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CONSUMPTION AND DISTRIBUTIONAL CONFLICTS IN DEMAND-LED GROWTH MODELS: EVIDENCE FROM THE PSID DATA

CONSUMO E CONFLITOS DISTRIBUTIVOS EM MODELOS DE CRESCIMENTO LIDERADO PELA DEMANDA: EVIDÊNCIAS A PARTIR DOS DADOS DO PSID.

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Abstract: Post-Keynesian growth models have incorporated household wealth dynamics as an important aspect of the relationship between growth and income distribution. Following these lines, this paper suggests a model in which households' consumption decision is determined by a dynamic adjustment of wealth to a targeted level. We also suggest that households' targeted level of wealth takes into account the average income that they earn over a period of eight years. We then run an empirical estimation using microlevel data for wealth and wages of US households available in the PSID (Panel Study on Income Dynamics) Database. We find that the model yields statistically significant results for most income and age groups. We also observe that the targeted wealth to wage ratio is not constant across groups of income and age. This ratio tends to increase with income and is actually negative for the lowest income bracket. This empirical analysis then suggests that there is evidence for claiming that household debt-financed consumption is a 'semi-autonomous' component of demand and can be incorporated into a demand-led growth model to explain the trajectory of the US economy in the period under analysis.
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Introduction

This paper aims to explore the connections between consumption and inequality through demand-led growth models. As it is largely emphasized in the post-Keynesian growth theories, income distribution has an impact on demand-led growth, as long as one assumes working households and capitalists have different propensities to save.[2] More precisely, following neo-Kaleckian models of growth, one would expect that as income inequality worsens, economies would stagnate given lower consumption expenditure, and, therefore lower demand. However, as largely emphasized by many post-Keynesians[3], the increase in household debt has allowed economies to keep growing, despite increased inequality, but at the expense of higher financial instability. As a result, demand-led growth models have slowly started to incorporate household debt dynamics into them[4]. This paper aims to contribute to this current post-Keynesian debate on consumption functions and growth, presenting some empirical results. With that in mind, this paper is organized into three sections beyond this introduction and a conclusion. In the first section we present a review of how household wealth dynamics has been incorporated in post-Keynesian growth models. While for neo-Kaleckian growth models, the autonomous component of demand is the investment function, which requires consumption to be determined by current income, under the supermultiplier framework the autonomous component of demand can be household consumption financed through credit or wealth. Therefore, under neo-Kaleckian theory, household consumption needs to be always determined by current income, even if it is financed by new loans, because the rate of growth of output is determined[5] by the rate of capital accumulation.

However, the supermultiplier literature suggests that household consumption can be the non-capacity generating autonomous component of demand that drives growth. The contributions on this side have emphasized that once we allow the possibility for consumption out of credit or wealth, we are then allowing consumption to no longer be determined by current income alone. In the second section then we suggest a model for household consumption and wealth dynamics where consumption decisions are explained by factors other than current

[2] See (Blecker 2002), (Taylor 1985), (Amitava Krishna Dutt 1984), (Amadeo 1986) and (Taylor 1990) for further details on this.
[3] See, for instance, (Palley 2010) and (Cynamon and Fazzari 2008)
[4] See, for instance, (Setterfield and Kim 2016) and (Fagundes 2017)
[5]

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income. We suggest a model for household wealth dynamics model where consumption decision is driven by a target of the wealth to wage ratio. We assume that households calculate a targeted level of wealth based on their income and then make their consumption and, therefore, savings decisions based on this targeted level of wealth. We then estimate different possibilities of the targeted level of wealth for the middle-income class. We start with a simple model where households just take into account their current income to calculate this target of wealth to income ratio and then we extend our model by including an average of wages to be taken into account when calculating the target.

Finally, we find that the model which yields the strongest results is the one where we incorporate in our target an account of the income households get for a period of eight years and we then extend the empirical estimation of this last model to other income brackets. In the third and final section we estimate the same model for different income and age and we find that the targeted ratio of wealth to wage tends to increase with income and age.

Household consumption and demand-led growth theories

As emphasized in (Albayrak 2020) even though household debt is an important factor in determining consumption patterns, and therefore, demand dynamics, it is not very often that we find theoretical works that look at the relationship between household consumption (or indebtedness) as a function of their position in the income distribution. Moreover, (Taylor et al. 2017, p. 265) emphasize that the bottom 40th percentile of US households have consistently negative savings, in other words, dissavings, which should be incorporated in the study of macroeconomic models. As a result of these observations, some examples of demand-led growth models that incorporate household debt and wealth dynamics into them can now be found. In this following section we will present a review of some of these models.

An introduction to the consumption function debate

As described in Taylor (2004), the typical Keynesian consumption function assumes that consumption is a linear function of income, such that:

$$C = c_0 + c_1 Y \tag{1}$$

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Where, Y is output, C is consumption, c_1 is the general marginal propensity to consume of the economy. It is also assumed that $c_1 < 1$, a condition known as Keynes' "fundamental psychological law", such that $\frac{dC}{dY} < 1$ and $\frac{dC}{dY} < \frac{C}{Y}$. However, the first problems with the Keynesian Consumption function started showing up when, in the post World War II period, spending from wealth resulted in consumption behavior not following the same pattern as disposable income. Furthermore, time-series analysis seemed to show that the marginal propensity to consume would vary counter-cyclically, falling in booms and rising in slumps. Following (Taylor 2004, p. 162) it is possible to see that the relationship between consumption and output is in fact necessarily given by:

$$\frac{C}{Y} = 1 - \frac{\Omega}{Y} g \qquad (2)$$

Where Ω is wealth and g is its rate of growth. In other words, the relationship between income and consumption is, therefore, influenced by savings (or dissavings) and wealth accumulation. In response to these issues a few early approaches to consumption behavior were developed. First, Duesenberry (1949) suggested that a household's consumption behavior is the result of learning, custom, and habit and that consumption is somewhat inertial (Taylor 2004, p. 163). Following Duesenberry (1949), when income rises, household consumption follows, but with a lower rate of growth. The reason for that is that as income falls households will have to reduce consumption, but they will try to retain existing standards of living, and for that reason, consumption will take longer to fall.

