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Abstract

This note aims to shed light on the relationship between interest rates and household savings in Norway. To this end, I use a simple life-cycle model that accounts for actual debt levels of Norwegian households. The starting point is that since Norwegian households tend to have negative net financial wealth, a low interest rate makes them better off. In a nutshell, reduced interest rate payments can be viewed as a transitory income increase. When households wish to smooth consumption, only a small fraction of the transitory income gift will be consumed, while most of the reduced income payments will be saved for consumption in future periods. Hence, a life-cycle model is able to explain why households increase savings when interest rates are low.

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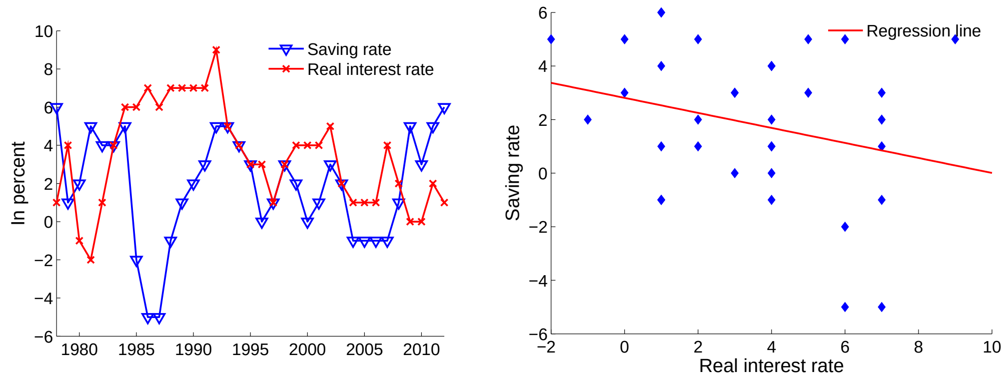
Figure 1: Savings in percentage of disposable income and real interest rates. 1978–2012.

(a) Time series

(b) Scatter plot with regression line



Note: Saving rates measured as savings in percentage of disposable income, excluding income from dividends. Savings exclude income from dividends because savings was extraordinary high in a period prior to introduction of dividend tax in 2006. Real interest rates are nominal 3-month NIBOR deflated with inflation (CPI). Interest rates before 1985 are based on a representative nominal interest rate. Source: Annual National Accounts and Norges Bank

1 Introduction

Since 2008 Norwegian household saving has increased in a period when interest rates have been low (see Figure 1a). In 2007, the saving rate was below 1 percent while it increased to 8.7 percent in 2012. In the same period, the real interest rate averaged 1.2 percent which is low compared to the historical average of approximately 3.5 percent. At first glance, it might seem strange why saving has increased, as low interest rates should induce households to shift consumption from the future to today. However, a negative relationship between saving rates and real interest rates is not a new phenomena. The correlation coefficient of annual saving rates and the real interest rate in the time period 1978-2012 is –0.24 indicating that historically the relationship has been negative (see Figure 1b). The negative correlation between saving rates and the real interest rate was in particular strong during the 1980s (correlation coefficient of –0.62). We have also seen this negative relationship recently with a correlation coefficient of –0.18 during the 2000s. In the 1990s, the correlation went in the opposite direction with a positive correlation coefficient of 0.62 between saving rates and the interest rate.

I aim to shed light on the relationship between interest rates and saving rates in Norway. The main message is that the financial position of Norwegian households is important when predicting the response in saving and consumption to an interest rate decrease. Norwegian households on average have negative net financial wealth. Hence, the low interest rate has reduced interest rate payments which can be viewed as a transitory income increase to debt holders. In a life-cycle model where households wish to smooth consumption, only a small fraction of the transitory income gift will be consumed, while most of the reduced interest payments will be saved for consumption in future periods. Hence, the life-cycle model predicts an increase in saving from the reduction in interest rates.

The total effect on consumption naturally depends on the size of the substitution effect. A decrease in the interest rate will make consumption today relatively more desirable than consumption tomorrow, due to low return on savings. The size of the substitution effect is determined by how willing consumers are to shift consumption between different periods.

Other possibly important explanations for the recent uprise in saving include precautionary saving, tightening of credit constraints, deleveraging by households and wealth effects (see e.g. Gudmundsson and Natvik (2012); Carroll et al (2012); Guerrieri and Lorenzoni (2011); Eggertsson and Krugman (2011); Hall (2011)). However, the return on savings is an important factor in the household's saving decision, and I believe it is important to understand the relationship between interest rates and saving more carefully with a specific emphasis on the role of households initial wealth.

I compute the effect a temporarily low interest rate has on saving and consumption in a deterministic life-cycle model. Throughout the paper I compare saving and consumption in a scenario where short run interest rates are temporarily low to the scenario where the interest rate is constant at the long run level. Since I am primarily interested in the effect of interest rates, I do not account for other complicating factors such as income uncertainty or credit constraints.

The data shows that the household sector in Norway has negative net financial wealth on average. However, net debt levels are especially high among households aged 25-34 and 35-44, but also households aged 45-54 are indebted on average. Thus, I calibrate the model for various age groups using data from Statistics Norway on net financial wealth and disposable income for various age groups of households. I only consider the households' liabilities or claims in terms of financial wealth, and I do not consider real capital such as housing. My set-up can be interpreted as an economy where all households are houseowners and plan to live in the house until they pass it on to their children. Hence, the value of their house is irrelevant when making the consumption decision. Households optimize consumption based on their financial wealth and future income stream.

The calibrations in this paper show that the households' initial asset positions can have large implications for the effect of a temporary interest rate reduction. Hence, the response in saving from an interest rate reduction will vary substantially across age groups.

Because households aged 25-34, 35-44 and 45-54 are indebted a temporarily low interest rate will induce higher saving among these households. Households aged 55-64 and older have positive net financial wealth on average and are therefore worse off from a lower interest rate because of the reduction in interest rate income. In the calibrations, they will still increase consumption because the substitution effect is at work and they shift consumption to the period with low interest rates. As a consequence of reduced interest rate income and higher consumption, saving go down for this household age group. The household sector as a whole benefits from the lower interest rate because households on average are indebted. However, because the net debt of the average household is rather small in size, a temporarily lower interest rate will induce a moderate increase in saving under the baseline assumption about preferences. The size of the increase in saving largely depends on the intertemporal elasticity of substitution. With high levels of intertemporal elasticity of substitution, the substitution effect create a boost in consumption which is sufficiently large to make saving decrease.

