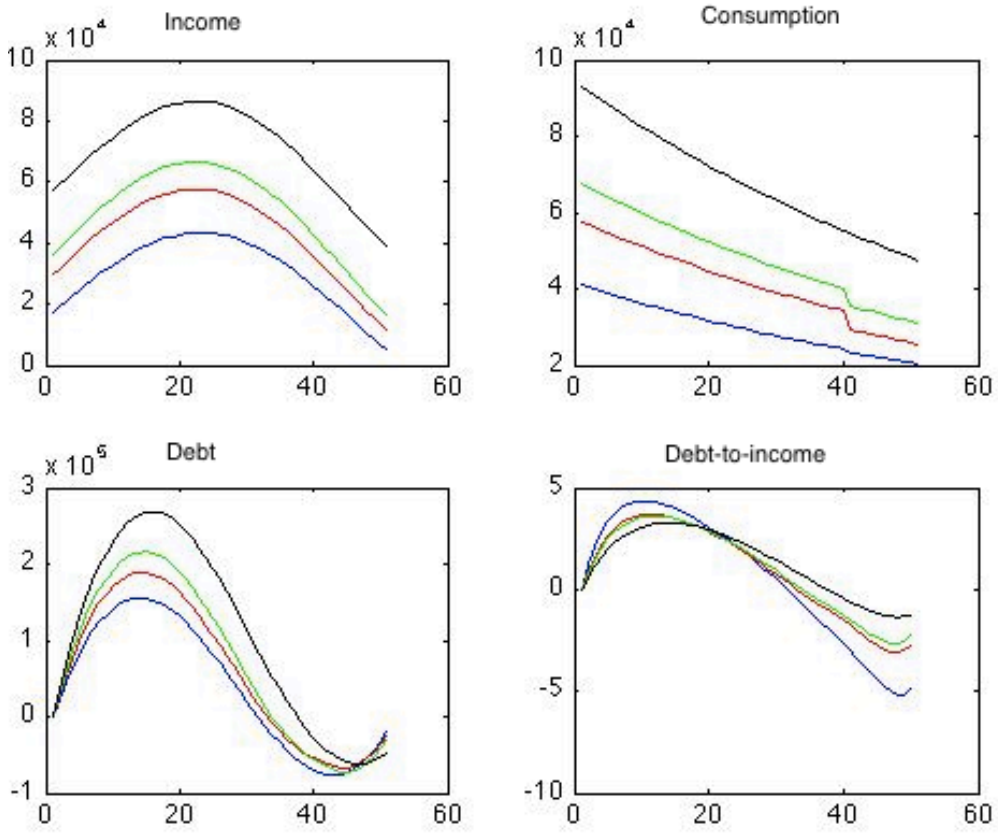


FIGURE 8: Model outputs for the second economy (1998-2002)



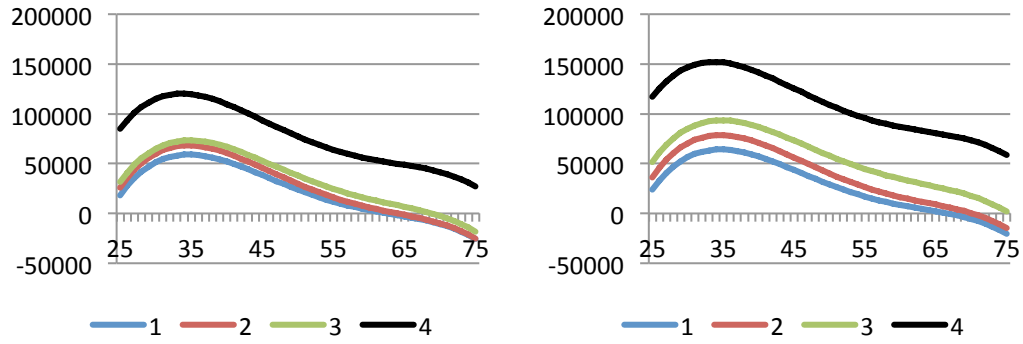
Appendix 5. Debt, consumption and debt-to-income profiles

All profiles have been estimated with an OLS-regression, using the same variables as equation 6.

Debt profiles

(7) $$totaldebt = \beta_0 + \beta_1 age + \beta_2 age^2 + \beta_3 age^3 + \beta_4 age^4 + \beta_5 educ\_period1 + \beta_6 educ_{period2} + \beta_7 period2$$

FIGURE 9: Debt profiles year 1989 and 2001

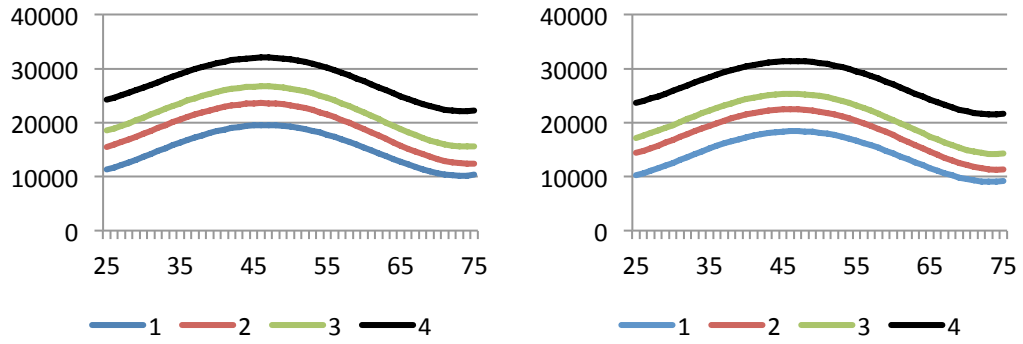


The X-axis represents ages and the Y-axis represents debt in USD.