The second approach is known as the "life cycle" consumption model of Modigliani, Brumberg, et al. (1954). According to Modigliani, an individual's consumption function is driven not only by income, but also by households' wealth and total income expected for the entire life cycle. This explanation was further developed by Friedman (1957) into the permanent income hypothesis (PIH) theory. The PIH theory assumes that households rationally maximize their utility across time by taking a constant consumption across time which is given by the sum of all of the person's expected income flows divided by the length of their expected lifetime. More recently, this model has been extended to cover uncertainty and precautionary saving, among other factors (see Deaton (1992) for more details), "but its key prediction remains: consumers form intertemporal plans aimed at smoothing their standard of living (or marginal utility of wealth) across predictable income changes over their life-cycle." (Cynamon and

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Fazzari 2008, 1) Cynamon and Fazzari (2008) argue that the PIH theory seeks to explain the rise of American consumption in the recent stagnation period through the rational behavior of consumers who follow this life-cycle model. However, they argue that the household debt explosion in the US Economy can in fact be explained by behavioral patterns based on social norms that cannot be incorporated in the life-cycle model. Cynamon and Fazzari (2008) claim that the macroeconomic implications of these behaviors has contributed to higher growth, but it also raises doubt about whether recent consumption trends can be sustained. Barba and Pivetti (2008) argue that the rise in household debt given increased inequality in the US goes against what is suggested in the Permanent Income Hypothesis theory, as it shows that households are not rational agents trying to smooth out their consumption across time, they are just trying to cope with low income while maintaining a minimum standard of living.

Post-Keynesian growth models have often assumed a consumption function similar to the originally proposed Keynesian consumption function and focused on the investment component of demand. However, a recent literature has started incorporating household debt-financed consumption as an important component of aggregate demand[6] and, therefore, growth. In these models, household indebtedness will either come from autonomous consumption expenditure, such as suggested by Pariboni (2016) under the supermultiplier model, or from an endogenous consumption, such as suggested by Amitava K. Dutt (2005, 2006) and Setterfield and Kim (2016, 2017, 2018) and others under the neo-Kaleckian approach.

The neo-Kaleckian growth model and household debt-dynamics

Under the neo-Kaleckian approach household debt dynamics have been incorporated through the definition of a workers' consumption function that allows them to consume beyond their income as they accumulate debt. However, since the neo-Kaleckian approach assumes an exogenous investment function, this accumulation of debt must always become, for some reason or another, determined by current income. Following these lines Amitava K. Dutt (2005, 2006) suggests that worker's consumption, C_W, and capitalists' consumption, C_Π, is given by the following two equations[7]:

[6] Palley (1994) first suggested a debt-financed consumption function and analyzed the effect of that for the short run aggregate demand.
[7] The equations for this model are slightly modifiyed from the original contribution of Dutt (2006) for consistency of notation throughout the paper

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$$C_W = (1-\pi)Y - iD + \frac{dD}{dt};\ C_\Pi = (1-s_\pi)(\pi Y + iD) \quad (3)$$

Where Y is income, i is the interest rate, π is profit share, s_π is the fraction of income that capitalists save and D is the stock of debt. It is also assumed that household accumulate a stock of debt, $\dot{D} = B$, given by a desired level of new borrowing, B_d, which is then determined by current income:

$$\frac{dD}{dt} = B = B_d = \beta[(1-\pi)Y - iD] \quad (4)$$

Where β is the borrowing to net income ratio. As emphasized by Hein (2012) and others, the assumptions of this model also imply that a household's stock of debt grows at the same rate as a household's income, since it is a direct function of it. As a result, one would not need to worry about the financial sustainability of a household's debt under steady state growth in this model. For this reason, there have been other attempts to incorporate household debt-financed consumption into a neo-Kaleckian framework as is done in Setterfield and Kim (2016, 2017, 2018). In their model total consumption, C, is given by:[8]

$$C = C_W + C_R + \dot{D};\ \dot{D} = \beta(C^T - C_W), \quad \beta > 0;\ C^T = \eta C_R - \omega_s, \quad \omega_s = t\Pi;\ C_W = c_W W_P N;\ C_R = c_\pi[\phi\alpha W_P N + (1-t)\Pi + iD_R] \quad (5)$$

Where C_W is consumption by working households, C_R is the consumption by rentier households, $\dot{D}$ is the borrowing by working households to finance additional consumption, c_W is the propensity to consume by working households, c_π is propensity to consume of rentiers households and t is tax rates of profits. Household borrowing is then determined by a targeted level of consumption, C^T, which, in its turn, is determined by η, the emulation (keeping up with the Joneses) effect, minus the ω_s, social wages (social welfare system). Finally, $D_R = D - D_W$ is the part of worker's debt that is owned by the rentiers and D_W is the part that is owned by other workers.

Given the equations above, it is then possible to solve the model and find short-run or temporary equilibria. However, Setterfield and Kim (2018) emphasize that this is only a short-run equilibrium because it assumes a constant net debt to capital ratio, $d_R = \frac{D_R}{K}$. "This net debt

[8] The equations of this model are reproduced from (Setterfield and Kim 2018)

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capital ratio will, however, vary endogenously over time, as workers accumulate debt and the economy grows."(Setterfield and Kim 2018, 10) It then becomes important to understand these debt dynamics and their implications for growth, which is done, following Setterfield and Kim (2016, 2018), by analyzing the long run steady state behavior of $d_R = \frac{D_R}{K}$.