2 A life-cycle model

This section derives the mathematical expression for the deterministic Euler-equation and the consumption function. Using the theoretical function for optimal consumption, we will analyze the effect of a temporary decrease in interest rates. In order to understand the underlying mechanisms which are driving the consumption response, we decompose the total change in consumption into the the income, substitution and wealth effects separately.

2.1 The multi-period Euler-equation and the consumption function

The households maximize utility from consumption:

$$\max \sum_{t=t_0}^{T} \beta^{t-t_0} u(C_t),$$

where C_t is consumption in period t, $u(C_t)$ is utility from consuming C_t, β is the discount factor, t_0 is the age of the household and T is the age of the household at the end of life.

In each period the household faces the budget constraint

$$A_{t+1} = (1 + r_t)\, A_t + Y_t - C_t,$$

where A_{t+1} is financial wealth at the start of period $t+1$, Y_t is yearly labor income, C_t is consumption and r_t is the interest rate in period t.

The recursive representation of the household's consumption problem is given by

$$V_t(A_t, Y_t) = \max_{C_t, A_{t+1}} u(C_t) + \beta V_{t+1}(A_{t+1}, Y_{t+1}),$$

subject to

$$A_{t+1} = (1 + r_t)\, A_t + Y_t - C_t \tag{1}$$

$$A_T = 0. \tag{2}$$

The first order condition is

$$u'(C_t) = \beta V'_{t+1}(A_{t+1}, Y_{t+1}).$$

Using the envelope theorem, the first order condition becomes

$$u'(C_t) = \beta(1 + r_{t+1})u'(C_{t+1}),$$

which is the standard Euler-equation. I assume CRRA-utility function:

$$u(C_t) = \frac{1}{1-\frac{1}{\rho}} C_t^{1-\frac{1}{\rho}},$$

where ρ is the intertemporal elasticity of substitution.

The marginal utility is equal to

$$u'(C_t) = C_t^{-\frac{1}{\rho}}.$$

With these preferences the Euler-equation can be written as

$$\frac{C_{t+1}}{C_t} = [\beta(1+r_{t+1})]^{\rho}. \tag{3}$$

We see that an increase of the interest rate has an unambiguous positive effect on consumption growth given that, $\rho > 0$. A higher level of interest rates will create higher consumption growth. To which extent the consumption growth responds to variations in the interest rate, depends on ρ: if the ρ is low, consumption growth responds very little. In the extreme case where the $\rho = 0$, consumption is constant, and consumption growth is unaffected by changes in the interest rate.

Using budget constraint (1) and (2), the life time budget constraint can be written as

$$\sum_{t=t_0}^{T} \frac{C_t}{(1+r_t)^{t-t_0}} = (1+r_1)A_1 + L, \tag{4}$$

where L denote labor wealth, $L = \sum_{t=t_0}^{T} \frac{Y_t}{(1+r_t)^{t-t_0}}$. The sum of financial wealth and labor wealth constitutes total wealth, $\Omega = (1+r_1)A_1 + L$.

The optimal consumption grows according to the Euler-equation (3) and can be rewritten as

$$\sum_{t=t_0}^{T} \frac{C_t}{(1+r_t)^{t-t_0}} = C_1 * \sum_{t=t_0}^{T} \left[\frac{G_t}{(1+r_t)}\right]^{t-t_0} = \Omega,$$

where $G_t \equiv \frac{C_{t+1}}{C_t}$.

The optimal consumption level is given by

$$C_1 = \frac{1}{\sum_{t=t_0}^{T} \left[\frac{G_t}{(1+r_t)}\right]^{t-t_0}} \Omega = \alpha\Omega, \tag{5}$$

where $\alpha \equiv \frac{1}{\sum_{t=t_0}^{T} \left[\frac{G_t}{(1+r_t)}\right]^{t-t_0}}$ is the marginal propensity to consume out of total wealth. Note that the interest rate affects the marginal propensity to consume in two ways: First, through the optimal consumption growth, G_t, which satisfies the Euler equation (3). Second, through the interest rate, r_t, which comes from the budget constraint (left-hand side of eq. (4)).

Saving in period t is defined as:

$$S_t = r_t A_t + Y_t - C_t,$$

and the saving rate in period t is:

$$s_t = \frac{S_t}{r_t A_t + Y_t}.$$

2.2 Decomposing the effect of a temporary decrease in the interest rate

We are now ready to analyze the impact of a temporary decrease in interest rates. To this end it is useful to distinguish between the substitution, income and wealth effects.

In steady state, the interest rate during the households life-time is constant and equal to the long run interest rate, $\overline{r}$:

$$\overrightarrow{r_b} = [r_1, r_2, ..., r_T] = [\overline{r}, \overline{r}, ..., \overline{r}].$$

This scenario is denoted with subscript b. In an alternative scenario the interest rate decreases and remains low the next four periods before returning to the long run interest rate, $\overline{r}$:

$$\overrightarrow{r_a} = [r_1, r_2, ..., r_T] = [\overline{r} + \Delta_1, \overline{r} + \Delta_2, \overline{r} + \Delta_3, \overline{r} + \Delta_4, \overline{r}, ..., \overline{r}].$$

This interest rate path scenario is denoted with subscript a. Note that the decrease in interest rates need not be equal in each of the four periods. The difference operator Δ is throughout the paper defined as the deviation in a variable between scenario a and b in a specific period.

In the following I present expressions for the income, substitution and wealth effect of the change in interest rates. I use numercial approximations to the formulas for the income, substitution and wealth effect presented in Cromb and Fernandez-Corugedo (2004).