Consumption profiles

(8) $$consumption = \beta_0 + \beta_1 age + \beta_2 age^2 + \beta_3 age^3 + \beta_4 age^4 + \beta_5 educ\_period1 + \beta_6 educ_{period2} + \beta_7 period2$$

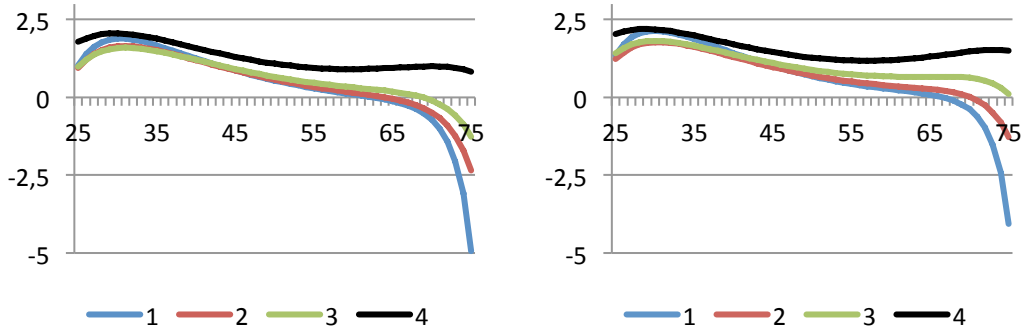
FIGURE 10: Consumption profiles, 1985-1989 and 1998-2002



The X-axis represents ages and the Y-axis represents consumption in USD.

Debt-to-income profiles

FIGURE 11: Debt-to-income profiles, 1985-1989 and 1998-2002



The X-axis represents ages and the Y-axis represents debt-to-income.

Appendix 6. Robustness

To test if the sensitivity of our results to the chosen time periods we estimated income profiles for slightly different time periods by adding two years to each time period. The first economy is now 1983 to 1989 and the second economy is 1996 to 2002.

Output from data

TABLE 15
Debt-to-income ratios from data

Group	*1983-1989*	*1996-2002*	*Difference*
1	0.583	0.951	63.00%
2	0.839	1.074	28.13%
3	0.982	1.175	19.63%
4	1.345	1.505	11.94%

Outputs from model

TABLE 16
Calibrated Parameter Values – Keeping up with the Joneses

Parameter	*Interpretation*	*Value*
β	Discount factor	0.9668
α_1	TVK-parameter, group 1	0.0046
α_2	TVK-parameter, group 2	0.1180
α_3	TVK-parameter, group 3	0.1074

TABLE 17
Debt-to-income ratios from model
Keeping up with the Joneses

Group	*1983-1989*	*1996-2002*	*Difference*
1	0.583	0.587	0.69%
2	0.839	0.852	1.55%
3	0.982	0.975	-0.71%
4	1.345	1.345	0.00%

TABLE 18
Calibrated Parameter Values – Keeping up with the neighbors

Parameter	*Interpretation*	*Value*
β	Discount factor	0.9668
α_1	TVK-parameter, group 1	0.0047
α_2	TVK-parameter, group 2	0.1073
α_3	TVK-parameter, group 3	0.0752

TABLE 19
Debt-to-income ratios from model
Keeping up with the neighbors

Group	*1983-1989*	*1996-2002*	*Difference*
1	0.583	0.586	0.51%
2	0.839	0.862	2.74%
3	0.982	1.002	2.04%
4	1.345	1.345	0.00%

TABLE 20
Calibrated Parameter Values – Keeping up with the richest

Parameter	*Interpretation*	*Value*
β	Discount factor	0.9668
α_1	TVK-parameter, group 1	0.0033
α_2	TVK-parameter, group 2	0.0828
α_3	TVK-parameter, group 3	0.0752

TABLE 21
Debt-to-income ratios from model
Keeping up with the richest

Group	*1983-1989*	*1996-2002*	*Difference*
1	0.583	0.589	1.03%
2	0.839	0.888	5.84%
3	0.982	1.002	2.04%
4	1.345	1.345	0.00%

Comparison of the three alternative models

TABLE 22
Debt-to-income ratios in the second economy from data, baseline model and the three keeping up models, 1983-1989 and 1996-2002

Group	*Data*	*(1)*	*(2)*	*(3)*	*(4)*
1	0.951	0.583	0.587	0.586	0.589
2	1.074	0.839	0.852	0.862	0.888
3	1.175	0.982	0.975	1.002	1.002
4	1.505	1.345	1.345	1.345	1.345

(1) Baseline model without keeping up utility, (2) Keeping up with the Joneses, (3) Keeping up with the neighbors, (4) Keeping up with the richest.