Palley (2010) and Pariboni (2016) emphasize that both models above require that $\frac{B}{D} = \frac{I}{K}$, i.e.: that the stock of capital and the stock of debt grow at the same rate. This means that the pace of total consumption, which includes both induced consumption and credit financed consumption, must be determined by the rate of accumulation. In Amitava K. Dutt (2005, 2006) this is done through the assumption that the desired level of borrowing B_d is determined by current income, as $B_d = b[(1-\pi)Y - iD]$. In this way the demand for loans is directly determined by current income and condition $\frac{B}{D} = \frac{I}{K}$ is satisfied. In the model of Setterfield and Kim (2016, 2017, 2018) we must also have that the rate of accumulation determines the rate of growth of aggregate demand. This is done through assuming an endogenous consumption target. Hein (2012) suggests a model similar to the ones mentioned above, but in which the new credit going to workers depends on rentiers' income and savings as indicated by[9]:

$$B = \theta S^{\Pi} = \theta(1 - c_\pi)(\pi Y + iD) \tag{6}$$

In Hein (2012) household worker's consumption, C_W is then determined by their wage income and by the credit they receive from rentiers such that:

$$C_W = W + B - iD = (1 - \pi)Y + B - iD \tag{7}$$

Where B is the flow of new loans that household take to consume and D is their total stock of debt. Additionally, it is assumed that rentier's consumption is determined by their total income, consisting of distributed profits of firms (πY) plus the interest payments from workers households (iD) and their propensity to consume (c_π), such that:

$$C_R = c_\pi(\pi Y + iD) \tag{8}$$

[9] The equations for this model are slightly modify from the original contribution of Hein (2012) for consistency of notation throughout this paper

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Therefore, in Hein (2012) the credit going to workers does not depend on workers' net income, as in Dutt (2005; 2006), but on rentiers' income and saving, as in Setterfield and Kim (2016, 2017, 2018). This allows Hein (2012) to focus on the issue of long-run stability of workers' debt-capital ratios in a similar way to how it is done in Setterfield and Kim (2018). However, as emphasized by Pariboni (2016), in the neo-Kaleckian approach the demand for loans must in the end be determined by capital accumulation rate and, consequently, cannot play any role in determining aggregate demand growth. Pariboni (2016) further argues that debt-led growth processes can be explained by looking at the autonomous pattern of credit-financed consumption, which is what we look at in the following section.

Consumption and income inequality

In neo-Kaleckian models, including the ones just described, it is often assumed that capitalists save at a higher rate than workers, such that "distribution influences demand via differential savings rates and profitability figures in the determination of planned investment" (Taylor, Foley, and Rezai 2019, p. 1335). However, it is also important to mention the work of (Taylor et al. 2017; Taylor, Omer, and Rezai 2015; Taylor, Foley, and Rezai 2019), as it goes even further into incorporating issues of income distribution and wealth dynamics into demand-led growth models. In that sense, the work of (Taylor et al. 2017) suggests a consumption function which would be a direct function of which income bracket households belong to. (Taylor et al. 2017) assume that all households consume a portion of their disposable income, however their disposable income will vary according to which income bracket households belong to. Furthermore, they also allow for a variation of the marginal propensity to save which is estimated also for different income groups.

Furthermore, (Taylor, Omer, and Rezai 2015) and (Taylor, Foley, and Rezai 2019) following the initial work of (Barbosa-Filho and Taylor 2006) developed models of cyclical dynamics of growth and distribution incorporating income inequality (beyond the functional income distribution) and wealth dynamics into them. As emphasized in (Taylor, Omer, and Rezai 2015) a complete model of growth and income distribution, should incorporate explanations of how households get income from profits and assets.

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Household consumption as the autonomous component of demand

Debt-financed consumption can also be incorporated into a model of demand-led growth following the supermultiplier approach, as developed by Serrano (1995), Cesaratto (2015), and Freitas and Serrano (2015). This approach has also been incorporated in a neo-Kaleckian framework by Lavoie (2016) and Allain (2014), as a possible solution to the issue of Harrodian instability described in Skott (2010). Following these contributions, Pariboni (2016) suggests a supermultiplier growth model where the autonomous component of demand is households' credit-financed consumption. He suggests that if we assume workers' consumption is partially determined by an autonomous and exogenous component, such that:

$$C_t^W = c_w[(1-\pi)Y_t - (i+\phi)D_t] + B_t;\ C_t^{\Pi} = c_{\Pi}\pi Y_t;\ C_t^a = B_t - c_w(i+\phi)D_t; \qquad (9)$$

Where C^W is workers' consumption, C^{Π} is capitalists' consumption, π is profit share, ϕ denotes the percentage of principal repaid every period, i is the interest rate, D is the stock of debt and B is new credit. We then have that $Z_t = C_t^a$, i.e., that the autonomous component of demand is household debt-financed consumption, then we have that $g^* = g^{C^a}$, where g^{C^a} is the exogenously given rate of growth of debt-financed consumption."[T]his result implies that, given enough time, demand and output will tend to evolve at the rate of growth of the autonomous components of demand; in this case, workers' autonomous consumption." (Pariboni 2016, p. 224)

Consequently, under the supermultiplier approach a non-capacity generating autonomous component of demand is suggested as the solution to the Harrodian instability problem. In the approach described above it is some portion of personal consumption expenditure that is designated as the non-capacity generating semi-autonomous expenditures. It is also interesting to observe that the fact that these expenditures represent financial dissaving, or are significantly financed through debt, ties in with the endogenous money approach and the credit-creating powers of banks (Fiebiger and Lavoie 2019, p. 250).

Barba and Pivetti (2008) have also analyzed the macroeconomic implication of increasing household level of indebtedness from a demand-led growth perspective. In their view "household indebtedness should be seen principally as a response to stagnant real wages and retrenchments in the welfare state, i.e.: as the counterpart of enduring changes in income

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distribution." (Barba and Pivetti 2008, 114). Additionally, they argue that the key issue concerns the sustainability of this process. Even though it has been shown that household debt-financed consumption can help sustain demand and activity, the real challenge concerns the feasibility of containing the long-run shortcomings of a growing stock of household debt.