Using eq. (5), the effect of this difference in the interest rate path on first period consumption can be decomposed into the combined income- and substitution effect and wealth effect:

$$\Delta C_1 = C_1(\overrightarrow{r_a}) - C_1(\overrightarrow{r_b}) = \underbrace{\Delta\alpha\Omega}_{\text{Income and sub. effect}} + \underbrace{\alpha\Delta\Omega}_{\text{Wealth effect}} + \underbrace{\Delta\alpha\Delta\Omega}_{\approx 0} \tag{6}$$

where the combined income- and substitution effect is

$$\Delta\alpha\Omega \equiv [\alpha(\overrightarrow{r_a}) - \alpha(\overrightarrow{r_b})] * \Omega(\overrightarrow{r_b}).$$

The next step is to decompose $\Delta\alpha\Omega$ into a substitution effect and an income effect. The substitution effect measures to which extent the household will shift consumption between the present and future periods in response to the interest rate change. A decrease in the interest rate makes current consumption relatively cheaper and induces people to consume more today. The substitution effect from an interest rate decrease is always positive, irrespective of households' net financial asset position. The substitution effect works through the marginal propensity to consume, α. To derive an expression for the substitution effect, I hold the interest rate associated with the budget constraint constant at r_b while the optimal consumption growth, G_t, changes. Hence, the substitution effect can be expressed as

$$Sub \approx [\alpha(\overrightarrow{r_b}, G(\overrightarrow{r_a})) - \alpha(\overrightarrow{r_b}, G(\overrightarrow{r_b}))] * \Omega(\overrightarrow{r_b}).$$

The income effect reflects how the present value of consumption changes for a given amount of total wealth, Ω. An interest rate reduction increases the discounted cost of a given consumption stream, making it more expensive to consume. Hence, a lower interest rate implies that the household needs to pay more out of their total wealth in order to fund a given amount of future consumption. They are therefore worse off in a life-time sense and the income effect, isolated, makes the household consume less and save more. The income effect from an interest rate decrease is always negative for both the borrower and the lender, and works in the opposite direction of the substitution effect.

Just like the substitution effect, the income effect also works through the marginal propensity to consume, α. I derive an expression for the income effect by treating the growth rate of optimal consumption, G_t, as constant, but changing the interest rate, r_t, associated with the budget constraint. Hence, the income effect can be expressed as

$$Inc \approx [\alpha(\overrightarrow{r_a}, G(\overrightarrow{r_b})) - \alpha(\overrightarrow{r_b}, G(\overrightarrow{r_b}))] * \Omega(\overrightarrow{r_b}).$$

The wealth effect comes from the change in lifetime wealth caused by the interest rate change. The wealth effect includes revaluation of both labor wealth and financial wealth. The dominating component is the revaluation of labor income. I will assume that the real wage growth is given and unaffected by the interest rate change. The lower the interest rate is, the more worth a given future income stream will be. Hence, the labor wealth increases from the interest rate reduction. The wealth effect reinforces the interest rate's substitution effect in increasing present consumption.

The wealth effect is the change in total wealth, Ω, times the marginal propensity to consume, α:

$$Wealth \approx \alpha \Delta \Omega \equiv \alpha(\overrightarrow{r_b}) \left[\Omega(\overrightarrow{r_a}) - \Omega(\overrightarrow{r_b})\right].$$

In total, the effect of an interest rate decrease on consumption will be positive if the sum of the wealth effect and the substitution effect exceeds the income effect.

Note that if the ρ is equal to one, which corresponds to logarithmic utility, the income and substitution effect completely cancel each other out and the only effect of the interest rate change is the wealth effect.

I follow the literature by separating out these three effects. However, to get an intuitive understanding of what is going on, one can really think of two main effects. Consider an interest rate reduction. The substitution effect reflects households willingness to shift consumption between periods. The substitution effect will contribute to tilt the slope of the consumption profile, so that consumption today increases relative to consumption in the future. The cumulative income and wealth effect reflects the impact of the interest rate change on the household's permanent income. Whether the household is better or worse off after the interest rate reduction, depends on the household's net financial asset position. If the household is a borrower, the household is better off from the interest rate reduction implying that the wealth effect is larger than the income effect. The reduction in interest rate payments allow the household to increase consumption in all periods. If the household is a lender, the reduction in interest income makes the household worse off.

3 Numerical Exercise

I assume that the long run interest rate is 4 percent and that the actual interest rate from 2013 until the end of 2015 follows the policy interest rate forecasts published by Norges Bank (2012).[1] Furthermore, I assume that the interest rate is back at its long run level of 4 percent in 2017. For 2016, I impute the interest rate by taking the average of the interest rate forecast in the end of 2015 and the long run interest rate. My interest rate assumptions are presented in Table 1.[2]

For households with debt, an interest rate reduction will increase interest rate income i.e. reduce interest rate cost, while it will reduce the interest rate income of households with positive net wealth. As wealth varies with age, I calculate the response in saving and consumption from the interest rate deviation for households in different age groups using the model in section 2 above. Aggregate numbers for the household sector are calculated by weighting the various groups according to the number of households belonging to each age group. Data on income after tax per household and net financial wealth per household are from Statistics Norway and is reported in Table 2. There is significant

[1] Because the interest rates are reported at quarterly frequency, for each year I compute the average interest rate.

[2] I assume that the market interest rate is 0.35 percentage points above the policy interest rate.

Table 1: Interest rate path and deviation from long run interest rate, numbers in percent

Year	Interest rate	Deviation
2013	1.91	-2.09
2014	2.44	-1.56
2015	3.16	-0.84
2016	3.70	-0.30
2017	4.00	0.00

Note: The second column presents my interest rate assumptions. The very right column is the short term interest rate less the long run interest rate.

Table 2: Household income and financial wealth

Age groups	**25-34**	**35-44**	**45-54**	**55-64**	**65-74**	**75-**
Representative age	30	40	50	60	70	80
Remaining life length	51	42	32	23	15	8
Income after tax (NOK)	419,208	574,577	606,707	552,467	434,569	294,482
Net financial wealth (NOK)	-904,560	-972,936	-379,988	152,890	617,641	678,783
Number of households	380,146	424,439	397,795	342,946	248,644	239,832

Note: The remaining life length is the longevity for the specific cohort in 2006-2010 reported by Statistics Norway. 2011 data on income after tax, net financial wealth and number of households are from Statistics Norway. Income after tax and net financial wealth are average per household.

variation in the financial positions of the various age groups. On average, households aged 25-34, 35-44 and 45-54 are net debtors. The two youngest groups of households have on average close to one million NOK in net debt. Households aged 45-54 are also indebted, but significantly less than the younger households. The standard life-cycle model predicts that households expecting income growth have debt in order to smooth consumption across life. Hence, it is not very surprising to see that young households have debt. Households aged 55 and older on average have a positive net financial asset position. Net financial wealth is positively correlated with age, and households aged 80 and older have the most wealth. In a standard life-cycle model older households dissave, so this is inconsistent with a standard life-cycle model. Bequest motives and precautionary saving are some motives suggested in the literature as explanations to why elderly hold wealth.

Furthermore, I assume a "representative age" for each age group in order to solve the model for the various age groups. To impute an expected life length for each cohort, I use the longevity estimates for the specific cohort reported by Statistics Norway. I assume that households retire when they are 67 years old. During the time they work, labor income grows by 4 percent annually, which is similar to the historical average growth rate of 4.3 percent in labor wage in Norway in the period 1987-2010 (Statistics Norway). After retirement, household income is constant at 62 percent of pre-retirement income, which is similar to the net replacement rate of the median earner in Norway according to OECD pension models (OECD, 2011). As a benchmark, I use a time preference rate equal to the long run interest rate of 4 percent which makes the discount factor, $\beta = \frac{1}{1+0.04} \approx 0.9615$.[3]

Importantly, I assume an intertemporal elasticity of substitution (ρ) of 0.25. I will discuss this assumption and do sensitivity analysis for a range of ρ with values from 0 to 1 later in the paper.

The effect on saving and consumption

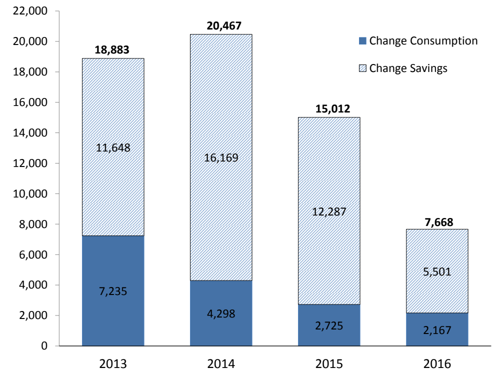
Figure 2 reports the difference in interest rate income and how much households' saving and consumption changes due to the temporary decrease in interest rates for different household age groups. The total deviation in interest rate income is noted on top of each bar. Furthermore, the deviation in interest rate income is split into the portion which is consumed and the portion which is saved. I show the effect for a household age group with negative net financial wealth (age group 25-34), a household age group with positive net financial wealth (age group 55-66) and the total effect for the household sector. To illustrate the importance of asset positions, I also show the effect for the household sector if I assume no initial wealth. Table 3 reports the saving rate deviation for the various age groups and for the aggregate household sector. In the appendix, Table 5 report the deviation in interest rate income, saving, consumption for all age groups, respectively and Table 6 reports the corresponding percentage deviation.

For an average household in the age group 25-34, the lower interest rate makes interest

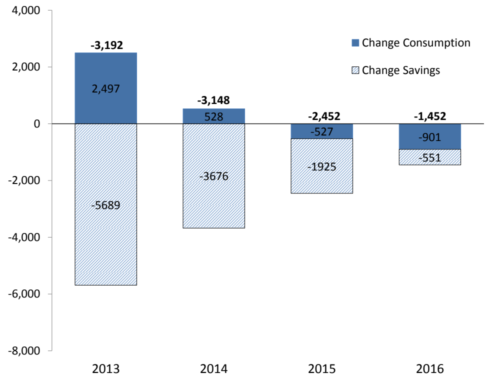
[3]Empirical evidence on the time preference rate is mixed. Frederick, Loewenstein and O'Donoghue (2002) review empirical research on intertemporal choice and the discount factor. They document that there is a huge variety in the literature when it comes to empirical estimates of the discount factor (estimates of the time preference rate varies from –6 percent to infinity). Hence, it is extremely difficult to pin down an exact value for the discount factor based on previous findings.

Figure 2: Effect on saving and consumption of a temporary interest rate reduction

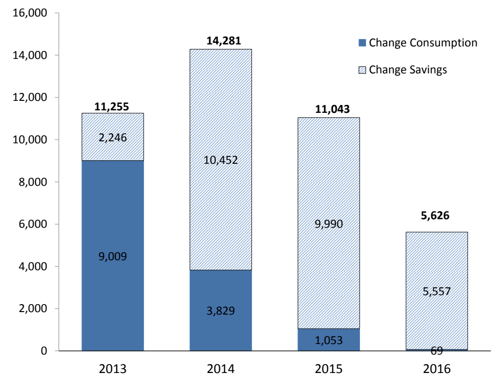
(a) Households aged 25-34, numbers in NOK



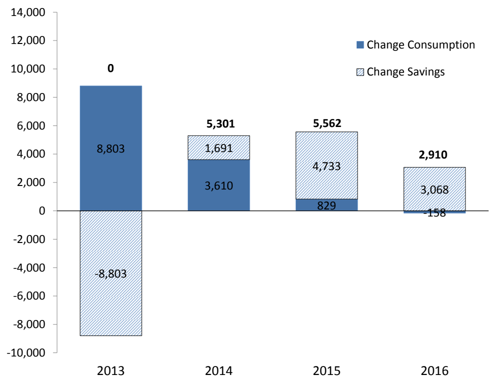
(b) Households aged 55-64, numbers in NOK



(c) Household sector in total, numbers in million NOK



(d) Household sector in total - no initial wealth, numbers in million NOK



Note: The total deviation in interest rate income is noted on top of each bar. Furthermore, the deviation in interest rate income is split into the portion which is consumed and the portion which is saved.

rate income increase by 18 883 NOK (+52.2 percent) in 2013. Out of this, the calibrated model implies that they will save 11 648 NOK (+3.0 percent), while only 7 235 NOK will be consumed (+0.9 percent). This implies that the saving rate is 7.7 percentage points higher in 2013. The interest rate income in 2014 is 20 467 NOK (+39.6 percent) higher in the low interest rate scenario, out of this 4 298 NOK (+0.6 percent) will be consumed while the remainder is saved. The saving rate is 9.1 percentage points higher in 2014. Similarly, in 2015 and 2016 saving rates increase by 6.8 and 3.2 percentage points respectively. Hence, the reduction in interest rates will induce an increase in saving among young indebted households.

Households aged 55-64 have positive net financial wealth on average and are therefore worse off due to the reduction in interest rates. An average household in the age group 55-64 will face a reduction in interest rate income of 3 192 NOK (–52.2 percent) in

Table 3: Saving rate deviation. All numbers in percentage points

	Year			
	2013	**2014**	**2015**	**2016**
Δr_t	-2.09	-1.56	-0.84	-0.30
Age	**With initial assets**			
25-34	7.65	9.07	6.78	3.28
35-44	4.53	5.11	3.59	1.59
45-54	0.72	1.25	0.94	0.40
55-64	-0.98	-0.57	-0.26	-0.05
65-74	-3.18	-1.96	-0.74	0.02
75-	-5.01	-2.78	-0.65	0.64
All households	0.64	1.51	1.30	0.68
	No initial assets			
25-34	-1.3	2.1	2.7	1.6
35-44	-1.1	1.0	1.4	0.8
45-54	-0.8	0.2	0.4	0.2
55-64	-0.5	-0.3	-0.1	0.0
65-74	-0.6	-0.2	0.0	0.1
75-	-0.5	-0.1	0.0	0.1
All households	-0.87	0.33	0.60	0.36

Note: The table presents the deviation in the saving rate comparing the saving rate in the two interest rate scenarios: $\Delta s_t = (s_{a,t} - s_{b,t})$. Δr_t is the interest rate deviation.