This discussion on household consumption and demand-led growth models showed the relevance of the question about whether household consumption is autonomous or not. If a household's debt-financed consumption is an autonomous component of demand and it is the component driving growth then this immediately raises the question of the sustainability of this debt-led growth regime. In the next section, we introduce a generic model for household consumption and we use empirical investigations to show that there is evidence to claim that household debt-financed consumption is not determined by current income alone.

Finally, under a supermultiplier framework households' consumption out of wealth has also been incorporated in Brochier and Silva (2018). In their model. households' autonomous consumption is given by a consumption out of previously accumulated wealth, which is then the endogenous, but autonomous component of demand driving growth in their model.

A model for household consumption and wealth dynamics

Following the recent contributions of the post-Keynesian growth theory literature mentioned above, we suggest in this paper a model in which household consumption decision is determined by a targeted level of wealth given household wages. More precisely, following the logic of Amitava K. Dutt (2005), we assume here that households' consumption decision targets a certain level of wealth (or debt), which is assumed to be a direct function of their income, multiplied by the targeted ratio on wealth to income Following the contributions of (Taylor, Omer, and Rezai 2015) and (Taylor et al. 2017), we will assume that this wealth target will change according to the income bracket in which households are. As a result, we allow for low-income households to actually target a certain level of debt, which just translates into a negative wealth in our model, as is precisely suggested in (Amitava K. Dutt 2005). Finally, we will also assume that the income that households take into account when deciding on a target for wealth is not necessarily just the income that they had in the period in which they are taking their consumption decision. We will allow for this target to be affected by previous incomes.

First, we define: i) $H[t]$ as total household wealth at time t; ii) $Y[t]$ as total household income at time t; iii) $w[t]$ as household income from wages at time t; iv) $S[t]$ as total household

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savings at time t; and v) $C[t]$ is total household consumption at time t. Second, we assume[10] that household decision to save is determined by a targeted wealth to wage ratio, σ:

$$S[t] = \beta(\sigma w[t] - H[t]) \tag{10}$$

Where σ is the targeted ratio of wealth to wage income and β is a measure of the sensibility of the savings function. In other words, households make savings decision trying to decrease the difference between actual wealth and its targeted level, which in this model is then given by: $H^T[t] = \sigma w[t]$. Additionally, we assume that household income is given by what they earn as wages plus the return on investments:

$$Y[t] = w[t] + rH[t] \tag{11}$$

Finally, we know that the flow of household income that is not saved is consumed:

$$C[t] = Y[t] - S[t] \tag{12}$$

Consequently, since change in wealth, or wealth dynamics, is given by households' savings decision:

$$\frac{d}{dt}H[t] = S[t] \tag{13}$$

We can then conclude from equations (13) and (10) that:

$$\dot{H}[t] = \beta(\sigma w[t] - H[t]) \tag{14}$$

As we have defined the target of wealth to be $H^T[t] = \sigma w[t]$, we can see that the equation above can then be rewritten as:

$$\dot{H}[t] = \beta(H^T[t] - H[t]) \tag{15}$$

[10] A similar model has also been suggested in (Avritzer 2022)

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As described in the equation above this model then assumes that households are constantly adjusting their wealth to a targeted level. Additionally, we have seen that this targeted level can be the determined by the wage at time t, such that $H^T[t] = \sigma w[t]$, or it can take the form of $H^T[t] = \sigma w^-$, where $w^- = \frac{\sum_{i=1}^{K} \quad w_{t-K}}{K}$ can be an average of earned wages over a certain period of time K. In order to establish what are the wages taken into account when households are determining their debt target we will use empirical estimations in this section. However, before moving to the empirical estimation, it is still important to emphasize that as the data is discrete and not continuous, the best representation of what we will estimate is actually:

$$\Delta H_t = \beta_0 H_t^T + \beta_1 H_t \quad (16)$$

In order to estimate equation (16) above we used data on wealth and wage income from the Panel Study of Income Dynamics (PSID) data. The PSID is a panel household survey data that began in 1968 with a nationally representative sample of over 18,000 individuals living in 5,000 families in the United States.

Our empirical approach was to first choose the best model that describes the dynamics for the middle-income class and then extend the estimation to other income classes. In order to do so we decided to subset the data in a group of households by the age of head of the households and by income brackets. With that in mind, the variables that were taken from the PSID data for each household were: i) the age of head of the households; ii) total family income; iii) wealth with equity, which is an imputed value; iv) wages and salaries of the head of the household; v) family and person identification number from 1968, in order to allow for continuity of observations and and vi) family sample weights.

Even though the PSID Survey has been done every year since 1968 we decided to use the PSID - Family Level from 1999 to 2015 following the usual procedure in the empirical literature that works with PSID Data. The reason for that is the change in the estimation of wealth after 1999 to a new methodology that is the same used until 2015. A histogram and some descriptive statistics of the used variables can be found in Appendix A.

Following the work of (Taylor, Omer, and Rezai 2015) and (Taylor et al. 2017), we know that households' consumption can be very different depending on the income bracket in which they are. With that in mind, we then divided our population observation into three groups

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of income: i) low-income class, with income between $\$0$ and $\$40,000$; ii) middle income class, with income between $\$40,000$ and $\$120,000$; iii) high income class, with income between $\$120,000$ and $\$300,000$. We also divided our population into four groups of ages: i) ages between 25 and 35; ii) ages between 35 and 45; iii) ages between 45 and 55; and iv) ages between 55 and 65. As mentioned before, we estimated different models with different specifications of the wealth target for the middle income, with total family income between $\$40,000$ and $\$120,000$, and the middle age group, where the head of the household has age between 35 and 45. We decided to run the first empirical tests with this group of households because it was the biggest share of our sample. Finally, we also decided to hold only one observation from each household to avoid autocorrelation in our data. The estimation equations and our results for this group are reported in the following section.