2013, 3 148 NOK (–40.9 percent) in 2014 and 2 452 NOK (–24.0 percent) in 2015 and 1 452 NOK (–10.5 percent) in 2016 due to the lower interest rate. In order to smooth consumption, these households do not wish to take the entire hit on consumption in one period. Instead, they wish to reduce consumption in all future periods. Hence, their consumption changes only slightly, while the increase in saving is larger. These households reduce their saving rates in the low interest scenario by around 1 percentage point in 2013 and 2014. The reduction in saving rates in 2014 and 2015 is more moderate. Consumption is higher in 2013 and 2014 because the interest rate is relatively low and the substitution effect dominates. However, in 2015 and 2016 consumption is lower after the interest rate cut.

The aggregate household sector has negative net financial wealth in total of 539 billion NOK, or 265 107 NOK on average per household.[4] Hence, the aggregate household sector benefits by the interest rate reduction, and interest rate income is 11 255 million NOK

[4]The aggregate household sector is here defined as households aged 25 and older.

(52.2 percent) higher in 2013 due to the lower interest rate. Figure 2d shows that this makes saving increase by 2 246 million NOK (0.6 percent) initially. The substitution effect is at work and makes consumption rise by 9 009 million NOK (0.7 percent) in 2013. In 2014, 2015 and 2016, almost the entire increase in interest rate income will be saved. These results illustrate the point that only a small fraction of the increase in interest rate income will be consumed. As a consequence, the temporary reduction in interest rates makes saving rates increase by 0.6 percentage points in 2013, 1.5 percentage points in 2014, 1.3 percentage points in 2015 and 0.7 percentage points in 2016.

As a comparison, Figure 2d shows the results from the interest rate decrease assuming that all households have zero net financial wealth initially. Hence, in 2013 there is no change in interest rate income from the lower interest rate. In 2014, 2015 and 2016 there is a small increase in interest rate income since the household sector builds up some debt. The main difference compared to the case with initial wealth, is the change in saving. Despite zero interest rate income in 2013, consumption still rises for the same reasons as in the case with initial wealth. Since income is unchanged, saving must decrease to enable the increase in consumption. In 2014, 2015 and 2016, there is a small increase in saving and saving rates, but the increase is smaller than in the case with initial debt.

The substitution, income and wealth effects

In the following I will discuss in more detail how consumption is affected by the interest rate decrease. In Table 4 I compare consumption in 2013 in the two different interest rate scenarios. In order to understand the drivers behind the total effect, I dissect it into the income, substitution and wealth effect. I also report the sum of the income and wealth effect, because the sum of the two determines whether the household is better or worse off.

If we look at the change in consumption in 2013 for the various age groups in Table 4, we see that the change in consumption is small for all age groups, and it is decreasing with age. The increase in consumption is largest for the young households as initial consumption increases by 0.94 percent. The effect on consumption for households above 75 years old is negative. So what can account for this pattern across age? Table 4 shows that the substitution effect of the interest rate decrease is positive and quite similar in size

Table 4: Percentage change in consumption and breakdown of the underlying effects for 2013

		Breakdown of total effect			
Age	Total effect	Substitution	Income+Wealth	Income	Wealth
All ages	0.66%	0.60%	0.12%	-2.35%	2.47%
25-34	0.94%	0.61%	0.39%	-2.41%	2.81%
35-44	0.92%	0.61%	0.38%	-2.40%	2.78%
45-54	0.77%	0.60%	0.23%	-2.38%	2.61%
55-64	0.48%	0.59%	-0.06%	-2.34%	2.28%
65-74	0.09%	0.57%	-0.44%	-2.25%	1.82%
75-	-0.51%	0.51%	-1.00%	-2.04%	1.04%

Note: The table presents the relative change in consumption defined as, $\Delta C_t = (C_{a,t} - C_{b,t})/C_{b,t}$ and shows the various effects which contribute to the total change in consumption.

across all age groups, while the wealth effect is what varies the most across age. Because the households aged 25-34, 35-44 and 45-54 have debt, the wealth effect is stronger than the negative income effect and contributes to increase consumption. Households aged 55 and older have positive financial wealth. For these households, the negative income effect is stronger than the wealth effect since they are worse off after the interest rate decrease. However, for households aged 55-64 and 65-74, the substitution effect is strong enough to increase consumption in 2013. Households aged 75 plus, have positive net financial wealth of 678 783 NOK. Since the reduction in interest rate income is even stronger for these households the sum of the income and wealth effect is even more negative. The substitution effect is not strong enough to compensate for the negative income- and wealth effect and the initial consumption falls.

The intertemporal elasticity of substitution

The results above, and in particular the substitution effect, rely on the assumption about the intertemporal elasticity of substitution ρ which was assumed to be 0.25.

In the literature there are many studies which estimate the intertemporal elasticity of substitution, and the results vary substantially. Many studies follow Hall's (1988) pioneering approach of analyzing data on aggregate consumption using the Euler-equation. In his influential paper, Hall (1988) finds that consumption growth is completely insensitive to interest rates indicating a value of ρ close to zero. In his paper Hall concludes:

"All the estimates presented in this paper of the intertemporal elasticity of substitution are small. Most of them are also quite precise, supporting the strong conclusion that the elasticity is unlikely to be much above 0.1, and may well be zero." Other papers using macro data on consumption have largely confirmed a value of ρ close to zero (see e.g. Campbell and Mankiw, 1989; and Patterson and Pesaran, 1992). On the other hand, calibrated macroeconomic models designed to match growth and business cycle facts typically require that ρ is close to one (see for example Weil, 1989; Lucas, 1990), and Lucas (1990) claims that any value of ρ below 0.5 are implausible. Kydland and Precott (1982) calibrate ρ to be 0.66.[5]

Attanasio and Weber (1995) capture heterogeneity between households by controlling for changes in demographics and labor-supply behavior over the life-cycle. Using data from the Consumer Expenditure Survey they estimate ρ to be around 0.6. Biederman and Goenner (2008) use a similar approach and estimate ρ to be between 0.2 and 0.8.

Guvenen (2006) argues that the discrepancy between the empirical studies using aggregate consumption and the macro literature is due to the lack of heterogeneity in both literature. Accounting for the fact that ρ differ between stock holders and non stock holders he estimates ρ to be in the range 0.4-0.5 on aggregate.[6]

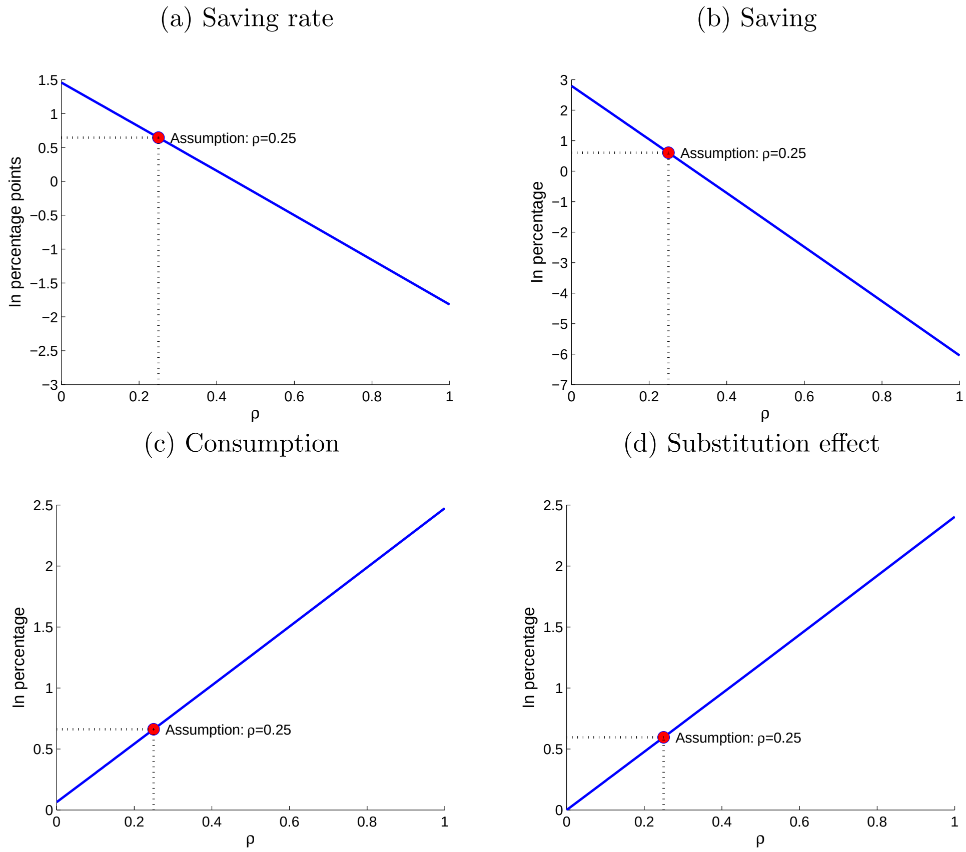
Figure 3 shows the sensitivity in the results for 2013 for all households under various assumptions about the intertemporal elasticity of substitution. The results under the base assumption (ρ=0.25) are highlighted in the plots.

Figure 3a and Figure 3b show the sensitivity in the saving rate deviation and the saving deviation, respectively. Assuming ρ of 0.4 or below would make the saving rate increase. In absolute terms, savings is higher in the low interest rate scenario if assuming a ρ below 0.33. With a ρ equal to zero, the substitution effect vanishes because households are unwilling to shift consumption across periods. With such preferences the only effects at work would be the income and wealth effects, and the saving rate deviation would be 1.5 percentage points while the saving deviation in absolute terms would be 3 percent. However, if I assume a high value for ρ, the substitution effect becomes large and increases present consumption to a level where the aggregate household sector saves

[5] NEMO applies log utility implying $\rho = 1$.

[6] Guvenen (2006) estimates that the ρ of stockholders lies close to 1, while the ρ of non-stockholders is around 0.1.

Figure 3: Sensitivity in saving and consumption deviation with respect to ρ



Note: The figure reports the sensitivity in the substitution effect and the deviation in the saving rate, saving (deviation in percent) and consumption (deviation in percent) for 2013 for the aggregate household sector under various assumptions about the intertemporal elasticity of substitution (ρ)

less after the interest rate decrease. Assuming log utility implying ρ=1 makes the saving deviation around –6 percent, and the saving rate would be roughly 2 percentage points lower in the low interest rate scenario.

Figure 3c shows the sensitivity in the change in aggregate consumption with respect to the intertemporal elasticity of substitution. With ρ=0, the total effect on consumption is close to zero, because the substitution effect is absent and almost the entire change in interest income is saved for future consumption. The total change in consumption is increasing with a higher value of ρ, because the substitution effect becomes larger and gives a boost to present consumption. If I assume a ρ=1, corresponding to log utility, the income and substitution effect offsets and the change in consumption is equal to the wealth effect.

The income and wealth effects are independent of the intertemporal elasticity of substitution under my baseline assumptions about the interest rate r and the discount factor β.

4 Conclusion

This note sheds light on why saving might increase in a period with historically low interest rates as in Norway today. Because the average Norwegian household has substantial debt, the interest rate reduction has made the household sector as a whole better off through reduced interest rate payments. In a nutshell, the reduced interest rate payments can be viewed as a transitory income increase. Based on a life-cycle model where households wish to smooth consumption, only a small fraction of the transitory income gift will be consumed, while most of the reduced income payments will be saved for consumption in the future. Hence, a life-cycle model predicts an increase in saving from the reduced interest rates and is able to explain why households do not increase consumption significantly, but raise saving when interest rates are low. However, for total saving in the household sector to increase we rely on assuming a low intertemporal elasticity of substitution. The limitation of the analysis is the lack of precise estimates of the intertemporal elasticity of substitution for Norwegian households.

The results from the calibration exercise in this paper correspond well to the findings of empirical studies on the relationship between saving and interest rates in Norway. Halvorsen (2013) applies panel data for the whole Norwegian population to examine how household saving and consumption react to a change in the interest rates. Similar to the findings in this paper, the results show that it is the net financial asset position that matter the most for the interest rate response. She finds that net borrowers end up lowering saving instead of consumption when interest rates go up.