Empirical estimations for the middle-income class

Our first attempt was to estimate a model in which the target for the wealth, at time t is determined by the wage earned in the previous year, $t-1$. In other words, we assume that the target of wealth is given by $H_t^T = \alpha w_{t-1}$, where α is our targeted wealth to wage ratio and our estimation equation is given by:

$$\Delta Wealth_{i,t+2} = \beta_0 * Wages_{i,t-1} + \beta_1 * Wealth_{i,t} \tag{17}$$

Where $\Delta Wealth_{t+2} = Wealth_{t+2} - Wealth_t$. We then estimated the model above for the middle-income class and the middle age group.[11]

Table 1 - Results with wealth target determined by current wage

[11] The PSID Family Data Survey is only conducted every two years, and this is why there is a space of two years in the change of wealth. Also, the variable for wages is always referenced to the year before the survey. This means that if, for example, we are using the data of 2013 for wealth, the wage for that year is the one households obtained in 2012.

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	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	45955.6194	30677.2083	1.498	0.134214
β_0	0.9024	0.5344	1.689	0.091394
β_1	-0.6334	0.1869	-3.390	0.000707

In Table 1 above we can first observe that the t values for β_0 and β_1 are 1.689 and -3.390, respectively. This shows that the estimated coefficients are significant for both β_0 and β_1. Furthermore, we can also see that the estimated value for β_0 is 0.90 and for β_1 is -0.63. Comparing this result to the coefficients from equations (17) and (16) we then have that $\hat{\beta} = -\widehat{\beta}_1$ is our estimated speed of adjustment and $\hat{\sigma} = \frac{\widehat{\beta}_0}{\beta} = -\frac{\widehat{\beta}_0}{\widehat{\beta}_1}$ is our estimated targeted wealth to wage ratio. Consequently, given the values estimated for β_0 and β_1, the estimated speed of adjustment in this first model is 0.6, and the estimated σ is equal to $\frac{0.90}{0.63} = 1.42$. It is important to mention here that what is estimated in this equation is similar to what is suggested in Amitava K. Dutt (2005, 2006), where the wealth dynamics becomes non-autonomous as the wealth target becomes determined by current income.

Given that the estimated coefficients for both β_0 and β_1 were statistically significant we can look further into the significance of the estimated speed of adjustment and targeted ratio. Since the speed to adjustment is given by $\beta = -\beta_1$ and the targeted ratio is calculated as $\sigma = -\frac{\beta_0}{\beta_1}$, we have that the 95% confidence intervals for the estimated speed of adjustment and the targeted ratio are $(0.26 - 1.01)$ and $(0.29 - 2.56)$, respectively.[12]

Following this first attempt a few other possibilities for the target of wealth were tested. In Table 2 we present the results that we got for different estimated wealth targets. The second model that we tested was one on which households take into account the wage that they get in

[12] We have that the speed of adjustment follows a Student t's distribution for which we can easily calculate the 95% Confidence Interval. Additionally, we have that the targeted ratio follows a Cauchy distribution, which can be approximated by a Student t's distribution and its variance is given by the sum of the variance of the estimated coefficients as we are assuming no correlation between them.

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the period of adjustment from t to $t + 2$, such that households' wealth dynamics would be given by:

$$\Delta Wealth_{i,t+2} = \beta_0 * Wages_{i,t+1} + \beta_1 * Wealth_{i,t} \tag{18}$$

The results for this estimation are presented in Table 2 below under the Model 2 column. In this model, the estimated parameter is not significant for β_0, only for β_1. We then considered the possibility that households take into account an average of wages that they get over an eight year period of time to calculate their wealth target. In this case, households' wealth dynamics is of the type:

$$\Delta Wealth_{i,t+2} = \beta_0 * Wealth_{i,t}^{T} + \beta_1 * Wealth_{i,t};\ Wealth_{it}^{T} = \frac{\sum_{k=1}^{5} Wage_{i,t-2k+1}}{5} \tag{19}$$

The results for this estimation are also presented in Table 2 below under the Model 3 column. The estimated parameters for β_0 and β_1 were significant, which shows an improvement from the previous estimation. Additionally, the t statistics for the estimated parameter of the wealth target is higher in Model 3, compared to Model 1 and 2. This shows then that there is empirical evidence to claim that households take into account an average of wages over a longer period of time and not just the current wage when forming their wealth target and, therefore, consumption decisions. We also considered the possibility that households take into account the wage that they get in the period of the adjustment when calculating the average of wages received in eight years. In this case the wealth adjustment dynamics will be of the type:

$$\Delta Wealth_{i,t+2} = \beta_0 * Wealth_{i,t}^{T} + \beta_1 * Wealth_{i,t};\ Wealth_{it}^{T} = \frac{\sum_{k=1}^{5} Wage_{i,t-2k+3}}{5} \tag{20}$$

The results obtained for this estimation can also be found in Table 2 below under the Model 4 column. For this model we obtained the most statistically significant results for β_0 and β_1. However, it is important to emphasize that this higher significance of wage earned in period $t + 1$ can be explained by the simple fact that it is just an income that households are getting from period t to period $t + 2$. Therefore, this higher significance might just be the result of the

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fact that the wage earned in time $t+1$ is a significant share of their change in wealth, but not necessarily because households were actually taking into account an expectation of the wage to be earned in the period of adjustment. For this reason, we decided to keep the results of Model 3 as the most significant one for our estimations.