The macroeconomic impact of monetary policy largely depends on the effect it has on household consumption. Hence, the results presented here imply that the asset positions of households can be an important determinant for the transmission mechanism of monetary policy.

References

Attanasio O.P. and Browning M. (1995). Consumption over the life cycle and over the business cycle. *The American Economic Review*, 1118–1137.

Biederman D.K. and Goenner C.F. (2008). A life-cycle approach to the intertemporal elasticity of substitution. *Journal of Macroeconomics*, 30(1), 481–498.

Campbell J.Y. and Mankiw N.G. (1989). Consumption, income and interest rates: Reinterpreting the time series evidence. In *NBER Macroeconomics Annual 1989, Volume 4*, 185–246. MIT Press.

Cromb R. and Fernandez-Coreugedo E. (2004). Long-term interest rates, wealth and consumption. *Bank of England Working Paper no. 243*.

Frederick S., Loewenstein G., and O'donoghue T. (2002). Time discounting and time preference: A critical review. *Journal of economic literature*, 40(2), 351–401.

Gudmundsson J., , and Natvik G.J. (2012). That uncertain feeling - how consumption responds to economic uncertainty in norway. *Norges Bank Staff Memo no. 23*.

Guvenen F. (2006). Reconciling conflicting evidence on the elasticity of intertemporal substitution: A macroeconomic perspective. *Journal of Monetary Economics*, 53(7), 1451–1472.

Hall R.E. (1988). Intertemporal substitution in consumption. *Journal of Political Economy*, 96(2).

Halvorsen E. (2013). The effect of interest rate changes on household consumption and saving. *Unpublished manuscript Statistics Norway*.

Kydland F.E. and Prescott E.C. (1982). Time to build and aggregate fluctuations. *Econometrica: Journal of the Econometric Society*, 1345–1370.

Lucas Jr R.E. (1990). Supply-side economics: An analytical review. *Oxford Economic Papers*, 293–316.

Norges Bank (2012). Monetary policy report. Number 3.

OECD (2011). Pensions at a glance 2011: Retirement-income systems in OECD and G-20 countries. *OECD Publishing*.

Patterson K.D. and Pesaran B. (1992). The intertemporal elasticity of substitution in consumption in the united states and the united kingdom. *The Review of Economics and Statistics*, 573–584.

Weil P. (1989). The equity premium puzzle and the risk-free rate puzzle. *Journal of Monetary Economics*, 24(3), 401–421.

Appendix

Table 5: Deviation in interest rate income ($\Delta(r_tA_t)$), consumption (ΔC_t) and saving (ΔS_t)

		Year			
		2013	**2014**	**2015**	**2016**
	Δr_t	-2.09 p.p.	-1.56 p.p.	-0.84 p.p.	-0.30 p.p.
Age		**With initial assets**			
25-34	$\Delta(r_tA_t)$	18,883	20,467	15,012	7,668
	ΔS_t	11,648	16,169	12,287	5,501
	ΔC_t	7,235	4,298	2,725	2,167
35-44	$\Delta(r_tA_t)$	20,310	20,871	14,806	7,411
	ΔS_t	12,190	16,104	11,835	5,077
	ΔC_t	8,120	4,767	2,971	2,334
45-54	$\Delta(r_tA_t)$	7,932	8,599	6,112	2,940
	ΔS_t	2,080	5,634	4,695	2,071
	ΔC_t	5,852	2,965	1,418	869
55-64	$\Delta(r_tA_t)$	-3,192	-3,148	-2,452	-1,452
	ΔS_t	-5,689	-3,676	-1,925	-551
	ΔC_t	2,497	528	-527	-901
65-74	$\Delta(r_tA_t)$	-12,893	-9,494	-5,350	-2,466
	ΔS_t	-13,341	-8,088	-2,952	284
	ΔC_t	447	-1,406	-2,398	-2,751
75-	$\Delta(r_tA_t)$	-14,170	-9,751	-5,034	-2,055
	ΔS_t	-12,155	-6,251	-738	2,524
	ΔC_t	-2,015	-3,500	-4,296	-4,579
All households	$\Delta(r_tA_t)$	11,255	14,281	11,044	5,626
	ΔS_t	2,246	10,452	9,990	5,557
	ΔC_t	9,009	3,829	1,053	69
		No initial assets			
All households	$\Delta(r_tA_t)$	0	5,301	5,562	2,910
	ΔS_t	-8,803	1,691	4,733	3,068
	ΔC_t	8,803	3,610	829	-158

Note: This table reports the change in interest rate income defined as the change in interest rate income, $\Delta(r_tA_t) = r_{a,t}A_{a,t} - r_{b,t}A_{b,t}$, the change in saving is defined as, $\Delta S_t = S_{a,t} - S_{b,t}$, the change in consumption is defined as, $\Delta C_t = C_{a,t} - C_{b,t}$. and the change in the saving rate is defined as, $\Delta s_t = s_{a,t} - s_{b,t}$. Interest rate income, saving and consumption for the household age groups are in NOK, while numbers for all households are in MNOK.

Table 6: Deviation in saving, consumption and interest rate income. All numbers in percent.

		Year			
		2013	**2014**	**2015**	**2016**
	Δr_t	-2.09 p.p.	-1.56 p.p.	-0.84 p.p.	-0.30 p.p.
Age		**With initial wealth**			
25-34	$\Delta(r_t A_t)$	52.2 %	39.6 %	22.4 %	9.3 %
	ΔS_t	3.0 %	4.2 %	3.2 %	1.4 %
	ΔC_t	0.9 %	0.6 %	0.4 %	0.3 %
35-44	$\Delta(r_t A_t)$	52.2 %	39.6 %	22.4 %	9.4 %
	ΔS_t	3.6 %	4.8 %	3.7 %	1.6 %
	ΔC_t	0.9 %	0.5 %	0.3 %	0.3 %
45-54	$\Delta(r_t A_t)$	52.2 %	39.3 %	21.9 %	8.9 %
	ΔS_t	1.2 %	3.8 %	3.6 %	1.9 %
	ΔC_t	0.8 %	0.4 %	0.2 %	0.1 %
55-64	$\Delta(r_t A_t)$	-52.2 %	-40.9 %	-24.0 %	-10.5 %
	ΔS_t	-14.3 %	-5.8 %	-2.2 %	-0.5 %
	ΔC_t	0.5 %	0.1 %	-0.1 %	-0.2 %
65-74	$\Delta(r_t A_t)$	-52.2 %	-40.5 %	-24.1 %	-11.8 %
	ΔS_t	-43.3 %	-25.2 %	-8.9 %	0.8 %
	ΔC_t	0.1 %	-0.3 %	-0.5 %	-0.6 %
75-	$\Delta(r_t A_t)$	-52.2 %	-40.3 %	-23.8 %	-11.5 %
	ΔS_t	-16.5 %	-8.2 %	-0.9 %	3.1 %
	ΔC_t	-0.5 %	-0.9 %	-1.1 %	-1.2 %
All households	$\Delta(r_t A_t)$	52.2 %	39.2 %	21.9 %	8.8 %
	ΔS_t	0.6 %	3.0 %	3.0 %	1.8 %
	ΔC_t	0.7 %	0.3 %	0.1 %	0.0 %
		No initial wealth			
All households	$\Delta(r_t A_t)$	NaN	37.5%	20.2%	7.3%
	ΔS_t	-2.5%	0.5%	1.5%	1.1%
	ΔC_t	0.6%	0.3%	0.1%	0.0%

Note: The table reports the percentage change in variable V_t is defined as $\Delta V_t = (V_{a,t} - V_{b,t})/abs(V_{b,t})$ for $V_t \in \{r_t A_t, S_t, C_t\}$.

Table 7: Deviation in interest rate income ($\Delta(r_t A_t)$), consumption (ΔC_t) and saving (ΔS_t)

		Year			
		2013	**2014**	**2015**	**2016**
	Δr_t	-2.09 p.p.	-1.56 p.p.	-0.84 p.p.	-0.30 p.p.
Age		**No initial assets**			
25-34	$\Delta(r_t A_t))$	0	6,000	6,540	3,650
	ΔS_t	-5,651	3,438	5,633	3,330
	ΔC_t	5,651	2,562	908	321
35-44	$\Delta(r_t A_t)$	0	5,363	5,758	3,137
	ΔS_t	-6,300	2,592	4,876	2,926
	ΔC_t	6,300	2,772	882	211
45-54	$\Delta(r_t A_t)$	0	2,582	2,627	1,307
	ΔS_t	-5,053	494	2,128	1,371
	ΔC_t	5,053	2,088	500	-64
55-64	$\Delta(r_t A_t)$	0	-756	-1,085	-822
	ΔS_t	-2,881	-1,705	-999	-368
	ΔC_t	2,881	949	-86	-453
65-74	$\Delta(r_t A_t)$	0	-61	-107	-127
	ΔS_t	-2,484	-894	-56	238
	ΔC_t	2,484	833	-51	-365
75-	$\Delta(r_t A_t)$	0	-37	-62	-68
	ΔS_t	-1,521	-440	135	341
	ΔC_t	1,521	403	-196	-409
All households	$\Delta(r_t A_t)$	0	5,301	5,562	2,910
	ΔS_t	-8,803	1,691	4,733	3,068
	ΔC_t	8,803	3,610	829	-158
		With initial assets			
All households	$\Delta(r_t A_t)$	11,255	14,281	11,044	5,626
	ΔS_t	2,246	10,452	9,990	5,557
	ΔC_t	9,009	3,829	1,053	69

Note: This table reports the change in interest rate income defined as the change in interest rate income, $\Delta(r_t A_t) = r_{a,t}A_{a,t} - r_{b,t}A_{b,t}$, the change in saving is defined as, $\Delta S_t = S_{a,t} - S_{b,t}$, the change in consumption is defined as, $\Delta C_t = C_{a,t} - C_{b,t}$. and the change in the saving rate is defined as, $\Delta s_t = s_{a,t} - s_{b,t}$. Interest rate income, saving and consumption for the household age groups are in NOK, while numbers for all households are in MNOK.

Table 8: Deviation in saving, consumption and interest rate income. All numbers in percent.

		Year			
Age		**2013**	**2014**	**2015**	**2016**
	Δr_t	-2.09 p.p.	-1.56 p.p.	-0.84 p.p.	-0.30 p.p.
Age		**No initial wealth**			
25-34	$\Delta(r_t A_t)$	NaN	38.2 %	20.8 %	7.8 %
	ΔS_t	-1.4 %	0.9 %	1.4 %	0.9 %
	ΔC_t	0.7 %	0.3 %	0.1 %	0.0 %
35-44	$\Delta(r_t A_t)$	NaN	38.0 %	20.6 %	7.6 %
	ΔS_t	-1.8 %	0.8 %	1.5 %	0.9 %
	ΔC_t	0.7 %	0.3 %	0.1 %	0.0 %
45-54	$\Delta(r_t A_t)$	NaN	37.3 %	20.0 %	7.0 %
	ΔS_t	-2.9 %	0.3 %	1.6 %	1.2 %
	ΔC_t	0.6 %	0.3 %	0.1 %	0.0 %
55-64	$\Delta(r_t A_t)$	NaN	-43.1 %	-24.3 %	-10.0 %
	ΔS_t	-6.6 %	-2.5 %	-1.1 %	-0.3 %
	ΔC_t	0.6 %	0.2 %	0.0 %	-0.1 %
65-74	$\Delta(r_t A_t)$	NaN	NaN	NaN	NaN
	ΔS_t	NaN	NaN	NaN	NaN
	ΔC_t	0.6 %	0.2 %	0.0 %	-0.1 %
75-	$\Delta(r_t A_t)$	NaN	NaN	NaN	NaN
	ΔS_t	NaN	NaN	NaN	NaN
	ΔC_t	0.5 %	0.1 %	-0.1 %	-0.1 %
All households	$\Delta(r_t A_t)$	NaN	37.5 %	20.2 %	7.3 %
	ΔS_t	-2.5 %	0.5 %	1.5 %	1.1 %
	ΔC_t	0.6 %	0.3 %	0.1 %	0.0 %
		With initial wealth			
All households	$\Delta(r_t A_t)$	NaN	37.5%	20.2%	7.3%
	ΔS_t	-2.5%	0.5%	1.5%	1.1%
	ΔC_t	0.6%	0.3%	0.1%	0.0%

Note: The table reports the percentage change in variable V_t is defined as $\Delta V_t = (V_{a,t} - V_{b,t})/abs(V_{b,t})$ for $V_t \in \{r_t A_t, S_t, C_t\}$.