Finally, we attempted to incorporate time dummies to our estimation, such that the households' wealth dynamics is of the type:

$$\Delta Wealth_{i,t+2} = \beta_0 * Wealth_{i,t}^T + \beta_1 * Wealth_{i,t} + D_{13} + D_{11} + D_{09} + D_{07};\ Wealth_{it}^T = \frac{\sum_{k=1}^{5} Wage_{i,t-2k+1}}{5} \quad (21)$$

The results obtained for this estimation can also be found in Table 2 below under the Model 5 column. As can be seen in Table 2, the inclusion of time dummies has not improved the estimation results. We then decided to maintain the results of Model 3 as the most significant for our estimations to be used in the extended estimations for other income and age groups. Finally, in Table 2 below we can also see that the estimated value for β_0 and β_1 in the case of Model 3 is 2.816 and -0.6481 respectively. This means that the estimated speed of adjustment for this model is 0.65, with a 95% confidence interval of $(0.29 - 1.01)$, and the estimated targeted wealth to wage ratio is $\frac{2.82}{0.65} = 4.34$, with a 95% confidence interval of $(1.76 - 6.93)$.

Our estimations then show that, first of all, households have a speed of adjustment around, but slightly higher than 0.5. A speed of adjustment near 0.5 means that between t and $t+2$ households in average will make half of the adjustment of their wealth to its targeted value. This result means then that households are, in average, making close to half of the adjustment to the target level of wealth from period t to $t+2$. Secondly, we can also see that the target of wealth to wage ratio is around 4. This means that following our model, households are targeting a wealth that is around four times their average earned wage in the last eight years.

Table 2 - Results from all the models

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$Wealth_{i,t}^{T}$	Model 1	Model 2	**Model 3**	Model 4	Model 5
Intercept	45955.6194	73843.9666^{**}	$-3.159e^{+04}$	80218.2960	$-7.384e^{+03}$
(t value)	(1.498)	(1.962)	(-0.542)	(1.372)	(-0.104)
$Wages_{i,t-1}$	0.9024*	-	-	-	-
(t value)	(1.689)				
$Wages_{i,t+1}$	-	0.2611	-	-	-
(t value)		(0.480)			
$\frac{\sum_{k=1}^{5} \quad Wages_{i,t-2k+}}{5}$	-	-	2.816^{**}	-	2.903^{**}
(t value)			(2.202)		(2.306)
$\frac{\sum_{k=1}^{5} \quad Wages_{i,t-2k+}}{5}$	-	-	-	-4.0649^{***}	-
(t value)				(-2.831)	
$Wealth_{i,t-1}$	-0.6334^{***}	-0.6159^{***}	-0.6481^{***}	0.7153^{***}	-0.6522^{***}
(t value)	(-3.390)	(-3.370)	(-3.577)	(4.865)	(-3.582)
d_{13}	-	-	-	-	$-6.543e+04^{**}$
(t value)					(-2.275)
d_{11}	-	-	-	-	$-5.257e+04^{*}$
(t value)					(-1.670)
d_{09}	-	-	-	-	$-1.684e+04$
(t value)					(-0.322)
d_{07}	-	-	-	-	$-1.121e+04$
(t value)					(-0.213)

Note: ∗ p-value < 0.1, ∗∗ p-value < 0.05 and ∗∗∗ p-value < 0.01.

Finally, we also considered the possibility that the wealth target was calculated taking into account the wages received in the past two, four and six years. The results of these estimations are presented in Table 3 below. Since the estimated results don't seem to change significantly when we change the number of years taken into account to calculate the wealth target, we decided to continue with the eight years average of Model 3 in Table 2.

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Table 3 - Other Attempts for the Targeted Wealth

$Wealth_{i,t}^{T}$	Intercept (t value)	$\hat{\beta}_0$ (t value)	$\hat{\beta}_1$ (t value)
$\frac{Wages_{i,t-1}+Wages_{i,t-3}}{2}$	14850.4311	1.5840^{**}	-0.6363^{***}
	(1.516)	(1.901)	(-3.386)
$\frac{\sum_{k=1}^{3} Wages_{i,t-2k+1}}{3}$	45948.8580	1.3353^{*}	-0.6183^{***}
	(0.373)	(1.972)	(-3.424)
$\frac{\sum_{k=1}^{4} Wages_{i,t-2k+1}}{4}$	8006.1175	1.8006^{*}	-0.6394^{***}
	(0.171)	(1.804)	(-3.456)

Note: ∗ p-value < 0.1, ∗∗ p-value < 0.05 and ∗∗∗ p-value < 0.01.

Consequently, taking into account the t values obtained in the different estimations, we have decided to estimate the model with the targeted ratio defined by the last eight years, excluding the wage in the period of adjustment, for the different groups of income class and ages. The results are presented in the following and final subsection.

Estimations for different groups of age and income brackets

Following the previous empirical exercise, we decided to estimate the following wealth dynamics model for the different income brackets and different age groups:

$$\Delta Wealth_{i,t+2} = \beta_0 * Wealth_{i,t}^{T} + \beta_1 * Wealth_{i,t};\ Wealth_{it}^{T} = \frac{\sum_{k=1}^{5} Wage_{i,t-2k+1}}{5} \quad (22)$$

The results of β_0 and β_1 estimated for each group, as well as their t values, can be found in the last table of Appendix B. In the two tables below, we report the speed of adjustment and the targeted wealth to income ratio estimated for each group.

First, it is interesting to observe that the estimated speed of adjustment is positive and below unity for almost all groups of age and income. The only exceptions are the following

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three groups: i) low income, with age between 55 and 65; ii) middle income, with age between 45 and 55; iii) high income, with age 35 to 45, for which it was estimated a negative speed of adjustment. Additionally, we can also observe that for these three groups, as well as for the high-income group with age between 45 and 55, the 95% confidence interval does not rule out the possibility that the speed of adjustment is actually equal to zero. The specific values for the speed of adjustment can be found in Table 4 below. These first results show that the model suggested here has limitations in describing the behavior of these four groups, as an estimated speed of adjustment equals to zero imply that households are not adjusting their wealth to the targeted level when they make consumption decisions.

Table 4: Estimated Speed of Adjustment

Categories	Age of 25-35	Age of 35-45	Age of 45-55	Age of 55-65
Low Income Class	0.9647651	0.81258186	0.57189696	−0.1511604
95% Confidence Interval	(0.9510; 0.9785)	(0.5771; 1.0481)	(0.2977; 0.8460)	(−1.1582; 0.8559)
Middle Income Class	0.8955495	0.648934	−0.05511687	0.1444408
95% Confidence Interval	(0.7682; 1.0229)	(0.2974; 1.0122)	(−0.6573; 0.5470)	(0.0072; 0.2816)
High Income Class	0.8886569	−0.03960115	0.26764348	0.2595410
95% Confidence Interval	(0.8016; 0.9757)	(−1.3956; 1.3164)	(−0.3071; 0.8425)	(0.0399; 0.4792)

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Table 5: Estimated Targeted Ratio

Categories	Age of 25-35	Age of 35-45	Age of 45-55	Age of 55-65
Low Income Class	−0.1107069	1.604609	−0.3660003	37.185477
95% Confidence Interval	(−0.3103; 0.0889)	(0.4443; 2.7649)	(−2.3759; 1.6439)	(12.4277; 61.9432)
Middle Income Class	0.6148614	4.338462	−12.9521322	11.702009
95% Confidence Interval	(0.0283; 1.2014)	(1.7622; 6.9349)	(−14.2959; −11.6083)	(10.2747; 13.1293)
High Income Class	0.3755237	−370.422908	9.9746356	4.055763
95% Confidence Interval	(−0.3891; 1.1401)	(−393.51; −347.33)	(6.8747; 13.0745)	(2.3681; 5.7434)

Additionally, Table 5 below reports the calculated value for the targeted ratio of wealth to wage for the different income and age groups.

In Table 5 above we can, first of all, observe that the targeted ratio tends, on average, to increase with age and income level, except for two clear outliers: the middle-income class, with age between 45 and 55, and the high-income class, with age between 35 and 45. However, the results of Table 4 already showed that this model does not describe well the wealth dynamics of these two groups.

Secondly, we can also observe that the only income group who seems to be smoothing consumption over time is the high-income group, which has its highest targeted ratio when they are between 45 and 55. For the other two income groups, which corresponds to the majority of the US population, the targeted ratio seems to increase with age.

Additionally, we observe that the targeted ratio for the lowest income bracket is quite high when they reach the age group of 55-65. It is important to emphasize that this does not necessarily mean that low-income households are targeting a high wealth level when they reach that age, it could just mean that they just have a low wage which also increases the estimated targeted ratio for them.

Finally, it is interesting to observe that for low-income households with ages between 25 to 35 and 45 to 55, the targeted ratio has been estimated negative, although not statistically significant, which suggests that these groups of households could be targeting a debt level, as opposed to a wealth one, much in line to what has been suggested by (Amitava K. Dutt 2005).

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Conclusion

In conclusion, we have suggested here a model where households are saving, and consequently consuming, so as to obtain a targeted level of wealth given their wage. In our model households' decisions to save are such that wealth is constantly adjusting to a certain desired ratio of wealth to wage. We then ran an empirical estimation with the purpose of determining, first, what are the wages that households take into account when making their savings decision and, second, what is the estimated target of wealth to wage ratio of households and how does it vary across different income and age groups.

Our empirical estimations show that the best results are obtained from a model that assumes households take into account an average of wages across a period of time of eight years. Additionally, we also found that this targeted ratio of wealth to wage tends to increase with age and income.

This exercise suggests then that there is an empirical justification for assuming a model for household debt in which they are targeting a certain level of wealth and that this level of wealth is affected by their wage. However, this target of wealth is not directly determined by current income, but by the average of household's income over an eight year period. This then takes us back to the idea of household consumption as the non-capacity generating and "semi-autonomous" component of demand, as suggested by the supermultiplier growth model.

Finally, it is interesting to observe that consumption decisions vary with income distribution, as much emphasized in (Taylor, Omer, and Rezai 2015) and (Taylor et al. 2017). This further suggests that income and wealth inequality should be incorporated into demand-led growth models especially when thinking about credit-financed consumption models.

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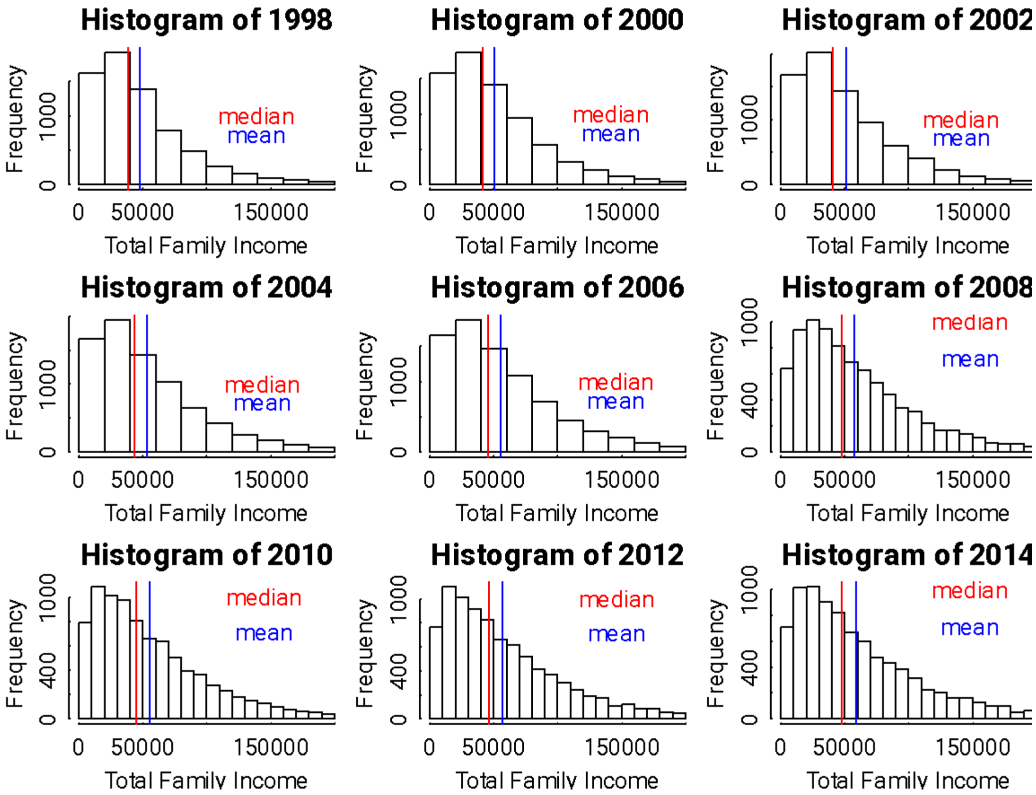
Appendix A - Descriptive statistics

Histograms of income



The histograms above show that the biggest share of our sample has an income between \$40,000 and \$120,000, which is the reason why we started our estimations with the middle-income class.

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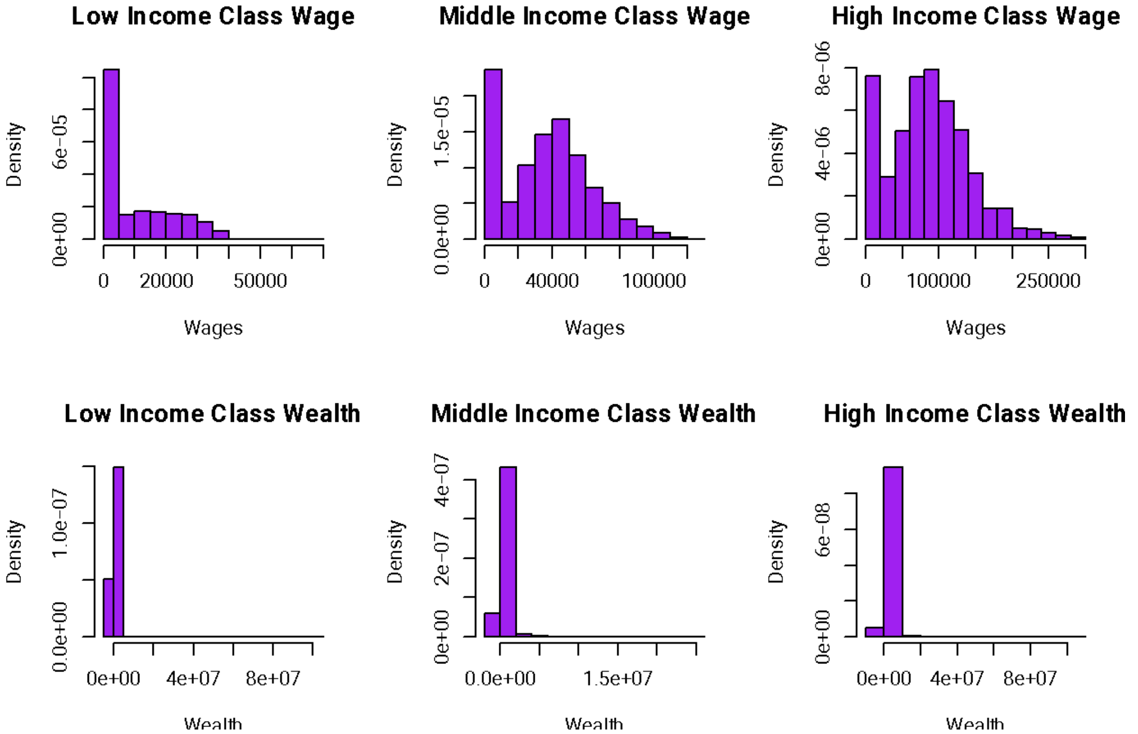
Histograms of Wage and Wealth for the different Income Groups



Descriptive Statistics

Income	Number of Observations	Wealth		Wages	
		Mean	S.D.	Mean	S.D.
Low Income Class	28399	65876.55	665172.9	11259.11	11689.37
Middle Income Class	28992	195548.9	545909.8	38017.07	24447.27
High Income Class	7056	660424.7	1878502	86523.23	53444.12

Table 6: Descriptive Statistics of the Survey Data

Income	Wealth		Wages	
	Mean	S.E.	Mean	S.E.
Low Income Class	117228.93	11424	10007.49	97.56

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Middle Income Class	279204.30	5438.9	37019.44	210.63
High Income Class	811640.27	30961	87449.83	811.81

Appendix B - Further estimations and statistics

In Table 10 below, we present the estimated values of β_0 and β_1 for the different groups of age and income using the following wealth dynamics model:

$$\Delta Wealth_{i,t+2} = \beta_0 * Wealth^T_{i,t} + \beta_1 * Wealth_{i,t};\ Wealth^T_{it} = \frac{\sum_{k=1}^{5} Wage_{i,t-2k+1}}{5}$$

Categories	Age of 25-35 β_0 (t-value)	Age of 25-35 β_1 (t-value)	Age of 35-45 β_0 (t-value)	Age of 35-45 β_1 (t-value)	Age of 45-55 β_0 (t-value)	Age of 45-55 β_1 (t-value)	Age of 55-65 β_0 (t-value)	Age of 55-65 β_1 (t-value)
Low Income Class	-0.1068	-0.9648	1.3039	-0.8126	-0.2093	-5.6210	0.1512	-0.2595
	(-1.07)	(-140.67)	(2.30)	(-6.90)	(-0.21)	(-4.17)	(-0.45)	(0.30)
Middle Income Class	0.5506	-0.8955	2.8162	-0.6481	0.7139	0.0551	1.6902	-0.1444
	(1.92)	(-14.07)	(2.20)	(-3.57)	(1.19)	(0.18)	(2.37)	(-2.11)
High Income Class	0.3337	-0.8887	14.6692	0.0396	2.6696	-0.2676	1.0526	-0.2595
	(0.88)	(-20.41)	(1.27)	(0.06)	(1.75)	(-0.93)	(1.26)	(-2.36)

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